

ORIGINAL

OFFICIAL TRANSCRIPT
PROCEEDINGS BEFORE

DKT/CASE NO. 50-537

TITLE UNITED STATES DEPARTMENT OF ENERGY PROJECT
MANAGEMENT CORPORATIONS
TENNESSEE VALLEY AUTHORITY

PLACE (Clinch River Breeder Reactor Plant)
Oak Ridge Tennessee

DATE November 17, 1982

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1 UNITED STATES OF AMERICA
 2 NUCLEAR REGULATORY COMMISSION

3 - - -

4 ATOMIC SAFETY AND LICENSING BOARD

5 - - - - - x
 6 In the Matter of x
 7 UNITED STATES DEPARTMENT OF ENERGY x
 8 PROJECT MANAGEMENT CORPORATION x
 9 x Docket No.50-537
 10 TENNESSEE VALLEY AUTHORITY x
 11 (Clinch River Breeder Reactor Plant) x
 12 - - - - - X

13 Hemlock Room

14 Executive Seminar Center Building

15 301 Broadway

16 Oak Ridge, Tennessee

17 Wednesday, November 17, 1982

18
 19 The hearing in the above-entitled matter was
 20 convened, pursuant to adjournment, at 8:00 a.m.

21 BEFORE:

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24 CADET HAND, Member
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C O N T E N T S

<u>WITNESSES</u>	<u>DIRECT</u>	<u>CROSS</u>	<u>REDIRECT</u>	<u>RECROSS</u>	<u>BOARD EXAM.</u>
ROBERT J. DUBE, ROBERT D. HURT, JOHN W. HOCKERT, CHARLES E. GASKIN, and HARVEY B. JONES, JR. (A Panel - Resumed)					
By Mr. Greenberg	3696				
By Mr. Jones			3700		
By Mr. Greenberg				3708	
By Mr. Jones			3712		
By Judge Linenberger					3713
By Mr. Jones			3728		
By Mr. Greenberg				3730	
By Mr. Edgar				3730	
THOMAS B. COCHRAN (Recalled)					
By Mr. Greenberg	3755				
By Mr. Edgar		3789			
By Mr. Jones		3843			
By Mr. Greenberg			3859		
By Mr. Edgar				3861	
By Judge Linenberger					3864
R. JULIAN PRESTON, ROGER O. McCLELLAN (recalled), JOHN W. HEALY (recalled) and ROY C. THOMPSON (recalled)					
By Mr. Edgar	3995				
By Ms. Finamore		3998			
By Mr. Swanson		4041			
By Ms. Finamore		4045			
By Judge Linenberger					4047
By Judge Hand					4053

C O N T E N T S

<u>WITNESSES</u>	<u>DIRECT</u>	<u>CROSS</u>	<u>REDIRECT</u>	<u>RECROSS</u>	<u>BOARD EXAM.</u>
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EDWARD F. BRANAGAN, JR.

and

MICHAEL A. BENDER

(A Panel)

By Mr. Swanson 4066

By Ms. Finamore 4066

By Mr. Swanson 4097

By Ms. Finamore 4103

By Judge Linenberger 4105

E X H I B I T S

<u>NUMBER</u>	<u>IDENTIFIED</u>	<u>RECEIVED</u>
Staff's:		
11	3701	3704
10	--	3732
12	4063	4111
13	4063	Not offered
Intervenors':		
12	3756	3886
12A	3760	3886
Applicants':		
40	3810	3864
41	3860	Not offered
42	3995	Not offered

P R O C E E D I N G S

JUDGE MILLER: Is everyone ready to resume the proceedings? Everyone seems to be in place.

Mr. Greenberg, were you cross-examining?

MR. JONES: Mr. Chairman, before we begin, I want to bring up one point.

JUDGE MILLER: Okay.

MR. JONES: Yesterday we indicated that because it involved classified -- the basis for the statement involved classified information, that at that time the witnesses could not discuss that information. We would have to withdraw a statement that appeared on Page 9 of the Staff's testimony.

JUDGE MILLER: Let us locate that.

MR. JONES: That was in Exhibit 10, and it's the sentence on Page 9 that begins, "However, it should be noted that dispersal of small quantities."

Last evening we called back to Washington to get a clarification of the classification, and have determined that the witnesses can discuss the basis and so that sentence will be a part of the exhibit when we offer it into evidence.

JUDGE MILLER: All right. Let's have the record show -- is that Exhibit 10? That's Exhibit 10, did you say?

1 MR. JONES: Yes, Exhibit 10.

2 JUDGE MILLER: Let the record show that
3 Staff Exhibit 10, being the testimony of the panel of
4 experts, Mr. Dube, et al., at Page 9, the last complete
5 sentence had previously been withdrawn by the Staff
6 following colloquy, the sentence commencing, "However, it
7 should be noted that..." and so forth, and ending on the
8 second-to-last line with the words, "...difficult to
9 acquire, period," has been restated by the Staff; and
10 that, of course, is proffered for cross-examination. Is
11 that correct?

12 MR. JONES: That is correct.

13 JUDGE MILLER: That portion is allowed, and
14 you may interrogate on that, as well as other matters.

15 I forget. Have you completed your examination
16 yet on this panel?

17 MR. GREENBERG: No, I had not.

18 JUDGE MILLER: No, you are just close to it.

19 MR. GREENBERG: Mr. Chairman, I believe I
20 indicated yesterday that it would be about two or three
21 more hours.

22 JUDGE MILLER: That's when we were all tired.
23 I remember now.

24 MR. GREENBERG: I hate to have to remind you of
25 that fact.

JUDGE MILLER: Okay, you may proceed.

Whereupon,

ROBERT J. DUBE

ROBERT DAVIS HURT

JOHN W. HOCKERT

CHARLES E. GASKIN

HARVEY B. JONES, JR.

resumed the stand as witnesses and, having been previously duly sworn, were examined and testified further as follows:

CROSS-EXAMINATION (Resumed)

BY MR. GREENBERG:

Q Let me turn, if I might, back to Paragraph -- I'm sorry -- Page 9, Answer A16, which is where there is a statement with respect to dispersal of small quantities of plutonium that, quote, would not be expected to cause significantly more widespread death than dispersal of small quantities of a number of other radiological, chemical or biological agents, unquote.

That's in the second full paragraph of Answer A16.

What specific radiological, chemical or biological agents are you referring to?

BY WITNESS HOCKERT:

A There are a number of such agents. One can refer to the various nerve gases, such as sarin in the

1 chemical range.

2 One can refer to biological agents, such as
3 botulism toxin or anthrax, and one can refer to a number
4 of radiological agents who have MPC's on the same order of
5 magnitude as that of plutonium within Part 20 of 10 CFR,
6 such as Actinium 227 and Thorium 230.

7 Q Now, you state that dispersal of quantities,
8 small quantities of plutonium, would not be expected to
9 cause significantly more widespread death than dispersal
10 of quantities of those agents.

11 When you talk about "widespread death," how
12 many deaths are you talking about?

13 BY WITNESS HOCKERT:

14 A That depends on what kind of scenario,
15 dispersal scenario, you are talking about. From the
16 estimates of plutonium toxicity in atmospheric dispersal,
17 one could imagine, for instance, dispersing, say, tens to
18 hundreds of grams of plutonium within a football stadium,
19 for example, at the Superbowl when it was rather crowded.

20 One could expect that to cause tens to perhaps
21 thousands of latent cancer fatalities occurring 15 years
22 later.

23 If one dispersed such chemical or biological
24 agents, one would expect a comparable number of deaths
25 within days to weeks.

Q Could there be larger numbers with different scenarios?

BY WITNESS HOCKERT:

A Conceivably, one could imagine an individual kidnapping a large population and spraying up each individual's nostril a lethal -- or a cancer-causing dose until one ran out of material.

Q Hypothetically, suppose one dispersed a plutonium device into a ventilation system of a large office building; the World Trade Center is often taken as an example.

BY WITNESS HOCKERT:

A That's a traditional, as you say, scenario.

Probably the efficiency of the plutonium under those circumstances, at least according to some authors, might be better there.

Some other authors who claim that the plutonium size particulate which would be most likely to cause cancer would also be most likely to plate out in the ventilation system.

Such a thing could cause perhaps 70 to 80 latent cancer fatalities per gram of plutonium effectively dispersed.

On the other hand, if such a scenario were used as an extortion threat, for instance, it would be not

1 terribly complicated to install filtration in the building
2 and significantly reduce the consequences.

3 Q You mentioned that agents that might cause
4 such widespread death include nerve gas and anthrax. Isn't
5 nerve gas considered to be an agent used for chemical or
6 biological warfare which is protected by the military?

7 BY WITNESS HOCKERT:

8 A It is indeed. However, the constituents of
9 nerve gas are used for routine scientific purposes and
10 can be obtained by an individual who has a genuine
11 research need for such constituents or purports to have
12 the same.

13 Q But wouldn't it be difficult to obtain nerve
14 gas in the form that it could be immediately used as a
15 dispersal device?

16 BY WITNESS HOCKERT:

17 A Yes, sir, it would, but perhaps conversion
18 would be no more difficult than building a plutonium
19 dispersal device.

20 JUDGE LINENBERGER: Excuse me, Mr. Greenberg.
21 Can we establish one thing here or clarify one thing.

22 Sir, you used the phrase "plutonium toxicity."
23 Can you clarify for us whether you are referring to a
24 traditional or classical chemical toxicity, or are you
25 referring only to the radioactive effects of plutonium when

1 you use that term?

2 BY WITNESS HOCKERT:

3 A Basically, the effects that I'm referring to
4 are the physiological effects from lung dose of insolubles,
5 basically. That's the dominant effect for a dispersal
6 device.

7 JUDGE LINENBERGER: If plutonium were non-
8 radioactive, would the quantity of chemical toxicity with
9 the permissible body burden be considerably higher?

10 WITNESS HOCKERT: Yes, sir.

11 JUDGE LINENBERGER: Thank you.

12 - - -

1 BY MR. GREENBERG:

2 Q Let me move on, if I might, to some of the
3 costs associated with this project.

4 At Page 8, Answer A15, there is a discussion
5 of the dollar costs of safeguards for the CRBR fuel cycle.

6 In making this statement, what dollar costs
7 did you consider?

8 BY WITNESS DUBE:

9 A I'm sorry. You need to be more specific in
10 your question.

11 Q Well, it's difficult to be more specific than
12 the answer itself. It says, "The Staff believes..." and
13 I'm quoting from the third-to-the-last sentence in
14 Answer A15, "...the dollar costs of safeguards for the
15 CRBR fuel cycle will be insignificant compared to the
16 over-all fuel cycle costs."

17 What costs are you referring to?

18 BY WITNESS DUBE:

19 A The costs that we are referring to there are
20 the costs of the safeguard systems that DOE has proposed.

21 Q Those are the costs as submitted by DOE?

22 BY WITNESS DUBE:

23 A The way this was analyzed was to do an
24 independent assessment of the costs, and in all cases
25 except one Staff was within 10 to 50 percent of the DOE

estimate, and in those situations we use the DOE number.

In one situation we believe DOE over-estimated the cost by probably a factor of four to five; but in that situation we still used DOE's numbers.

Q When you say "independent assessment," do you mean an independent assessment conducted by the Staff or conducted by an outside contractor?

BY WITNESS DUBE:

A It was conducted by Battelle Northwest for us.

Q Then you accepted the assessment that was provided by Battelle; is that correct?

BY WITNESS DUBE:

A We reviewed Battelle's submittal on the Staff, yes.

Q At Page -- Let me refer you to Page 12-38 of the Final Supplement to the Final Environmental Statement. That's in Volume 1.

There is a discussion on this page of the impact that the CRBR might have on proliferation.

Is it possible in your judgment that construction and operation of the CRBR could have some impact on proliferation problems?

MR. EDGAR: Objection. That raises the question of proliferation. It is a programmatic issue.

The need for CRBRP or a demonstration facility

1 is established under the Commission's August '76 decision,
2 and there is no need to go into that issue here.

3 MR. GREENBERG: Mr. Chairman, I believe that
4 issue is directly raised by the Staff's discussion in the
5 Impact Statement at Page 12-38 where it reaches specific
6 conclusions with respect to the impact of the CRBR on
7 foreign weapons proliferation.

8 MR. JONES: Mr. Chairman, I might point out
9 that the reference in the Staff's statement is in fact a
10 response to a comment.

11 It was not something brought up by the Staff
12 originally in the statement. It's a response to a question
13 by the California Energy Commission.

14 JUDGE MILLER: Does it so appear? Is that
15 in the Comment Section?

16 MR. JONES: Yes, Section 12 is the Comment
17 Section.

18 MR. GREENBERG: With all due respect, it seems
19 to me that that's irrelevant. If it's the position of the
20 Staff that nonproliferation issues were outside the scope,
21 it simply should have stated that in the Impact Statement.

22 Instead, it proceeded to conduct an analysis
23 of the issue.

24 (Bench conference.)

25 JUDGE MILLER: Let me inquire of the Staff,

11 1 are there examples in Section 12 where there is a reply or
2 response to comments where the Staff goes into matters which
3 it deems to be irrelevant and beyond the scope of the FES,
4 of an EIS for NEPA purposes?

5 MR. GREENBERG: Yes.

6 JUDGE MILLER: I'm asking Staff as such, Staff
7 Counsel.

8 MR. JONES: I think that is the case,
9 recognized that we're not saying it is not an environmental
10 effect to be analyzed, but what's been stated was it was
11 done in a Programmatic Impact Statement for the LMFBR
12 program.

13 To that extent, when we got a comment, it was
14 answered, but it was not necessarily within the scope of
15 this Environmental Statement.

16 JUDGE MILLER: What I'm asking the Staff
17 Counsel now is whether in preparation of responses by
18 whoever did it, whatever experts were doing it, that
19 somebody had to set the policy for the documents being
20 filed by the Staff, by Staff Counsel, the Final
21 Supplement.

22 MR. JONES: That's correct.

23 JUDGE MILLER: What I'm inquiring now is
24 whether all comments were answered simply because they
25 were comments or whether there was some screening for

1 relevancy or materiality by the Staff before including such
2 responses in this document, this Final Supplement to the
3 FES, which is Staff Exhibit No. 8?

4 MR. JONES: Mr. Chairman, the policy was to
5 answer all comments quite openly if we had the information
6 when they came in.

7 A judgment was not made that we should refuse
8 to answer a comment simply because it was outside the
9 scope of NEPA.

10 JUDGE MILLER: Thank you.

11 MR. JONES: We did not perform independent
12 analysis. If we had the information, we just simply
13 answered it.

14 MR. EDGAR: One reference that might be
15 important here is on the prior page. If you look up on
16 Page 12-37, the paragraph under Section 12.8.4.7, the second
17 paragraph in that section, it clearly reflects the fact
18 that the Staff's review was not to evaluate nonproliferation
19 policy, but to determine if the proposals for safeguarding
20 the fuel were adequate; that the Staff review was limited
21 to consideration of sub-national theft, diversion and
22 sabotage.

23 JUDGE MILLER: It does so appear.

24 MR. GREENBERG: Mr. Chairman, I don't think
25 it's quite an accurate statement to say that the Staff

1 answered all questions regardless of relevance or
2 materiality.

3 I'm looking at Page 12-57 of the Impact
4 Statement under discussion of fuel availability where
5 Staff explicitly states, and I quote: "Because this
6 question is outside the scope of this proceeding and
7 goes beyond the proper issues relevant to the CRBRP, the
8 Staff does not believe that an answer is required."

9 So looking -- that's down in the second
10 paragraph under 12.12.D.1. They clearly are taking
11 different approaches to this problem.

12 JUDGE MILLER: Maybe because they felt the
13 Board had already ruled on that matter in response to
14 earlier motions.

15 MR. JONES: I might note just as the same
16 situation as Mr. Edgar just quoted, the Staff indicated
17 there that it was beyond the Staff's assessments, also,
18 beyond the scope of the assessments.

19 We had the information from the Programmatic
20 Statement and they gave it on proliferation.

21 MR. GREENBERG: Mr. Chairman, from reading
22 this section at Page 12-38, I certainly cannot conclude
23 that this is based upon a discussion in the LMFBR
24 Environmental Impact Statement. This appears to be the
25 Staff's judgment.

1 JUDGE MILLER: Well, where in the Staff's
2 expert witnesses' testimony that we're now addressing,
3 which is Staff Exhibit 10, do you find any discussion?

4 MR. GREENBERG: There is no discussion in
5 the testimony itself. That is correct.

6 JUDGE MILLER: Granted that, I think we are
7 going to regard it as not being included within the
8 testimony nor within the scope of cross-examination.

9 Section 12 appears to be a mixed bag, although
10 on the whole, it appears that the Staff furnished
11 information if they had it, and in some cases they said
12 it was beyond and in others did not say it was beyond.

13 So the Board is exercising no judgment on that.
14 We were inquiring as to background information, but we
15 do believe, subject to me being outvoted now. Just a
16 minute....

17 (Bench conference.)

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1 (Bench conference.)

2 JUDGE MILLER: I survived that time. I didn't
3 get outvoted.

4 (Laughter)

5 MR. GREENBERG: Well, Mr. Chairman, --

6 JUDGE MILLER: I'm not through, though.

7 (Laughter.)

8 JUDGE MILLER: The Board believes that in
9 making its own ruling, it should look at the issues that
10 it deems to be those that are both relevant and material,
11 that is defined, let us say, in the Federal Rules of
12 Evidence, where they don't use the word "material" but they
13 encompass the concept. That is to say, something that is
14 significant for decision-making.

15 Now, using that standard, we now believe it is
16 within the scope of the testimony.

17 I am also reminded by my colleagues that this
18 whole question of proliferation is one that was dealt with
19 heavily by the administration of President Carter and that
20 there seems to be some changes of attitude. Now, it is not
21 anything that this Board has any jurisdiction over and we
22 mention it only because the proliferation matter has
23 different aspects or appearances and looms larger at certain
24 points in time and less significant at somewhat later
25 dates.

1 We note this as being possibly some background
2 information on the comments, then the responses to the comments
3 with regard to proliferation but the Board does not believe
4 that it itself, either should or must go into the matter.
5 We will, therefore, sustain the objection of going into
6 those matters as being beyond the scope of the contentions
7 and the issues of this inquiry.

8 MR. GREENBERG: I take exception for the record.

9 JUDGE MILLER: Yes. You may have an exception.

10 BY MR. GREENBERG:

11 Q At Page 12-67 of the final supplement, in the
12 second full paragraph, there is a statement to the effect
13 that the Staff, and I quote:

14 "Does not believe that the use of
15 CRBR fuel cycle would be an
16 efficient or effective way to
17 produce weapons-grade plutonium."

18 Now, isn't it a fact that there is weapons-
19 grade plutonium that will be used in the CRBR fuel cycle?

20 BY WITNESS HOCKERT:

21 A Some weapons-grade plutonium will be used in
22 the initial fueling of the CRBR.

23 Q And to your knowledge, have breeder reactors
24 ever been considered as candidates for production reactors
25 in weapons programs?

1 BY WITNESS HOCKERT;

2 A To my knowledge, no, sir.

3 Q Is it possible, however, that they could have
4 been?

5 BY WITNESS HOCKERT:

6 A I have no information to say that it is
7 impossible.

8 Q Couldn't a breeder reactor be used for
9 production purposes?

10 BY WITNESS HOCKERT:

11 A A breeder reactor could be used to produce
12 plutonium. Production of weapons-grade plutonium, I suppose,
13 would be theoretically possible, but would be one of --
14 certainly would be one of the least efficient ways to do so.

15 Q Do you have any assurance from DOE that the
16 CRBR will not be used for weapons production purposes?

17 BY WITNESS HURT:

18 A No.

19 Q Now, turning to the fuel cycle, in Page E-13
20 of the final supplement, Volume 2, Paragraph E.6.4, you
21 state that:

22 "The proposed DOE facility design
23 for the DRP is 'conceptual' in nature".
24 What do you mean by the term "conceptual"?
25

1 BY WITNESS HURT:

2 A No portion of the DRP is presently under
3 construction. The entire facility exists only on paper and
4 only in the form of conceptual designs.

5 Q And it's possible, therefore, that there may
6 be a number of changes before the DRP is ultimately designed
7 and constructed?

8 JUDGE LINENBERGER: Excuse me, Mr. Greenberg,
9 but, sir, in answering that question which went to the
10 meaning of the word "conceptual", you used the word
11 conceptual in explaining the meaning.

12 Can you, perhaps, explain it in a way that
13 does not make it a snake chasing its tail, as it were?

14 WITNESS HURT: The only special significance to
15 the term "conceptual" in connection with the DRP is related
16 to the fact that the DRP is not yet built or under
17 construction, unlike some of the other facilities in the
18 CRBR fuel cycle.

19 JUDGE LINENBERGER: Let me probe that just a
20 moment.

21 To make a perhaps meaningless analogy, I'm
22 sure that there are aircraft detailed designs and plans
23 existing in various airplane manufacturers facilities, that
24 are indeed designs for production items that have not gone
25 into production. The fact that they have not gone into

2-5

1 production, have not been built, does not, by some people's
2 definition of the word "conceptual" mean that their
3 designs are conceptual, it's only that they are final
4 designs, they have not been translated into hardware yet.

5 Now, in the case of DRP, are we saying the
6 final designs have not yet been translated into hardware
7 and is conceptual, the threshold of going from final
8 design to hardware or is conceptual a little broader than
9 you have defined it, in this context?

10 JUDGE MILLER: Or another possibility; do you
11 know?

12 WITNESS HURT: Yes, I do.

13 JUDGE LINENBERGER: I say, don't speculate.

14 WITNESS HURT: Well, perhaps, the word
15 conceptual is a poor choice in this case.

16 The information DOE provided us regarding DRP
17 safeguards, was of a systems nature, fairly general in
18 scope.

19 I believe it's also true that detailed
20 safeguards systems designs that would be required at the
21 implementation stage are not available for the DRP.

22 In any case, the Staff did not require that
23 level of detail for its review.

24 JUDGE LINENBERGER: Thank you.
25

1 BY MR. GREENBERG:

2 Q Now, in the same section you determined that
3 at the time frame of design construction of the DRP, the
4 safeguards system as described by the DOE can be the
5 assessment criteria.

6 I take it, however, that if a processing
7 facility other than the DRP is used, then that particular
8 assessment no longer holds; is that correct?

9 BY WITNESS HURT:

10 A The Staff's interpretation has been that
11 commitments DOE has made for safeguards performance in the
12 DRP would be met in other facilities, should they choose
13 to use other facilities.

14 Q Is it your judgment that those commitments
15 could be made in other facilities?

16 BY WITNESS HURT:

17 A We have not performed a specific review of
18 DOE's safeguards capabilities in other facilities.

19 Q Let me explore, if I might, the validity of
20 what may be termed a "limited error" approach to measuring
21 differences in inventory.

22 There is a discussion at Page 12-69 of Volume
23 1 of the supplement to the Final Environmental Statement
24 of reprocessing safeguards. Referring specifically to
25 Section 12.12 E.6.

2-7

1 Now, in this hypothetical reprocessing system
2 that is proposed by the Department of Energy and assuming
3 the limits of error which are set forth in the ER and in
4 the final supplement, is it possible to distinguish a theft
5 of, for example, two kilograms of plutonium from random
6 error in the system?

7 BY WITNESS DUBE:

8 A If you mean basing your action limits on
9 measurement error, which I presume is what you mean by
10 random error --

11 Q Yes.

12 BY WITNESS DUBE:

13 A Then, yes, it is possible.

14 Q Is it possible to distinguish the theft of one
15 kilogram?

16 BY WITNESS DUBE:

17 A With the limited number of errors we use in
18 the environmental statement, the detection capability is
19 on the order of about 600 grams. That's a ninety percent
20 (90%) probability detection.

21 Q Now, when you consider this reprocessing plant
22 and you look at the limit of error, are you considering
23 the entire throughput or just the contribution of the
24 Clinch River Breeder Reactor?
25

2-8

1 BY WITNESS DUBE:

2 A We are looking only at the Clinch River Breeder
3 Reactor, which is --

4 Q So, if you consider the entire throughput of
5 the plant, then that difference in measurement could be
6 higher than two kilograms?

7 BY WITNESS DUBE:

8 A That is correct.

9 Q Turning to the overall analysis which you
10 conducted of the safeguards for the Clinch River Breeder
11 Reactor plant and it's fuel cycle, at Page E-1 of Volume 1
12 -- excuse me, Volume 2 of the final supplement, there are
13 three criteria that are set out in the middle of the page.

14 Do those criteria represent basically what you
15 refer to in your testimony at in Answer A-13, Page 7, as a
16 "systems approach"?

17 BY WITNESS DUBE:

18 A The criteria together with the threat definition
19 and it is explained in testimony, in situations where we
20 needed standards to judge adequacy, we used our regulations
21 if the regulations were pertinent.

22 Q But assuming that the CRBR and the safeguards
23 for the CRBR and its supporting fuel cycle, met all these
24 three criteria, that does not assure, does it, that the
25 CRBR will, in fact, meet the licensing criteria that the

1 Commission used?

2 BY WITNESS DUBE:

3 A That's correct.

4 Q If you can attach probabilities to your
5 assessments, would you say on the basis of your application
6 of these criteria of this system, that there is a high or
7 medium or a low assurance that safeguards will be
8 effective for the CRBR and its supporting fuel cycle in the
9 future?

10 BY WITNESS DUBE:

11 A I cannot attach probabilities to the review
12 the Staff took.

13 Q Now, in your testimony at Page 6, Answer 13,
14 you state at the end of the first paragraph, last sentence,
15 that the safeguards system for the various supporting fuel
16 cycle facilities would comply with the requirements of DOE
17 orders.

18 On what did you base that judgment?

19 BY WITNESS DUBE:

20 A On Page 5.7-40 of the Applicants' environmental
21 report, the following statement is made:

22 "It assumed that the mixed oxide
23 fuel for the CRBRP will be fabricated
24 in DOE facilities and the spent fuel
25 will be reprocessed in a DOE facility,

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1 subject to the safeguards security
2 requirements specified in DOE orders
3 5630, 5631 and 5632."

4 Q Your judgment, in other words, is based upon
5 the representations made in the ER by DOE?

6 BY WITNESS DUBE:

7 A Yes.

8 Q Now, did you conduct any examination of current
9 DOE facilities to determine if those facilities were in
10 compliance with the DOE orders?

11 BY WITNESS DUBE:

12 A No.

13 Q And beyond the DOE assurances, did you employ
14 any criteria to assess the likelihood of compliance?

15 BY WITNESS DUBE:

16 A No.

17 JUDGE MILLER: Now, let me inquire while we're
18 at it, these DOE orders, 5630, 5631 and 5632, described
19 on Page 6 of Exhibit 10, could the Board be supplied with
20 one copy of those?

21 I don't mean instantaneously but in the course
22 of today, perhaps, or --

23 WITNESS HURT: I have one copy with me at
24 present.

25 JUDGE MILLER: Okay.

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1 WITNESS HURT: If you would like it.

2 JUDGE MILLER: Thank you.

3 MR. EDGAR: We can supply it, Judge Miller --

4 JUDGE MILLER: All right.

5 You don't need to interrupt the proceedings to
6 do it. I just wanted to have it available if it was
7 available and I see that it is, so you may proceed.

8 BY MR. GREENBERG:

9 Q Now, I take it that safeguards requirements
10 change from time to time? For example, the NRC safeguards
11 requirements have changed from time to time; have they not?

12 BY WITNESS DUBE:

13 A Yes.

14 Q And DOE safeguards requirements may change from
15 time to time, might they not?

16 BY WITNESS DUBE:

17 A That is likely.

18 Q Now, how long might it take if the requirement
19 change for the facilities -- strike that.

20 How long might it take to upgrade regulations
21 or orders, with respect to safeguards? Based upon your
22 experience.

23 BY WITNESS DUBE:

24 A It depends on how crucial the upgrade is.

25 Q Well, looking at upgrades which have been

2-12 1 conducted by the Commission in the past, for example, with
2 respect to the physical security regulations, about how long
3 did that take?

4 BY WITNESS DUBE;

5 A The regulation itself took several years,
6 however, there were upgrades implemented within a matter of
7 weeks or months through license conditions when the effort
8 first started.

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1 BY MR. GREENBERG:

2 Q In other words, some upgrades might be ac-
3 complished in weeks to months, but others may take longer,
4 on the order of years?

5 BY WITNESS DUBE:

6 A Yes. We have issued regulations when we felt
7 there was the need to take corrective action quickly,
8 in as short as about three months. We could issue an
9 order overnight to have corrective action taken now
10 through license conditions.

11 Q Is it conceivable that threat levels could
12 change, but might not be detected, either by intelligence
13 agencies, or by DOE and NRC, so that an upgrade rule
14 might never be initiated, even though there was a hypo-
15 thetical need for it?

16 MR. EDGAR: Objection. We're going beyond the
17 regulations again.

18 JUDGE MILLER: Sustained.

19 BY MR. GREENBERG:

20 Q In the final Environmental Statement at Page
21 12-68 of Volume I --

22 JUDGE MILLER: Is this the Supplement now,
23 or are we --

24 MR. GREENBERG: Yes. I'm referring to the
25 Supplement. I'm sorry.

1 BY MR. GREENBERG:

2 Q There is a discussion in the first full para-
3 graph of the technical feasibility of implementing a
4 "computerized data handling system." It' stated that
5 that would provide MC&A information with "acceptable
6 timeliness."

7 What do you mean by the term, "acceptable time-
8 liness"?

9 BY WITNESS DUBE:

10 A We have no regulations right now that require
11 any kind of prompt accountability capability. We are in
12 the process of preparing the proposed regulation that
13 would include those kind of capabilities. At this stage
14 of the process, Staff is considering detection capabilities
15 on the order of three to five days.

16 Q Are those capabilities available today?

17 BY WITNESS DUBE:

18 A We believe the basic technology is there,
19 yes.

20 Q But that technology has not yet been imple-
21 mented in an operational sense?

22 BY WITNESS DUBE:

23 A It has -- Portions of it have in some types
24 of facilities.

25 Q What about the type of system that is proposed

1 for the DRP?

2 BY WITNESS HURT:

3 A The sentence in the Environmental Statement
4 Supplement that you're referring to says that the Staff
5 believes that it would be technically feasible to implement
6 a computerized data handling system that will function
7 reliably and provide information with acceptable timeli-
8 ness.

9 It should be emphasized that the Staff was
10 referring there to the data handling portions of a rapid
11 MC&A system.

12 We feel confident that those technical
13 capabilities have been thoroughly demonstrated in many
14 analogous operations.

15 Q When you say "analogous operations," are you
16 referring to operations that would have a through put at
17 the level of the DRP?

18 BY WITNESS HURT:

19 A Yes.

20 BY WITNESS DUBE:

21 A In some cases we're talking through put that's,
22 I would say, several orders of magnitude higher.

23 Q At Page 12-70 there's a reference in the second
24 full paragraph to DOE proposals for rapid material
25 accounting. You indicate that while these measurement

1 capabilities have not yet been demonstrated on an opera-
2 tional basis, "it should be possible for DOE to implement
3 this sort of advanced MC&A system DOE has proposed."

4 You're dealing in the realm of probabilities
5 and possibilities here, are you not?

6 BY WITNESS HURT:

7 A Perhaps I can elaborate on my earlier
8 response and explain to you what the basis is for the
9 Staff's conclusions in this area.

10 There are basically two components to a rapid
11 material accounting system, one that involves the use of
12 computerized data handling system. The other component
13 would involve the use of specialized measurement instru-
14 ments to provide the data for the computerized system.

15 The Staff's statement on the earlier page you
16 referenced was that we are highly confident that the data
17 handling portion of such a system will be available for
18 implementation in these facilities.

19 We believe that at present there has not been
20 a full-scale demonstration of the measurement capability
21 portion of the system that would be required.

22 There have been relatively few opportunities
23 to demonstrate such a system, given the small number of
24 comparable fuel cycle facilities within this country.

25 However, many of the individual measurement

1 instruments have been developed on a pilot scale and
2 tested successfully at a number of similar sites.

3 Q But we will have to await the final outcome
4 of R&D efforts, will we not, to know if a successful system
5 can be implemented?

6 BY WITNESS HURT:

7 A It's my personal opinion that all of the com-
8 ponents required are currently available. There has not,
9 however, been a full-scale demonstration of a rapid account-
10 ing system in an operating facility.

11 Q And you are aware -- Are you -- Excuse me.
12 Strike that.

13 Are you aware of critiques such as those
14 made by the GAO in Intervenor's Exhibit 11, introduced
15 into evidence yesterday, which indicates substantial doubt
16 as to the ability of DOE to implement an effective MCS
17 system?

18 BY WITNESS HURT:

19 A I'm speaking only of the technical capabilities
20 that are available. I have no basis for judging DOE's
21 financial capabilities for implementing these systems.

22 Q Now, in your testimony at Page 7, in the carry-
23 over paragraph, Answer 14, there is a statement to the
24 effect -- and I quote: "Active material control would be
25 accomplished by using the latest advances in remotely

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1 controlled automated processing and rapid accounting
2 techniques."

3 Now, how do you know that the latest advances
4 will be used?

5 BY WITNESS HURT:

6 A Which answer did you say you were referring
7 to?

8 Q I'm referring to Answer A.13. It's the carry-
9 over paragraph on Page 7. I'm looking at the last
10 sentence -- I'm sorry -- second-to-last sentence in that
11 answer.

12 BY WITNESS HURT:

13 A And the question was how does the Staff know
14 that the latest advances will be implemented?

15 Q Correct.

16 BY WITNESS HURT:

17 A May I refer to the Applicants' Environmental
18 Report for that portion of their commitment?

19 Q You're relying once again on a commitment
20 that they're making that the latest advances -- whatever
21 those advances are, you don't really know what those
22 advances will be -- are going to be incorporated; is that
23 correct?

24 BY WITNESS DUBE:

25 A We are relying on their statement in the

1 Environmental Impact Statement, that they will provide that
2 capability, and on our own judgment of the likelihood
3 that those techniques can be implemented.

4 Q Now, are you familiar with -- Strike that.

5 Do you have any particular advances in mind
6 when you refer to these latest advances?

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1 BY WITNESS HURT:

2 A As I indicated earlier, the only area where
3 the Staff has any reason to believe that technologies have
4 not currently been demonstrated is in the area of measure-
5 ment capabilities for rapid material accounting.

6 We would expect continued research and develop-
7 ment in that area, and would believe that some further
8 advances may be necessary to achieve the measurement
9 capabilities DOE has indicated they are striving for.

10 Q And you recognize the fact that DOE is subject
11 to budgetary restraints, that its research priorities can
12 change, and that it is subject to all the other constraints
13 on its operation that federal agencies are subject to?

14 BY WITNESS HURT:

15 A Yes, we recognize that.

16 It may be useful to point out that the near
17 real-time accounting capability that we're discussing in
18 this context is not a system currently required by NRC
19 regulations, but an additional capability that DOE has
20 volunteered for provide for DRP.

21 Q Now, on Page 6 in Answer A13, the second full
22 paragraph, you state that in considering CRBR fuel cycle
23 activities, you considered the combined effectiveness of
24 physical production and MC&A.

25 Does that mean that you looked at these systems

1 as one complementing another in order to assess their
2 overall effectiveness?

3 BY WITNESS HURT:

4 A. Yes.

5 Q. Did you seek to determine if one system stand-
6 ing alone would provide effective safeguards?

7 BY WITNESS DUBE:

8 A. No, we don't do that in our own regulatory
9 framework.

10 Q. Now, you state -- or have stated at various
11 times in your testimony yesterday and today that you rely
12 on figures supplied by DOE with respect to limits of
13 error and so forth.

14 Do you attach any confidence levels to those
15 figures which have been provided by DOE?

16 BY WITNESS DUBE:

17 A. We have not attempted to attach any confidence
18 levels to that.

19 Q. Now, in looking at the dollar costs of this
20 system, have you attempted to evaluate what the costs
21 might be if the system failed?

22 BY WITNESS DUBE:

23 A. I'm sorry. Could you repeat the question?

24 Q. The question is: You've looked at dollar
25 costs of the safeguards system. Have you sought to

1 calculate the dollar costs that might be involved if the
2 safeguards system failed?

3 BY WITNESS DUBE:

4 A. No.

5 JUDGE LINENBERGER: Mr. Greenberg --

6 MR. GREENBERG: Yes.

7 JUDGE LINENBERGER: -- with respect to your
8 last question, were you referring to costs associated with
9 restoring the operability of the system, or were you
10 referring to costs associated with whatever impacts the
11 inoperability of the system --

12 MR. GREENBERG: I was referring to impacts
13 associated with inoperability of the system.

14 JUDGE MILLER: Environmental impacts?

15 MR. GREENBERG: Environmental impacts.

16 Mr. Chairman, I have no further questions for
17 this panel.

18 JUDGE MILLER: Thank you.

19 Does anyone else have any questions?

20 MR. EDGAR: I have a few.

21 JUDGE MILLER: All right.

22 CROSS - EXAMINATION

23 BY MR. EDGAR:

24 Q You were asked about limit-of-error numbers
25 used in the DRP analysis submitted by DOE. In your

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1 judgment based on your knowledge of the state of techno-
2 logy for material control and accounting, are the limit-
3 of-error numbers specified by DOE achievable?

4 BY WITNESS DUBE:

5 A Yes.

6 Q You were asked -- and I believe this was
7 directed to Mr. Dube -- you were asked about the prob-
8 ability that safeguards for CRBR and its fuel cycle would
9 be effective.

10 Can you provide a qualitative description of
11 your level of assurance as to effectiveness?

12 BY WITNESS DUBE:

13 A We can say that we feel that there is reason-
14 able assurance that the capabilities will be provided.

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1 BY MR. EDGAR:

2 Q There was a -- At Page A13 of your testi-
3 mony, there is discussion of -- in the second paragraph
4 on A13 --

5 JUDGE MILLER: A13 is a question.

6 MR. EDGAR: I'm sorry. Page 6, Answer 13.
7 The second paragraph.

8 BY MR. EDGAR:

9 Q There is discussion in a particular sentence
10 here, "For all the CRBR fuel cycle activities, the Staff
11 considered the combined effectiveness of physical pro-
12 tection and material control and accounting."

13 Could you describe the relationships or
14 dependencies between physical protection and material
15 control and accounting, how those two systems interact?

16 BY WITNESS DUBE:

17 A I'm sorry. Did you say "physical protection
18 and material control and accounting"?

19 Q Yes.

20 BY WITNESS DUBE:

21 A Both DOE and NRC take an integrated safe-
22 guards approach where physical security and material con-
23 trol and accounting complement each other. For example,
24 if one is concerned with the possible theft of material
25 by an adversary physically attacking a facility, primary

1 reliance is placed on physical security for detection of
2 the attempted theft and for attempting to repel that
3 theft -- or attempt.

4 Material control also contributes in that
5 area by -- for example -- containing the material and
6 controlling the placing of the material in the facility
7 in such a way that the access to the material might be
8 minimized.

9 Is that sufficient detail or do you --

10 Q Yes. That's ... What is your definition of
11 weapons-grade plutonium, in terms of the content of
12 plutonium 240?

13 BY WITNESS HOCKERT:

14 A We use the definition which is in the OTA
15 Report, which my recollection is is about under ten percent
16 plutonium 240.

17 Q Are you aware that the initial core load for
18 Clinch River is presently expected to be 12 percent
19 Pu₂₄₀?

20 BY WITNESS HOCKERT:

21 A No, sir, I was not. I gather I misspoke myself
22 in previous testimony.

23 JUDGE LINENBERGER: Excuse me, Mr. Edgar,
24 but you referred to a definition in what report, with
25 respect to weapons-grade plutonium?

1 WITNESS HOCKERT: I'm sorry. The OTA Report
2 on Nuclear Proliferation Safeguards.

3 JUDGE LINENBERGER: And what does OTA stand
4 for?

5 WITNESS HOCKERT: Office of Technology Assess-
6 ment, U. S. Congress.

7 JUDGE LINENBERGER: Thank you.

8 MR. EDGAR: I have no further questions.

9 JUDGE MILLER: Staff?

10 MR. JONES: Can we have just about a ten-minute
11 break, please?

12 JUDGE MILLER: Yes.

13 (A short recess was taken.)

14 JUDGE MILLER: All right.

15 MR. JONES: I would like to start the redirect
16 with a question to Dr. Hockert.

17 REDIRECT EXAMINATION

18 BY MR. JONES:

19 Q Yesterday you were asked some questions with
20 respect to the ease with which a clandestine explosive
21 device could be constructed from stolen plutonium. In one
22 of your answers you referred to an article by Dr. J.
23 Carson Mark which you said summarized your views on the
24 subject.

25 Do you have a copy of that article before you?

1 BY WITNESS HOCKERT:

2 A Yes, sir, I do.

3 MR. JONES: I'd like now to distribute to the
4 Board and parties a copy of that article.

5 JUDGE MILLER: Very well.

6 MR. JONES -- and mark it as Staff Exhibit 11
7 for identification.

8 (Staff Exhibit No. 11 was
9 marked for identification.)

10 MR. JONES: Let me start out by way of identify-
11 ing the document. This is a typewritten, three-page docu-
12 ment. The title of it is "Note on the 'Ease' of Producing
13 a Nuclear Explosive by J. Carson Mark for Pugwash Symposium."

14 BY MR. JONES:

15 Q Is this the original of the article?

16 BY WITNESS HOCKERT:

17 A No, sir, it is not.

18 Q Who made this copy of the article?

19 BY WITNESS HOCKERT:

20 A I was provided a xeroxed copy that was about
21 six generations by Dr. Mark's secretary on the ACRS. It
22 was virtually illegible, and I knew that if we brought
23 it down to provide it to the Board and the parties, it would
24 not be readable. So I had the article retyped.

25 Q Is this copy accurate to the best of your

1 knowledge?

2 BY WITNESS HOCKERT:

3 A Yes, sir.

4 Q Now, you state that this article summarizes
5 your views on the ease with which a clandestine nuclear
6 explosive device could be constructed. I ask you to turn
7 specifically to the last page, Page 3 of that document,
8 and wonder if you would read out loud the last two para-
9 graphs of that article.

10 BY WITNESS HOCKERT:

11 A Certainly.

12 "The business of obtaining a workable design,
13 of constructing an object which will behave as intended,
14 and of developing assurance that this has been done properly
15 and that nothing of major importance has been overlooked
16 is not 'easy.' It is possible. It is even possible on
17 a first attempt. But a great deal depends on the techni-
18 cal experience and competence of the person or persons
19 involved; and even under circumstances which are favorable
20 in this respect there is likely to be some residue depend-
21 ing on luck.

22 "In conclusion it should be noted that most,
23 if not all, of the proposals developed by amateurs, cranks,
24 graduate students, would-be saboteurs, and such, and which
25 have been said to have been worked out in impressively

1 short order, and which on occasion have been said to com-
2 prise 'workable designs,' and which, finally, have been
3 adduced as evidence that building a nuclear explosive is
4 'easy,' in fact consist merely of 'schematics' in the
5 sense of the present discussion."

6 Q Do you agree with those statements?

7 BY WITNESS HOCKERT:

8 A Yes, sir.

9 Q One last question: Are you familiar with the
10 author of this article?

11 BY WITNESS HOCKERT:

12 A Yes, sir.

13 Q Do you consider him an expert in the field
14 of safeguards?

15 BY WITNESS HOCKERT:

16 A Not in the field of safeguards --

17 Q I'm sorry --

18 BY WITNESS HOCKERT:

19 A -- nuclear weapons design.

20 Q -- of nuclear weapons design?

21 BY WITNESS HOCKERT:

22 A Yes, sir. He was the Director of the
23 Theoretical Division at Los Alamos for quite a number of
24 years. He served as Chairman of the Task Force on Nuclear
25 Weapons for the Office of Technology Assessment, Nuclear

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1 Proliferation and Safeguards Report.

2 He's a member of the NRC/ACRS and a consultant
3 to the Commission.

4 MR. JONES: I'd like at this time to offer
5 Exhibit 11 into evidence.

6 JUDGE MILLER: Any objection?

7 MR. GREENBERG: With the understanding that it is
8 offered solely as indicating a basis for the opinions
9 of Mr. Hockert and not reflecting the opinions of Mr.
Mark.

11 JUDGE MILLER: I'm not sure you can make that
12 distinction.

13 It will be admitted without reservation --
14 or limitation.

15 (Staff Exhibit No. 11 was
16 received in evidence.)

17 JUDGE MILLER: You will be permitted to cross-
18 examine, of course.

19 BY MR. JONES:

20 Q Mr. Hurt, yesterday, you were asked a
21 question with respect to the cost of safeguards concerning
22 the plutonium conversion facility. You indicated that DOE
23 had not provided any cost estimates.

24 What is the basis for the Staff's conclusions
25 regarding the costs of safeguards at the plutonium

1 conversion facility?

2 BY WITNESS HURT:

3 A In their Environmental Report, DOE made the
4 commitment to provide safeguards for the conversion
5 facility, if indeed one is needed, that would be very
6 similar to the safeguards provided for the fuel fabrica-
7 tion facility.

8 The Staff has reviewed the various systems
9 that would be involved in safeguarding those facilities
10 and has concluded that the costs of providing those systems
11 at the conversion plant would not exceed the costs of
12 providing the same system for the fuel fabrication
13 facility.

14 In the case of the fuel fabrication facility,
15 it was determined that the costs of safeguards proposed
16 by DOE were reasonable and not a large proportion of the
17 cost of the entire CRBR fuel cycle.

18 Q Mr. Dube, I believe it was addressed to you
19 earlier -- a question with respect to -- in conducting its
20 analysis of reprocessing, whether the Staff considered
21 through put of material through the DRP other than CRBR
22 material, and you responded no.

23 I want to make sure it's clear. When the
24 Staff did their analysis, did it include the through put
25 of all material related to the Clinch River Breeder

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1 Reactor through the DRP?

2 BY WITNESS DUBE:

3 A Yes, it did.

4 Q Also, you were asked a question with respect
5 to whether or not the NRC Staff had determined whether the
6 likelihood of DOE compliance with DOE orders, and you
7 answered that that assessment had not been done.

8 Was any assessment done to determine whether,
9 in fact, DOE orders can reasonably be complied with with
10 present technology?

11 BY WITNESS DUBE:

12 A Yes, it was.

13 Q And what was the result of that?

14 BY WITNESS DUBE:

15 A We concluded that it was reasonable.

16 Q You were also asked specifically whether or not
17 we had attached any confidence levels to DOE commitments
18 throughout the environmental approach that we referred to.
19 You indicated that we did not.

20 Again, with respect to that, was an assess-
21 ment made of whether or not, in fact, DOE could meet those
22 commitments?

23 BY WITNESS DUBE:

24 A Yes. Staff concluded that there was reason-
25 able assurance that we could.

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1 Q A final question: There was some discussion
2 about whether or not the plutonium produced from the
3 Clinch River Breeder Reactor could be used in nuclear
4 weapons.

5 I wondered if anyone on the panel is aware of
6 whether or not the use of plutonium from Clinch River
7 in a nuclear weapon is permissible.

8 BY WITNESS DUBE:

9 A When Congress passed the continuing resolution
10 this fall, it specifically prohibited any use of Clinch
11 River material in the weapons program.

12 MR. JONES: I have no further redirect.

13 JUDGE MILLER: Recross?

14 MR. GREENBERG: A couple of questions, if I
15 might, with respect to the Carson Mark article.

16 JUDGE MILLER: Staff Exhibit 11.

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RECROSS-EXAMINATION

BY MR. GREENBERG:

Q Can I direct your attention, Mr. Hockert, to Page 7-21 of the Final Environmental Statement dated February 1977? Do you have a copy of that statement?

That is Staff Exhibit 7.

BY WITNESS HOCKERT:

A I'm sorry. By the time I found the document I lost the page reference.

Q Page 7-21. Do I have you at Page 7-21?

BY WITNESS HOCKERT:

A Yes.

Q If you look at the fourth full paragraph, there is a sentence that reads as follows, and I'll quote: "Experts are divided as to the true difficulty that might stem from such considerations as those mentioned above," and the considerations mentioned above relate to construction of a CFE, "...and as to what might be the requirements if a determined group would undertake the simplest possible means of creating a crude but effective nuclear explosive."

Does that still represent the Staff's views?

BY WITNESS HOCKERT:

A The Staff cannot deny that experts in the area are divided.

2
1 JUDGE MILLER: Is Mr. Mark among those quoted
2 following that statement where the three different opinions
3 are set forth to show the range of views?

4 WITNESS HOCKERT: Yes, sir.

5 JUDGE MILLER: I see number one is Willrich
6 and Taylor, 1974.

7 Just generally, no detail, what was the point
8 of view of Willrich and Taylor?

9 WITNESS HOCKERT: Willrich and Taylor, I
10 believe, tended to emphasize the ease -- I believe that
11 it was easier than Dr. Mark did.

12 JUDGE MILLER: And I think you've already
13 identified J. Carson Mark as quoted in Schmidt and
14 Bodansky, 1975, as being the same author of Staff Exhibit
15 11; is that correct?

16 WITNESS HOCKERT: Yes, sir.

17 JUDGE MILLER: What views were expressed
18 there? Were they generally similar to those in Exhibit 11?

19 WITNESS HOCKERT: Yes, sir.

20 JUDGE MILLER: And finally, then, what were
21 the nature of the views on Paragraph No. 3 of M. Levenson
22 and E. Zebroski, 1975?

23 WITNESS HOCKERT: They believed or stated
24 that it would be more difficult than Dr. Mark so stated.

25 JUDGE MILLER: Very well. You may proceed.

BY MR. GREENBERG:

Q Mr. Hockert, are you familiar with the OTA report entitled, "Nuclear Proliferation and Safeguards"?

BY WITNESS HOCKERT:

A Yes, sir, I am.

JUDGE MILLER: That's the Office of Technological Assessment, OTA?

MR. GREENBERG: I think it's Office of Technology Assessment, Mr. Chairman.

JUDGE MILLER: Office of Technology Assessment?

MR. GREENBERG: Office of Technology Assessment, Congress of the United States, "Nuclear Proliferation and Safeguards," dated 1977.

JUDGE MILLER: Thank you.

BY MR. GREENBERG:

Q Do you know who the Chairman of the Task Force on Nuclear Weapons was?

BY WITNESS HOCKERT:

A Yes, sir. I cited that as Dr. Mark.

Q Dr. Mark. Now, at Page 141 of the OTA report, and I'll show you the document, in the discussion of the possibility --

JUDGE MILLER: Remember, you are to use the mike because you are getting recorded.

MR. GREENBERG: All right.

BY MR. GREENBERG:

Q In the discussion of the possibility of the construction of a CFE, the following statement appears, and I quote: "There is a clear possibility that a clever and competent group could design and construct a device which would produce a significant nuclear yield (i.e., a yield much greater than the yield of an equal mass of high explosives)."

Mr. Hockert, does that represent your view?

JUDGE MILLER: You are wandering from the mike.

WITNESS HOCKERT: Yes, sir, it is quite consistent with the quotation given by Dr. Mark that such an effort is possible. It's possible on the first attempt.

MR. GREENBERG: Thank you. I have no further questions.

JUDGE MILLER: Thank you.

Applicant?

MR. EDGAR: I have none.

JUDGE MILLER: Is there any reason -- you have one?

MR. JONES: I only have one question.

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FURTHER REDIRECT EXAMINATION

BY MR. JONES:

Q On the article by Dr. Mark, do you have --
Staff Exhibit 11 -- do you have a date for when this
article was written, approximate?

BY WITNESS HOCKERT:

A It is approximately concurrent with the
"Nuclear Proliferation and Safeguards" document, but the
copy of it that I was given was not dated. So what I
would have to go back to is the date on the note from
his secretary that transmitted it to me. I can provide
that.

JUDGE MILLER: Can you give us an approximate
date?

WITNESS HOCKERT: It's approximately 1977,
1978.

JUDGE MILLER: Does anybody wish or require it
to be any more refined than that?

All right. That will be sufficient then.

Do you have anything further? Is there any
reason why the panel may not be discharged?

There is a good reason. Judge Linenberger.

MR. EDGAR: That just cost you your next vote.

(Laughter.)

JUDGE MILLER: I was afraid of that, but you

1 notice we started out with only one member present. They
2 asked me how we did that.

3 JUDGE LINENBERGER: I've got quite a score.
4 I appreciate the Chairman's interest in expedition, but
5 there are a few little matters I would like to clarify.

6 BOARD EXAMINATION

7 BY JUDGE LINENBERGER:

8 Q Since we've been discussing the Car Mark
9 statement, let me ask the person who read the last
10 two paragraphs if he understands what is the meaning of
11 the word "residue" on the last line of the next-to-last
12 paragraph?

13 Now, sir, I'm not asking you to look inside
14 Dr. Mark's mind, but does that word have a specific
15 meaning to you in the context in which it is used?

16 BY WITNESS HOCKERT:

17 A It has meaning to me that should a group,
18 even competent and well studied, attempt this project,
19 there is a clear possibility that they would not succeed,
20 and that it would require some luck to be successful.

21 Q All right, thank you.

22 Mr. Dube, would you please restate what you
23 said in answer to Counsel's question about weapons grade
24 plutonium and CRBR in the context of the statement you made
25 concerning the language of the continuing resolution?

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1 BY WITNESS DUBE:

2 A I believe the continuing resolution stated
3 that plutonium produced in the CRBRP could not be used in
4 the weapons program.

5 Q Okay. Do you make a distinction between
6 "could not" and "would not"?

7 BY WITNESS DUBE:

8 A I think Congress has specifically prohibited
9 it.

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1 Q So you don't read that as having anything
2 to do with the technical characteristics of the plutonium?

3 BY WITNESS DUBE:

4 A No.

5 Q Thank you.

6 From now on, anybody answer that feels
7 qualified.

8 What is the meaning of the term "formula
9 quantity"?

10 BY WITNESS HOCKERT:

11 A It means 5,000 grams of material computed by
12 the formula, grams containing uranium and uranium
13 enriched to 20 percent or greater, plus 2.5 times grams
14 contained as plutonium, grams contained as Uranium-233.

15 That's a regulatory definition.

16 Q That's a regulatory definition.

17 BY WITNESS DUBE:

18 A If you would like a simpler definition...

19 BY WITNESS HOCKERT:

20 A What we are talking about relative to this
21 proceeding is 2 kilograms or more of plutonium.

22 Q Well, I gather --

23 BY WITNESS DUBE:

24 A Equivalent to that is 5 kilograms of uranium
25 enriched -- 5 kilograms of U-235 in uranium enriched

greater than 20 percent.

Q Understood. The thing that was troubling me and still is is that it seems to me the term "formula quantity," basically it relates, if you will, to the extent to which plutonium has been adulterated, in this case by depleted U-238, and I don't see how it necessarily has to tie in any amount.

You could have 10 kilograms of formula material and that would carry an inference of 4 kilograms of plutonium, for example.

So how does the term "formula quantity" itself imply a specific weight of anything?

BY WITNESS HOCKERT:

A It does not imply a specific weight of an isotopic mix.

Q Okay, thank you. That was my hangup.

Gentlemen, the term "threat level" has been used quite a bit yesterday and today, and I see that as possibly falling into two definitional categories.

There is some kind of -- I don't know how one determines it -- actual threat level that perhaps only God and the saboteurs know the extent of, and there is something which I will call a perceived threat level, which people in NRC and DOE hope somehow relates to the actual threat level so that you know what you are up against

1 in trying to protect certain activities from.

2 Now, my concern is what sort of ongoing
3 activity is there within your direct knowledge, not
4 speculation, that tries to assure over the passage of time
5 that the perceived threat level somehow is realistic with
6 respect to the actual threat level?

7 Is my question understood?

8 BY WITNESS DUBE:

9 A Yes. We have addressed this in roughly a
10 three or four-page submittal in one of the interrogatories.
11 It is outside my area of expertise and perhaps Mr. Jones
12 could summarize it for you.

13 BY WITNESS JONES:

14 A The Staff as part of its continuing
15 responsibilities under the Atomic Energy Act constantly
16 reviews situations of the United States and overseas which
17 could pose a threat to NRC licensed activities.

18 We rely on information developed by other
19 agencies, including elements of the intelligence
20 community.

21 We rely on studies which are produced by
22 contractors of NRC and other agencies such as DOE.

23 The evidence of this statement is found in
24 a document which we produce every six months for the
25 Director of the Division of Safeguards reviewing events

11 1 and making a judgment as to whether or not the current
2 design basis threat statements found in 10 CFR Part 73
3 are currently valid.

4 There is nothing to indicate as of this time
5 that our threats are in fact not a prudent design basis
6 based on historical evidence.

7 Q So there is a routine ongoing semiannual
8 review of this to see if any updating is necessary, I guess,
9 is what you are saying?

10 BY WITNESS JONES:

11 A The semiannual review is focused on the
12 contents of the regulations. Should we in our day-to-day
13 review uncover something which warrants our attention,
14 we have a mechanism by which we can issue an immediately
15 effective order to require a site or sites to upgrade
16 their security requirements to in fact meet what we
17 understand the threat to be.

18 Q All right, sir.

19 I believe some, if not all, of you gentlemen
20 were present yesterday when the Applicants' panel
21 testified at some length about procedures, techniques,
22 instrumentation advances and so forth that would be
23 brought to bear in reducing the likelihood of success
24 of any particular threat.

25 Am I right that you gentlemen heard that?

BY WITNESS DUBE:

A. Yes, sir.

Q. I indicated at the end of that presentation the Board's concern that whereas there seemed to be a wealth of information about how to do things, how to prevent things from being done, kinds of procedures that we'll implement here, new technologies and so forth, concern about what kind of obligation or forcing function or whatever would assure that all of these nice improvements really get somehow implemented into the Clinch River program.

I'm sure you heard the answers that came from Applicants' panel yesterday. I would like to ask if any of you gentlemen have anything further to add here from the NRC's side of this question or problem?

BY WITNESS DUBE:

A. In the case of the Clinch River reactor itself, of course, there will be future licensing review and a much more detailed review of the security system at Clinch River.

If any particular thing has to be implemented at that stage of the game, then we have a regulatory mechanism of doing that.

In the case of the other facilities, the fuel cycle facilities, Congress has not given us any

13 1 licensing authority over those facilities.

2 However, any of those facilities which would
3 be built in the future or would require any significant
4 modifications to the existing facilities in order to make
5 them useful for the Clinch River purposes would, of course,
6 be subject to NEPA requirements and DOE would have to
7 prepare an Environmental Impact Statement.

8 Q All right, sir.

9 Let me look at your answer just a little bit
10 here.

11 BY WITNESS DUBE:

12 A Sure.

13 Q You used words to the effect that in various
14 licensing reviews if anything needs to be changed -- I
15 think that is similar to your words -- there is a mechanism
16 for doing it.

17 Yes, I accept that. In fact, I even believe
18 it.

19 What I'm concerned about is who is on top of
20 what needs to be changed? I can see your organization,
21 Mr. Dube, saying, "Well, gee, there are all sorts of good
22 things coming along. Somebody is going to be sure to let
23 us know about them and we'll get them in."

24 And somebody else saying, "Well, I know about
25 these things coming along, but that's Dube's responsibility

-14 1 to get them in," and lo and behold, things get built and
2 some of the things don't get in.

3 What keeps that from happening?

4 BY WITNESS DUBE:

5 A Mr. Gaskin is going to be addressing the --
6 will address the plant itself, since he is the licensing
7 project manager on it, the safeguards licensing project
8 manager.

9 I would like to point out, however, before I
10 let him address that, that in doing its environmental review,
11 Staff did not rely on any research and development
12 programs with the exception of research and development on
13 implementation of prompt accountability capabilities in
14 a reprocessing facilities.

15 In that particular area there is no regulatory
16 requirement for that and we have no standards that require
17 that; however, we think it is a desirable approach and
18 we certainly would support DOE's going in that direction.

19 Mr. Gaskin will address the plant.

20 BY WITNESS GASKIN:

21 A As a reviewer of the Clinch River, I will not
22 only review their submittal at the time of the FSAR
23 submittal, but I will expect to go through a comment cycle
24 until we come up with approved commitments which we feel
25 will meet our regulations.

1 Then after, if and when they obtain an
2 operating license, after they have implemented these
3 commitments, as a reviewer I also monitor their progress
4 through our inspection process from our regions.

5 If any problems arise, then I would get back
6 into the act and ask them to correct them. Either I will
7 ask them or tell them through license conditions to do so.

8 Between now and the time they become
9 licensed, it's difficult to predict just exactly what type
10 of new systems or whatever will be available or, for
11 example, what threat or what regulations will be in; but
12 nevertheless, whatever the regulations, we will review to
13 those regulations and expect them to meet it.

14 Their statements regarding what they plan on
15 doing, as a reviewer, I give those no weight at this time,
16 because I'm only interested in their solid commitments in
17 their submittal.

18 As I said, once we have reviewed and approved
19 those, then we will follow through on those.

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1 BY WITNESS HOCKERT:

2 A If I might add a little bit with regard to
3 awareness in the areas of research development.

4 The NRC, in the safeguards area, has an ongoing
5 program in which we, DOE and DOD exchange every year a
6 description of each technical assistance and research
7 project that we perform.

8 This accomplishes two things.

9 It assures that there is no duplication of
10 effort among the agencies, and it identifies programs being
11 conducted by other agencies which are of interest.

12 This information is then disseminated to the
13 Staff who might have an interest in it. In our case,
14 the Power Reactors Safeguards licensing Branch, of which
15 Chuck and I are both members, and is available with points
16 of contact in other agencies.

17 BY JUDGE LINENBERGER:

18 Q Okay. Just to carry your comment one step
19 further, Mr. Gaskin, you indicated that there would be a
20 review of that and a determination with regard to whether any
21 approaches or systems proposed by Applicants met the
22 regulations.

23 Now, I can envisage that in some absolute way
24 that is not necessarily good enough. There may be twenty-
25 year old technology that might meet the regulations. There

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1 may be some one-year old technology that will do better than
2 meet the regulations.

3
4 Now, again, perhaps looking under the bed,
5 but is the Staff going to be content with the twenty-year
6 old technology because it meets the regulations or what
7 assures that an attempt to try to do better than meet the
8 regulations, in terms of the overall accomplishment with
9 respect to safeguards?

10 BY WITNESS GASKIN:

11 A We would expect the Applicants to take a very
12 conservative approach to the security program at the site
13 and if there is a new technology that is better than the
14 twenty-year old technology, we would expect them to
15 explore using that at the site, if, indeed, it is better
16 and meets with the safety and operational constraints.

17 BY JUDGE LINENBERGER:

18 Q Let me ask you just a moment about the
19 underlying objective or attempt of what has been termed
20 "near real time" accountability.

21 I can view this as a program, a thing, a
22 system -- let's call it a system, if you will, that reduces
23 the time delay between a diversion and the detection of
24 that diversion and concede that perhaps that is the
25 basic objective.

1 On the other hand, I can view it as a system
2 that attempts to detect the onset of a diversion before it
3 has a chance to be successful and start to do something
4 about it.

5 Now, this is my own kooky division of ideas
6 here, but does NRTA fall into either of those categories,
7 as you gentlemen view it?

8 BY WITNESS DUBE:

9 A I believe you have hit on two facets, or some
10 additional ones. I'll expand on that a little, if you
11 like.

12 First of all, let me make clear that the
13 intent of detecting attempted theft, we place primary
14 reliance on our physical security provisions and some
15 material control provisions that supplement those. We focus
16 on detecting any attempt while the attempt is in progress
17 so we can respond immediately.

18 In many scenarios, of course, in no kind of
19 material controlled accounting will we back off, because
20 there are some provisions -- but, typically, the kinds of
21 prompt accountability that we're talking about would not
22 necessarily contribute to all those kinds of scenarios, so
23 we're still relying on physical security and the support
24 of the material control provisions.

25 However, as you indicated, there are certain

1 scenarios, prolonged scenarios, which could be detected
2 promptly enough to cause the physical security system to
3 react and to stop the attempts.

4 Similarly, the promptness of detection would
5 help in any recovery efforts if somehow the system did get
6 defeated, the security system did.

7 But there's another facet you haven't hit on
8 yet and that's the detection process is basically a two-
9 step one.

10 First, you need some kind of alarm to alert you
11 that there is some kind of a problem.

12 Secondly, you need the capability of
13 determining whether that alarm is a real one or whether it's
14 just some inadvertent indication that there was a potential
15 problem.

16 Staff believe that the -- that identifying the
17 possibility of a problem quickly, on a localized basis,
18 which are characteristics of the prompt accountability,
19 contribute significantly to that resolution capability and
20 that's another thing we put very heavy weight on.

21 BY JUDGE LINENBERGER:

22 Q Thank you.

23 Finally, gentlemen, is there anything about your
24 pre-filed testimony that is in any significant way dependent
25 upon what is the source of the plutonium fuel that will go

1 into Clinch River?

2 BY WITNESS DUBE:

3 A. No.

4 BY JUDGE LINENBERGER:

5 Q Thank you very much.

6 JUDGE LINENBERGER: That's all I have, Mr.
7 Chairman.

8 JUDGE MILLER: Dr. Hand?

9 JUDGE HAND: No.

10 MR. JONES: Mr. Chairman, we have one area of
11 about two or three questions, which would actually be in
12 the nature of rebuttal of the Applicants' testimony.

13 If you wish, I could ask those questions now
14 while the panel is here and get them out of the way. I
15 don't know if we will have any rebuttal to Dr. Cochran's
16 testimony but this is to the Applicants' testimony.

17 JUDGE MILLER: Which portion of the Applicants'
18 testimony?

19 MR. JONES: Specifically, it was to some
20 statements made yesterday by the Applicants' witnesses as
21 to whether quantities of strategic nuclear materials were
22 used in any commercial reactors at this time.

23 JUDGE MILLER: Might as well cover it now.

24 MR. JONES: Okay.

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FURTHER REDIRECT EXAMINATION

BY MR. JONES:

Q I direct this to the panel as a whole.

Yesterday one of the DOE witnesses stated that there were no commercial reactors which were using -- or he wasn't aware of any -- using formula quantities of strategic nuclear material.

I wonder if anyone on the panel disagrees with that statement?

B Y WITNESS DUBE:

A Yes, I do..

FFTF, the Fast Flux Test Facility in Richland, Washington, uses plutonium. It's been in operation, I believe, for two years.

The plutonium used in that facility was manufactured in commercial licensed fuel fabrication facilities, beginning, I believe, around 1969 or 1970.

During that time frame there were approximately ten fuel fabrication or research and development facilities using significant quantities of plutonium, that were licensed.

In addition, there is currently in operation the Fort St. Grain reactor in Colorado, which utilizes high risk uranium and, of course, there is a corresponding head-in to the fuel cycle for that reactor.

1 BY MR JONES;

2 Q Is anyone on the panel aware of the security
3 at Fort St. Grain?

4 WITNESS GASKIN;

5 A Yes. I'm the reviewer at Fort St. Grain and
6 I'm familiar with the security regulations applying at
7 Fort St. Grain, both 7345, 46 and 7355.

8 BY MR. JONES:

9 Q Are you aware of any problems involving either
10 theft or sabotage at Fort St. Grain that have occurred?

11 WITNESS GASKIN;

12 A None that I know of.

13 BY MR. JONES:

14 Q Are there also other nuclear reactors using
15 mixed oxide fuel?

16 WITNESS DUBE;

17 A Yes. There are several lightwater reactors that
18 have individual fuel pits or assemblies containing
19 plutonium.

20 BY MR. JONES:

21 Q So, in that respect, Clinch River is not
22 unique in it's use of plutonium as a fuel source?

23 WITNESS DUBE:

24 A That's true.

25 MR. JONES: I have no further questions.

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1 JUDGE MILLER: Cross examination?

2 MR. GREENBERG: I have one question.

3 FURTHER RECROSS-EXAMINATION

4 BY MR. GREENBERG:

5 Q On the last point you mentioned, LWR's that
6 used quantities of mixed oxide fuel, I believe you said;
7 aren't those quantities substantially smaller than the
8 amounts that would be used at Clinch River?

9 WITNESS DUBE:

10 A Yes, that's true.

11 MR. GREENBERG: No further questions.

12 JUDGE MILLER: Applicants?

13 MR. EDGAR: One question.

14 FURTHER RECROSS-EXAMINATION

15 BY MR. EDGAR:

16 Q Did you mean to imply that FFTF was a commercial
17 reactor?

18 WITNESS DUBE:

19 A I did not mean to imply that it was a power
20 reactor, no.

21 MR. EDGAR: Thank you.

22 JUDGE MILLER: I believe that's all.

23 Now, may the panel be discharged?

24 (No response.)

25 JUDGE MILLER: Thank you, gentlemen.

1 MR. GREENBERG: Before we discharge the
2 panel, if I --

3 JUDGE MILLER: I've already discharged the panel.

4 MR. JONES: One technical point.

5 We have to offer Exhibit 10

6 JUDGE MILLER: Are there any objections?

7 MR. GREENBERG: No objections but --

8 JUDGE MILLER: Exhibit 10 as modified. There
9 may have been some changes as we went along.

10 Pardon me.

11 MR. GREENBERG: There was a reference during
12 Mr. Dube's testimony to the continuing resolution with
13 respect to the funding of Clinch River.

14 JUDGE MILLER: Yes.

15 MR. GREENBERG: Clinch River Breeder Reactor.

16 I wonder if we could ask for that to be
17 supplementally submitted for the record and we can
18 stipulate as to its authenticity?

19 JUDGE MILLER: Yes.

20 MR. EDGAR: Surely.

21 JUDGE MILLER: That will be provided.

22 I recall the matter you referred to and Staff
23 can provide it, I believe.

24 MR. SWANSON: Yes.

25 JUDGE MILLER: I take it there are no objections?

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1 MR. EDGAR: No, I don't think -- for that
2 matter, it's a matter of law, so anybody would be free to
3 cite a matter of law.

4 JUDGE MILLER: We are getting it in a
5 convenient form.

6 MR. EDGAR: Understood, and as a matter of
7 convenience, I see no problem.

8 JUDGE MILLER: Thank you.

9 You are discharged.

10 (Witnesses excused.)

11 JUDGE MILLER: Who goes next in the
12 presentation of evidence?

13 MR. JONES: How about Exhibit 10?

14 JUDGE MILLER: Exhibit 10 will be admitted.

15 (The document heretofore
16 marked Staff Exhibit No. 10
17 for identification, was
18 received in evidence and
19 follows.)

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BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

Docket No. 50-537

A2: I have had the principal responsibility for updating the safeguards portions of the CRBR Environmental Statement and responding to CRBR discovery items in connection with the environmental impact review.

Q3: Mr. Hurt, please state your name and present occupation.

A3: My name is Robert Davis Hurt, Process Licensing Engineer, Advanced Fuel and Spent Fuel Licensing Branch, Division of Fuel Cycle and Material Safety, Office of Nuclear Material Safety and Safeguards. A copy of my qualifications statement is attached to this testimony.

Q4: Please describe the extent of your participation in the Staff's CRBR environmental impact review.

A4: Under Mr. Dube's direction, I have been responsible for the overall coordination of the safeguards portions of the CRBR Final Environmental Statement Supplement (FESS) and to the CRBR discovery process.

Q5: Mr. Hockert, please state your name and present occupation.

A5: My name is John W. Hockert, Senior Safeguards Technical Analyst, Power Reactor Safeguards Licensing Branch, Division of Safeguards, Office of Nuclear Material Safety and Safeguards. A copy of my qualifications statement is attached to this testimony.

Q6: Please describe the extent of your participation in the staff's CRBR environmental impact review.

A6: I have been responsible for providing technical support in areas related to clandestine fission explosives, plutonium dispersal, and reactor sabotage.

Q7: Mr. Gaskin, please state your name and present occupation.

A7: My name is Charles E. Gaskin, Plant Protection Analyst, Power Reactor Safeguards Licensing Branch, Division of Safeguards, Office of Nuclear Material Safety and Safeguards. A copy of my qualifications statement is attached to this testimony.

Q8: Please describe the extent of your participation in the Staff's CRBR environmental impact review.

A8: I have been responsible for providing technical assistance in areas related to reactor safeguards.

Q9: Mr. Jones, please state your name and present occupation.

A9: My name is Harvey B. Jones, Jr., Security Specialist, Power Reactor Safeguards Licensing Branch, Division of Safeguards, Office of Nuclear Material Safety and Safeguards. A copy of my qualifications statement is attached to this testimony.

Q10: Please describe the extent of your participation in the Staff's CRBR environmental impact review.

A10: I have been responsible for providing technical support in areas related to the safeguards design basis threat.

Q11: What is the purpose of this testimony?

Q11: The purpose of this testimony is to address contentions 4 and 6(b)(4), which state:

"4. The Applicant does not analyze the health and safety consequences of acts of sabotage, terrorism or theft directed against the CRBR or supporting facilities nor does it adequately analyze the programs to prevent such acts or disadvantages of any measures to be used to prevent such acts.

"a) Small quantities of plutonium can be converted into a nuclear bomb or plutonium dispersion device which if used could cause widespread death and destruction.

"b) Plutonium in an easily usable form will be available in substantial quantities at the CRBR and at supporting fuel cycle facilities.

"c) Analyses of the potential threat from terrorists, saboteurs and thieves conducted by the Federal Government demonstrate several credible scenarios which could result in plutonium diversion or releases of radiation (both purposeful and accidental) and against which no adequate safeguards have been proposed by the Applicant.

"d) Acts of sabotage or terrorism could be the initiating cause for CDA's or other severe CRBR accidents and the probability of such acts occurring has not been analyzed in predicting the probability of a CDA."

and,

"6. The ER does not include an adequate analysis of the environmental impact of the fuel cycle associated with the CRBR for the following reasons:..."

"b) The impacts of the actual fuel cycle associated with CRBR will differ from the model LMFBR and fuel cycle analyzed in the LMFBR Program Environmental Statement. The analysis of fuel cycle impacts in the ER must be done for the particular circumstances applicable to CRBR. The analysis of fuel cycle impacts in the ER is inadequate since:..."

"4) The impact of an act of sabotage, terrorism or theft directed against the plutonium in the CRBR fuel cycle, including the plant, is not included nor is the impact of various measures intended to be used to prevent sabotage, theft or diversion."

Q12: How has the Staff analyzed the health and safety consequences of acts of sabotage, terrorism, or theft directed against the CRBR or supporting facilities?

A12: The Staff believes that the health and safety consequences of a successful act of sabotage or theft of plutonium could be severe. The NRC's safeguards objective is to deter, prevent, or respond to such acts in a way that insures against a significant risk of death, injury, or property damage to the public. This objective was the basis for the three criteria listed on page E.1 of FESS. The Staff's approach to this environmental review has accordingly been to focus on the likely effectiveness of the

A12: (con't)

Applicants' proposed safeguards system and to determine that a successful act of theft or sabotage is unlikely, rather than to perform a detailed analysis of consequences.

Q13: How has the Staff analyzed the programs designed to prevent acts of theft and sabotage?

A13: The basis for the Staff's analysis was the Applicants' supplement to the CRBR Environmental Report, Amendment No. XIV to the Environmental Report for the Clinch River Breeder Reactor Plant, Docket No. 50-537, June 1982. This supplement provided a description of the safeguards systems that the Applicant proposes to employ. The safeguards systems for the CRBRP will be required to be designed to satisfy the NRC requirements of 10 CFR 50, 70, and 73. The safeguards system for the mixed-oxide fuel fabrication facility, the reprocessing facility, and transportation activities would comply with the requirements of DOE Orders 5630, 5631, and 5632.

The systems described in Amendment No. XIV cover each activity in the proposed CRBR fuel cycle, including material transportation. The descriptions include both physical protection and nuclear material control and accounting (MC&A) capabilities, thus providing defense in depth. For all the CRBR fuel cycle activities the Staff considered the combined effectiveness of physical protection and MC&A. The physical protection systems would include such features as security zones, facility architectural and design features, personnel and vehicle access controls, intrusion detection and assessment systems, automated alarm reporting, surveillance, communications, and computer security. Material control and

accounting systems would include both passive and active features. Passive material control would be accomplished by placing barriers or impediments between special nuclear material and an inside adversary. Active material control would be accomplished by using the latest advances in remotely-controlled automated processing and rapid accounting techniques, in addition to traditional longer-term physical inventories. PuO₂ and fresh fuel in transit would be protected by the DOE Safe Secure Transport System.

Q14: How detailed was the Staff's review?

A14: The Staff's assessments were performed on a systems level. Operating procedures, equipment specifications, and other details have not been considered at this time. The Applicants' proposals have been judged in terms of whether the safeguards systems would cover all necessary fuel cycle activities, are appropriate for the types of activities to which they would be applied, and are likely to be able to protect against theft, diversion and sabotage. The Staff believes that the systems level assessment is appropriate for an environmental impact review. A detailed review of a safeguards and security plan is not required until the operating license stage. See 10 C.F.R. § 50.34(c)(d).

The Staff's assessment method was to evaluate DOE's proposed safeguards systems against three general performance criteria. The evaluation took account of the safeguards design basis threats and, when necessary, depended on comparisons between DOE's proposals and specific NRC regulations. The Staff's assessment is discussed in more detail in the CRBR Final Environmental Statement Supplement (FESS), Section 7.8 and Appendix E.

Q15: Has the Staff analyzed the disadvantages, such as environmental impacts and dollar costs, of preventative programs?

A15: The Staff believes that the environmental impact of the safeguards measures necessary to minimize the risk of a successful act of theft or sabotage will be negligible compared to the overall environmental impact of the CRBR fuel cycle. The safeguards systems that DOE proposes to employ for the CRBR fuel cycle will involve minimal construction beyond that required for the operation of the fuel cycle facilities themselves. No new construction will be required for transportation safeguards. The number of operating personnel required for safeguards and the amount of equipment required for their support will be small compared to the overall personnel and equipment requirements of the CRBR fuel cycle. The operation of the safeguards system will not impact the environment beyond the immediate vicinity of the fuel cycle activities. The Staff also believes that the dollar cost of safeguards for the CRBR fuel cycle will be insignificant compared to the overall fuel cycle costs. An assessment of the expected costs of safeguards at each facility is contained in Appendix E of the FESS. The Staff believes that these costs are generally comparable to safeguards costs at NRC-licensed facilities.

Q16: What is the Staff's position on clandestine fission explosives and plutonium dispersal devices?

A16: As discussed in Section 2.3 of Appendix E of the CRBR FESS, the Staff policy has been to make the conservative assumption "that a small non-national group of people could design and build a crude nuclear explosive device which would produce significant nuclear yield, that is, a yield much greater than the yield of an equal mass of high explosive. To accomplish this, they would need an amount of special nuclear material which is at least equal to the five-kilogram formula quantity (two kilograms of plutonium), and they would have to possess the appropriate technical capabilities." The basis for the choice of two kilograms of plutonium as the assumed minimum quantity for fabrication of a crude nuclear explosive device is information supplied from the DOE and its contractors, upon whom the NRC relies for determinations on technical matters associated primarily with nuclear weapons technology.

Plutonium can also be fabricated into a dispersal device that could cause serious public health consequences. ~~However, it should be noted that dispersal of "small quantities" of plutonium would not be expected to cause significantly more "widespread death" than dispersal of "small quantities" of a number of other radiological, chemical, or biological agents that are safeguarded to a lesser degree than plutonium and are not extremely difficult to acquire.~~ However, it should be noted that dispersal of "small quantities" of plutonium would not be expected to cause significantly more "widespread death" than dispersal of "small quantities" of a number of other radiological, chemical, or biological agents that are safeguarded to a lesser degree than plutonium and are not extremely difficult to acquire. In any case, the staff believes that plutonium dispersal would have public health consequences orders of magnitude less

than the consequences of the detonation of a nuclear explosive device. If the safeguards for the CRBR fuel cycle are required to be adequate to protect against the risks associated with clandestine fission explosives, the Staff believes that they would also be adequate to protect against the risks associated with plutonium dispersal.

Q17: How much plutonium would be present in the CRBR fuel cycle?

A17: The CRBR and several of its supporting facilities would contain quantities of plutonium that are of safeguards significance. The plutonium throughput of the CRBR fuel cycle would be slightly more than 1,000 kg per year. The average plutonium inventory in the reactor, the reprocessing plant, and the fuel fabrication facility would be many formula quantities at each location.

Much of the plutonium in the CRBR fuel cycle would be contained in highly radioactive media such as irradiated fuel. Irradiated fuel would be found in the reactor core, stored on the reactor site, stored at the reprocessing plant, and in transit between the reactor and reprocessing sites. This material would be protected against sabotage but is not considered a theft target for non-national groups.

Plutonium in the form of moderately radioactive liquids or powders, or contained in unirradiated fuel, would be found in other parts of the CRBR fuel cycle, including the later stages of reprocessing, the fuel fabrication

plant, the reactor site, and in transit to and from the fuel fabrication plant. This material is considered a potential theft target and would be heavily safeguarded against both theft and sabotage. The measures proposed by the Applicants to safeguard the CRBR fuel cycle are described and assessed in Appendix E of the FESS.

Q18: How has the Staff addressed the issue of the potential threat from terrorists, saboteurs, and thieves?

A18: In accordance with NRC's safeguards mandate, the NRC Staff has conducted analyses of the potential theft and sabotage threat to licensed nuclear activities. Because the incidence of nuclear sabotage and theft is very low, such analyses have relied primarily on the study of events in non-nuclear, high value, or high risk environments. Some nuclear events have also been included in the analyses. These studies have attempted to analyze the characteristics of potential adversaries to nuclear programs, including their degree of motivation, equipment, tactics, and organization. The design basis threats contained in 10 CFR Part 73.1(a) represent the Staff's best judgment of the characteristics of potential adversaries nuclear activities.

Q19: Has the Staff considered whether the Applicants' proposed safeguards would provide adequate protection against a design basis threat?

A19: As a licensed operating facility, the CRBRP would have to satisfy the safeguards requirements of 10 CFR Part 70 and 73, and would thus have to protect against the NRC design basis threats. The details of compliance with the regulations will be reviewed at a later stage in the licensing process for the CRBRP. As part of the environmental review, the Staff has assessed the general reactor safeguards systems proposed by the Applicants and has concluded that it is likely that the Applicants will be able to satisfy the safeguards regulations. This assessment is contained in Appendix E of the CRBR FESS.

For non-licensed fuel cycle facilities that would support the CRBRP, the safeguards systems would be designed in accordance with the DOE's 1976 threat guidance, which is similar to the NRC's design basis threat. The Staff believes that safeguards programs designed in accordance with the DOE's guidance will provide a level of protection at least as high as that provided by programs designed in accordance with the NRC's design basis threat.

In Amendment XIV to its Environmental Report, the DOE provided descriptions of its proposed safeguards for the CRBR fuel cycle. Appendix E of the NRC's FESS discusses the design basis threats and assesses the DOE's proposed safeguards. The Staff concluded that the proposed safeguards systems would be likely to be able to protect against the design basis

threats and that the safeguards risks associated with the CRBR fuel cycle would be no greater than the risks associated with other similar nuclear activities.

Q20: Has the Staff addressed the issue of whether the acts of sabotage could initiate severe accidents at the CRBR?

A20: Yes. The Rasmussen Report (WASH-1400) and the Lewis Panel, in its Risk Assessment Review Group Report to the U.S. Nuclear Regulatory Commission (NUREG/CR-0400), recognized that the probability of sabotage of a nuclear power plant cannot be estimated with sufficient confidence to be included in current risk assessments. The Staff's position is that radiological sabotage, by a single insider or as a result of a determined violent external assault by several persons, is possible and could have severe consequences. The NRC has promulgated regulations requiring the design of safeguards programs to protect against acts of radiological sabotage (10 CFR 73.55). We also note that design features to protect against accidents increase the inherent sabotage resistance of the plant. The safeguards design features of the CRBRP will be required to be responsive to the requirements of 10 CFR Part 73. A preliminary assessment of the Applicant's proposed CRBRP physical security system is contained in Appendix E of the FESS. The Staff's conclusion was that the CRBRP safeguards systems appear reasonable for meeting the regulatory requirements.

Q21: Have the Staff's conclusions in the FESS differed significantly from those in the FES?

A21: In both reviews the Staff concluded that it is possible to provide adequate safeguards for the CRBRP and its fuel cycle. In the previous review it was assumed that all of the CRBR fuel cycle activities would be licensed by the NRC. In the present review it has been assumed that only the reactor will be licensed and that the DOE will conduct the other fuel cycle functions in unlicensed facilities. The Staff has also assumed that transportation activities related to the CRBR will be unlicensed. This change in the expected status of the supporting fuel cycle activities has prompted the Staff to change the scope of its environmental review so that the unlicensed activities are explicitly considered. In the previous review the fuel cycle activities were not considered as extensively since it was reasonable to expect that each of them would be subject to its own NRC environmental review. Despite this change in scope the Staff's conclusion remains the same: that it is possible to provide adequate safeguards for the CRBR fuel cycle and that the Applicants' proposed systems have the potential for doing so. The Staff has also concluded that the costs of safeguards for the CRBR fuel cycle will be a small fraction of the overall costs.

EDUCATIONAL AND PROFESSIONAL QUALIFICATIONS

Robert J. Dube
Division of Safeguards
U. S. Nuclear Regulatory Commission

My name is Robert J. Dube. I am the Section Chief, Regulatory Activities and Analysis Section, Fuel Facilities Safeguards Licensing Branch, Division of Safeguards. I have had 19 years experience in nuclear regulation and policy with the Atomic Energy Commission, the Federal Energy Administration, and the Nuclear Regulatory Commission. This has included 13 years of experience in safety, environmental, and safeguards aspects of fuel cycle facilities. I am currently responsible for the development of regulations, guidance, and acceptance criteria for nuclear fuel facilities, spent fuel storage installations, and non-power reactors. My responsibilities also include monitoring and analyzing data submitted by licensees for safeguards implications.

Since joining the Division of Safeguards in 1976 I have been involved in the resolution of technical safeguards issues, and in the development of regulations related to material control and accounting and physical security for nuclear materials, physical security for power and non-power reactors, physical security for storage and transportation of spent fuel, and safeguards for reprocessing facilities.

Educational and Professional Qualifications

R. Davis Hurt
Division of Safeguards
U.S. Nuclear Regulatory Commission

My name is R. Davis Hurt. I am a MC&A program analyst for the Fuel Facility Safeguards Licensing Branch of the Division of Safeguards. I am responsible for the development of safeguards guidelines for reprocessing plants and the evaluation of advanced MC&A techniques for licensed fuel cycle facilities. My recent projects have included work on the Material Control and Accounting Requirements for Facilities Possessing Formula Quantities of SSNM and experimental work on the application of rapid alarm resolution methods to scrap recovery processes.

I received a Bachelor of Engineering degree in engineering physics from the University of Illinois in 1976 and a Master of Engineering degree in nuclear engineering from the University of Washington in 1978.

From 1977 to 1981 I worked as a nuclear engineer at the Oak Ridge National Laboratory. My duties included the design of advanced MC&A systems for reprocessing plants and the supervision of experiments in the use of computerized process data for reprocessing safeguards.

EDUCATIONAL AND PROFESSIONAL QUALIFICATIONS

John W. Hockert
Division of Safeguards
U.S. Nuclear Regulatory Commission

My name is John W. Hockert. I am a Senior Safeguards Scientist in the Regulatory Effectiveness Section, Power Reactor Safeguards Licensing Branch, Division of Safeguards, U.S. Nuclear Regulatory Commission. I am responsible for developing and recommending NRC policies associated with malevolent use of nuclear materials in fission explosive devices and for planning, development and conduct of regulatory effectiveness reviews of NRC licensees to determine the adequacy of existing safeguards programs. My recent projects have included the following: a technical review, performed in conjunction with the Department of Energy, of the NRC Operating Assumption Covering the Relative Ease of Fabricating Clandestine Fission Explosives; development of techniques to assess the sabotage vulnerability of light-water reactors; and completion of a safeguards case study of the NUMEC Apollo Uranium facility.

I received a Bachelor of Science in Physics, with honors, from California Institute of Technology in 1969 and a Master of Arts and Doctorate of Philosophy in theoretical nuclear physics from the State University of New York at Stony Brook in 1970 and 1975, respectively.

From 1975 to 1976, I served as a postdoctoral research associate at the State University of New York at Stony Brook working in the area of medium energy theoretical nuclear physics with emphasis on mesonic effects on the nucleon-nuclear interaction.

My experience includes review of statistical practices in nuclear material control and accounting, development and implementation of safeguards vulnerability assessment techniques applicable to nuclear fuel cycle facilities and light water reactors, and review and analyses, in conjunction with DOE, of scientific and technical bases for requirements for safeguards against fabrication of clandestine fission explosives.

I am co-author of technical articles entitled "Meson Exchange Currents in Deuteron Electrodisintegration: and "A New Method for Determining the Energy Independent Effective Interaction" published in Nuclear Physics and Physics Letters, respectively.

EDUCATIONAL AND PROFESSIONAL QUALIFICATIONS

Charles E. Gaskin
Division of Safeguards
U.S. Nuclear Regulatory Commission

My name is Charles E. Gaskin. I am a Plant Protection Analyst in the Power Reactor Safeguards Licensing Branch, Division of Safeguards. I have had 22 years experience in the security and law enforcement fields with the U.S. Navy, the Central Intelligence Agency, the Department of Justice and the Nuclear Regulatory Commission. In the capacity of a Plant Protection Analyst, I am responsible for performing reviews and assessments of the adequacy of site physical security plans developed to protect against radiological sabotage and against theft of special nuclear materials. I am currently responsible for the 10 CFR 73.55 review of the Clinch River Breeder Reactor Physical Security Plan.

Prior to transferring to the Nuclear Regulatory Commission, I provided technical operational support in law enforcement for the Drug Enforcement Administration (DEA). While in the position of project manager with that organization, I gained experience in the positive operational side of security and participated in the establishment of security regulations for the DEA. I also developed equipment and techniques for surveillance purposes.

While at the CIA I was a technical security officer with overseas experience in both physical as well as technical security. I developed and implemented security systems and programs.

While in the U.S. Navy, I was with the Naval Security Group and was involved in communications security.

My educational qualifications consist of a B. S. in Electronics Engineering from the South Dakota School of Mines and Technology with additional technical and management training related to my professional career. I am a member of the IEEE and participate in the writing of engineering standards for the industry. I am also associated with a law enforcement organization which endeavors to bring an increased professionalism to law enforcement through training and the application of technology.

EDUCATIONAL AND PROFESSIONAL QUALIFICATIONS

Harvey B. Jones, Jr. (Brant)
Division of Safeguards
U.S. Nuclear Regulatory Commission

My name is Harvey B. Jones, Jr. (Brant). I am a Safeguards Analyst in the Division of Safeguards, U.S. Nuclear Regulatory Commission. As a safeguards analyst I am responsible for the analysis and assessment of complex safeguards threat information and the evaluation of the credibility, seriousness and immediacy of any hazards associated with threats to nuclear facilities and/or the transportation of SNM. I am responsible for maintaining regular liaison with other federal agencies to provide timely and coordinated responses to time sensitive threats and to obtain threat related data for use in rule-making, import/export review, and safeguards system design. Also, I am an alternate member of NRC's Information Assessment Team (IAT). As a result of these efforts I participate in the development of new or updated safeguards policy.

I received a Bachelor of Arts in Psychology, with a minor in nuclear physics, in 1972 from Emory University and continued on there in 1973 for one year of graduate work in applied nuclear physics. In 1976 I received a Master of Science degree in Criminology from Georgia State University.

Since November of 1976 I have been employed in my present position with the U.S. Nuclear Regulatory Commission. During this period, a significant amount of my time has been involved in the development and maintenance of several nuclear related threat data bases and co-authorship of two major studies utilizing data from at least two of these data bases. These studies are the "Generic Adversary Characteristics" study and the "Potential Threat to Licensed Nuclear Activities from Insiders (Insider Study)."

1 JUDGE MILLER: Have we ruled on Exhibit No. 11?

2 MR. SWANSON: Yes.

3 JUDGE MILLER: We have. Exhibit 11 has been
4 admitted.

5 All right.

6 We will take a brief recess for the obvious
7 reasons or for those who want to take a quick smoke.

8 (Short recess.)
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1 JUDGE MILLER: Okay. Are we ready to proceed,
2 please?

3 Ms. Finamore, I believe you are examining
4 the witness; is that correct?

5 MR. GREENBERG: No.

6 JUDGE MILLER: All right. I'm wrong. Who
7 will be examining?

8 MR. GREENBERG: I will, Mr. Chairman.
9 Whereupon,

10 THOMAS B. COCHRAN
11 was recalled as a witness by and on behalf of the Inter-
12 venors and, having been previously duly sworn, was
13 examined and testified as follows:

14 DIRECT EXAMINATION

15 BY MR. GREENBERG:

16 Q Please state your name for the record.

17 A Thomas Brackenridge Cochran.

18 Q Where do you reside?

19 A 4836 North 30th Street, Arlington, Virginia.

20 Q Have you prepared testimony with respect to
21 Contentions 4 and 6(b)(4) in this proceeding?

22 A I have.

23 MR. GREENBERG: Mr. Chairman, I would like
24 to mark at this time written testimony entitled "Testimony
25 of Dr. Thomas B. Cochran, Part V, Intervenor's Contentions

1 4 and 6(b)(4)."

2 Could we have that marked as Intervenor's
3 Exhibit 12 for identification?

4 JUDGE MILLER: Yes. That's Part V?

5 MR. GREENBERG: Part V.

6 JUDGE MILLER: And is that the testimony that
7 was filed November 1?

8 MR. GREENBERG: Yes, it was, Mr. Chairman.

9 (Intervenors' Exhibit No. 12
10 was marked for identification.)

11 BY MR. GREENBERG:

12 Q Dr. Cochran, do you have a copy of that testi-
13 mony in front of you?

14 A Yes, I do.

15 Q Does that testimony represent your views
16 today?

17 A Yes. I would wish to make a few minor
18 corrections.

19 Q Will you state what those corrections are?

20 A First, on Page 11 at Line --

21 JUDGE MILLER: Pardon me just a moment here.
22 We seem to have a Supplement to Part V, but I don't have
23 a Part V as originally filed. I have Parts III and IV
24 and then another witness, Dr. --

25 MR. GREENBERG: All right. We have extra

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1 copies here. Let me hand them up, Mr. Chairman.

2 JUDGE LINENBERGER: Is it your understanding
3 that those were transmitted to the Board, by the way?

4 MS. FINAMORE: Yes, they were, Judge Linen-
5 berger, on November 1st.

6 JUDGE MILLER: I've got Part III and Part
7 IV, Exhibit 1, testimony of Dr. Cochran, Part IV. Then
8 the next one is testimony of Dr. Karl Johnson dated
9 October 28.

10 That seems to be true for the rest of the mem-
11 bers of the Board.

12 We do, however, have the more recently filed
13 Part V -- the Supplement. So I guess we're going to have
14 to have Part V. We just don't seem to have it.

15 Now you've just handed up to us copies of
16 the testimony of Dr. Thomas B. Cochran, Part V, roman
17 numeral five, which, parenthetically, refers to Inter-
18 venors' Contentions 4 and 6(b)(4), dated November 1,
19 1982, which has now been marked for identification as
20 Intervenor's Exhibit 12; is that correct?

21 MR. GREENBERG: Correct.

22 JUDGE MILLER: Okay, you may proceed.

23 BY MR. GREENBERG:

24 Q Dr. Cochran, you were in the process of in-
25 dicating whether you had any corrections to make in the

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1 body of that testimony.

2 A. Yes. Let me start from the top again.

3 At Page --

4 JUDGE MILLER: Let me just -- You're getting
5 gun shy.

6 I see a stamped "Confidential" and then
7 something "Unclassified" on the face. Now I want to be
8 sure that we're not into any security problems.

9 MR. GREENBERG: I don't believe we are, Mr.
10 Chairman.

11 Let me explain the process of the submission
12 of this testimony. When the testimony was prepared, my
13 understanding is that it was sent initially on November 1st
14 to the Commission's Office of Security for classification
15 review to insure that there were no portions of the
16 testimony --

17 JUDGE MILLER: I do recall a reference to
18 that, which is probably why we don't then have the --
19 the Board doesn't have five because it was never
20 sent to the Board following whatever that procedure was
21 for -- I don't know whether it was cleansing or ... what
22 the --

23 MR. GREENBERG: My understanding now is that
24 that classification review is completed, and with the ex-
25 ception of one page which we may be discussing -- the

1 version you have has "classified" references deleted,
2 with the exception of that one page which we will be dis-
3 cussing and which was the subject of our notice of intent,
4 the testimony is unclassified.

5 JUDGE MILLER: Well, how was it originally
6 classified?

7 MR. GREENBERG: Well, I believe that Dr.
8 Cochran classified it on his own authority.

9 JUDGE MILLER: Okay. Then he has unclassified
10 it. The Lord giveth, and the Lord taketh away. We don't
11 have any --

12 MR. GREENBERG: It was a prophylactic measure,
13 Mr. Chairman.

14 (Laughter.)

15 JUDGE MILLER: Okay, I see. You may proceed.

16 THE WITNESS: Well, for the third and final
17 time, I'll start from the top.

18 JUDGE MILLER: Go ahead.

19 THE WITNESS: On Page 10 at Line 7, strike
20 the words at the end of the line, "two or more insiders,"
21 and substitute, "inside assistants."

22 At Page 14, Line 5, strike the word "of"
23 and insert "among."

24 Excuse me. That's Line 6.

25 And on Line 7, strike the words "one insider"

1 and substitute "two insiders."

2 JUDGE MILLER: Which line?

3 THE WITNESS: Line 7, the first two words,
4 it should read "two insiders," so that the sentence reads:
5 " ... collusion among more than two insiders."

6 And in the next sentence, for clarification,
7 strike the word "it," -- "Further, it," and insert the
8 words "the external threat," so that the sentence begins,
9 "Further, the external threat does not appear to include
10"

11 At Page 35, the second line that's not in-
12 dented at the very end, it should read "ER 5.7-57."

13 JUDGE MILLER: Instead of "56"?

14 THE WITNESS: Instead of "56."

15 Now, I have one other minor correction on the
16 front of the Supplement, which has not been offered yet.

17 JUDGE MILLER: Is that 12A -- the Supplement
18 is 12A?

19 MR. GREENBERG: Let us mark that as 12A for
20 identification.

21 (Intervenors' Exhibit No. 12A
22 was marked for identification.)

23 THE WITNESS: On the cover page, strike the
24 words -- where it refers to Contentions 1, 2 and 3, strike
25 "1, 2 and 3" and substitute "4 and 6(b)(4)."

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1 MR. JONES: Excuse me. Could we have a
2 clarification on the record as to what Exhibit 12A is?
3 Is there a supplement to this testimony?

4 JUDGE MILLER: 12A is the Supplement to the
5 Testimony of Thomas B. Cochran, Part V, dated November 12,
6 1982.

7 MR. JONES: Excuse me, but I don't believe we
8 ever received that. We have a supplement to the fuel
9 cycle testimony, but not to the safeguards --

10 MR. GREENBERG: I have extra copies here,
11 which I'll be happy to give out.

12 Just to explain that, this Supplement does
13 not reflect any substantive change in the testimony. It
14 merely updates the testimony to refer to the Final Sup-
15 plement to the Final Environmental Statement instead
16 of to the Draft Supplement to the Final Environmental
17 Statement.

18 JUDGE MILLER: Yes. There appears to be
19 nothing substantive.

20 We'll need one copy for the Board, please.
21 Dr. Hand's is probably in the mail. Gus and I have ours.

22 THE WITNESS: I have no further corrections
23 to the testimony.

24 BY MR. GREENBERG:

25 Q Dr. Cochran, with those corrections, is the

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1 testimony before you, to the best of your belief, true and
2 correct?

3 A. Yes.

4 Q And you adopt it as your direct testimony in
5 this proceeding?

6 A. I do.

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1 THE WITNESS: Excuse me. Am I still sworn in
2 from the previous day --

3 JUDGE MILLER: Yes, sir. You remain under
4 oath. I think you might as well stay under oath until we
5 finish this phase of the hearing, and we won't have to
6 bother each time.

7 MR. GREENBERG: Mr. Chairman, the witness is
8 now available for cross-examination.

9 JUDGE MILLER: All right. Who cares to
10 cross?

11 MR. EDGAR: I have some voir dire.

12 Just a point of clarification: Are we still
13 having counsel make a proffer as to the expertise of the
14 witness, the purpose for which it is presented?

15 JUDGE MILLER: Yes.

16 MR. EDGAR: Could we get that --

17 JUDGE MILLER: Yes. Would you indicate the
18 area of expertise for which the witness is proffered as
19 an expert; in other words, those areas upon which you
20 contend his qualifications permit him to give opinion
21 testimony and the like?

22 MR. GREENBERG: Mr. Chairman, Dr. Cochran's
23 qualifications are set out --

24 JUDGE MILLER: We know that. It's just the
25 areas of expertise for which you are proffering him.

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1 MR. GREENBERG: We are proffering him to deal
2 with all areas covered by Contentions 4 and 6(b)(4).

3 JUDGE MILLER: That doesn't quite do it.

4 Regarding him as an expert witness -- pretend
5 we don't know him or you. If there was a jury sitting
6 here, you would then indicate the areas upon which other
7 matters, such as his previously stated qualifications,
8 would enable him to be examined and cross-examined as an
9 expert.

10 Do it briefly.

11 MR. GREENBERG: Well, Mr. Chairman, as appears
12 from his biographical statement, he has been involved,
13 since becoming employed at the Natural Resources Defense
14 Council on a number of matters relating to safeguards and
15 physical security at NRC and DOE facilities.

16 He has authored testimony on this subject --

17 JUDGE MILLER: But you're telling us about
18 his qualifications.

19 MR. GREENBERG: Well, I'm --

20 JUDGE MILLER: All we want you to do is tell us
21 what areas -- assuming his qualifications -- you are prof-
22 fering him now for cross-examination as an expert witness.
23 Just identify the areas of expertness.

24 MR. GREENBERG: The areas of expertness are
25 safeguards risks and consequences.

1 JUDGE MILLER: Do you require anything more
2 precise than that for voir dire purposes?

3 MR. EDGAR: I suppose not.

4 JUDGE MILLER: Proceed.

5 MR. EDGAR: A preliminary matter, Mr. Chairman,
6 we have filed for the convenience of the Board and the
7 parties and dated November 12th, a Motion to Strike
8 Portions of Intervenor's -- of the document which is now
9 marked for identification as Intervenor's Exhibit 12.

10 We have also filed a Response to the Notice
11 of Intent to Introduce Classified Information. We're
12 prepared to proceed with voir dire and cross-examination.
13 However, we think the cross-examination might be expedited
14 if the Board were to rule on the Motion to Strike.

15 JUDGE MILLER: You're referring now to your
16 Motion to Strike Portions of the Testimony of Dr. Cochran
17 as to Part III? You've got a separate motion --

18 MR. EDGAR: Let me be more precise. There's
19 a motion dated November 12 moving to strike portions of
20 Part III.

21 There is a separate motion to strike portions
22 of Part V. Part V is Intervenor's Exhibit 12.

23 JUDGE MILLER: All right. Now what about the
24 National Security information? That is a different
25 matter which does not impinge upon the examination at the

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1 moment?

2 MR. EDGAR: That's correct. We think we can
3 conduct our examination independent of that. However, it
4 may arise that there is a need for resolution of that
5 issue. I can't predict it.

6 All I can tell you at the moment is that we
7 don't see the need to get into that.

8 JUDGE MILLER: What do you suggest as being
9 the most expeditious way to handle the objections that
10 you raise by a motion to strike portions of the testimony
11 of Dr. Cochran on Part V, which is Intervenor's Exhibit
12 12 for identification?

13 MR. EDGAR: Well, we filed it with the idea of
14 giving people advance notice on it. We can proceed with
15 cross-examination.

16 However, we may have -- I have tried to
17 divide the cross-examination into those areas dependent
18 on the motion to strike in those areas which are in-
19 dependent of it.

20 I can proceed on the part which is independent
21 of it, and perhaps we can get a ruling. My preference,
22 quite frankly, is to have a ruling up front, so that we
23 can get the matter resolved.

24 JUDGE MILLER: All right. We have your motion.
25 We have also received a memorandum from Intervenor's which

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1 addresses in part the motion to strike testimony of
2 Dr. Cochran on Part V.

3 I don't think that addresses the motion to
4 strike Part III.

5 MR. GREENBERG: No, it does not.

6 JUDGE MILLER: All right. We'll hear from your
7 briefly, since we've read quickly -- but we, nevertheless,
8 read the motion and the response.

9 We'll hear from you briefly in summary form,
10 and then we might as well get a ruling first.

11 MR. EDGAR: Let me suggest, Mr. Chairman, if
12 there's any question -- it may make sense to defer the
13 ruling until after the testimony is in to see what the
14 record shows.

15 JUDGE MILLER: Let's have about a five-minute
16 recess.

17 (A short recess was taken.)

18 JUDGE MILLER: All right. Are we ready to go
19 ahead with Dr. Cochran's cross-examination?

20 I apologize for having to step down. I had
21 an important telephone call that came through by note, and
22 I had to take it while it was there.

23 But I assume that you used the time wisely
24 and well.

25 I think now we were about to hear briefly from

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1 counsel as to the pending motion of Applicants' to strike
2 part of Dr. Cochran's Part V testimony -- Intervenors'
3 Exhibit 12, and the response thereto by Mr. Greenberg.

4 You may go in whatever order you wish.

5 MR. EDGAR: I'll lead.

6 Our motion, dated November 12, is predicated
7 on prior Board rulings. We have gone through the testi-
8 mony and identified those portions which are in conflict
9 with Board rulings.

10 The particular Board rulings were set forth
11 in the Board's May 27th order for -- protective order,
12 in the Board's special prehearing conference memorandum
13 and order of April 6, in the Board's order of April 14.
14 We believe that in all cases identified in the motion that
15 the testimony in question directly conflicts with the
16 Board's order.

17 The specific Board orders are identified as
18 to each section in the motion.

19 We think for those reasons the testimony
20 should be stricken and not admitted into evidence.

21 MR. GREENBERG: If I may respond.

22 JUDGE MILLER: Yes, you may.

23 MR. GREENBERG: Mr. Chairman, it seems to me
24 we're talking more about interpretation of the Board's
25 orders than anything else.

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1 In our judgment, the testimony is not ruled
2 out by the Board's prior orders relating to discovery,
3 and perhaps it makes sense to break these areas down into
4 four -- at least four areas, as I see it.

5 The first area, which relates to Answer A9,
6 Paragraph 3, is one which Applicants claim that the ef-
7 fects which we're discussing -- or the risks we're dis-
8 cussing -- that is, the risk of hijacking of irradiated
9 fuel are beyond the scope of NEPA because they relate
10 in Applicants' view to actions which take place outside
11 the jurisdiction of the United States.

12 As we've pointed out in our response, this
13 testimony, by its terms, is not directed to ocean trans-
14 port to foreign countries; it's not particularly directed
15 to the regulations and requirements of other foreign
16 countries, which, as I understand it, was the Board's
17 basic concern when it issued its protective order of
18 May 27th.

19 It's concerned with the general problem of
20 the risk of ocean transport.

21 The second area of objection relates to
22 several answers, which Applicants characterize as con-
23 stituting an attack on the Commission's regulations. We
24 don't believe that we are attacking the regulations. We
25 are including references to -- and critiques of various

1 aspects of the regulations in order to explain the basis
2 for our testimony, and further in order to develop issues
3 both with respect to residual risks and the comparability
4 of safeguards which are employed by the Department of
5 Energy and the Nuclear Regulatory Commission.

6 The third area involved a number of answers
7 which Applicants contend relate to the adequacy of safe-
8 guards at various DOE or NRC-licensed facilities.

9 We think that's basically a semantic exercise.
10 We are not challenging the adequacy of safeguards in the
11 context of this proceeding.

12 But as I think became apparent during the
13 testimony of the Commission staff, a critical part of the
14 analytic exercise in this proceeding is comparability of
15 safeguards and examining what is or is not done at
16 DOE fuel cycle facilities.

17 If we can't introduce evidence with respect to
18 safeguards risks at those facilities, it seems to me that
19 we're effectively precluded from challenging the analytical
20 approach taken by the Commission.

21 Finally, the fourth area relates to the
22 relevance of Answer A30, which involves non-proliferation
23 impacts.

24 And as to that area, I guess I must accede,
25 given the Board's ruling this morning on my

1 cross-examination, that that has been ruled out. I
2 don't think it would make much sense for me to press
3 that at this time.

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1 JUDGE MILLER: That is as to Question and
2 Answer 30?

3 MR. GREENBERG: Yes.

4 JUDGE LINENBERGER: Mr. Greenberg, perhaps you
5 can shed some light on what appears to me to be a
6 contradiction between what you said about Answers A.9(3)
7 and what the answer says.

8 The answer quoted on Page 2 of Applicants'
9 motion clearly predicates the consideration there on the
10 matter of water transport of irradiated fuel over the
11 open ocean; and yet I thought I heard you say that's not
12 what --

13 MR. GREENBERG: No. I meant open ocean, but
14 it could be in domestic commerce. It could be with
15 U.S. flag vessels, and it doesn't raise the particular
16 problems of application of foreign rules and foreign
17 regulatory requirements, which seems to me motivated the
18 Board's order of May 27.

19 JUDGE LINENBERGER: Secondly, with respect to
20 A.13, the testimony states that account is taken of
21 Commission regulations and the judgment is offered that
22 Commission regulations may be inadequate.

23 Well, now, I don't particularly care how you
24 label that, as a challenge or not, but 10 CFR certainly
25 has well defined procedures as to how one moves in

1 circumstances where there is belief that the Commission
2 regulation is inadequate.

3 I believe it's -- I have forgotten the
4 section number of Part 2, but at any rate, it talks about
5 special -- a pleading of special circumstances, and that
6 route has not been taken here.

7 MR. GREENBERG: No, and we don't intend to
8 take that route, Mr. Chairman.

9 We are offering this evidence solely for
10 purposes of the residual risk analysis under the
11 National Environmental Policy Act.

12 MR. EDGAR: My response to that is that the
13 residual risk concept deals with those risks that reside
14 from operation in compliance with the regulations.

15 A.13 questions the adequacy of the regulations
16 and suggests in the alternative additional standards.

17 MR. GREENBERG: I don't believe that we are
18 suggesting additional standards. We are suggesting that
19 if there is compliance with the regulations, there may be
20 risks which are run by the CRBR and the fuel cycle
21 facilities which are not bounde by those regulations.

22 MR. JONES: Mr. Chairman, I think this is a
23 little bit different. We are not dealing with a situation
24 where a threat or risk has been identified and the
25 regulations don't deal with it. With respect to safeguards

1 we have a risk, a threat established by the regulations,
2 and the regulations purport to deal with that threat and
3 provide safeguards for that threat.

4 Therefore, the type of analysis in the context
5 of these regulations that he's proposing on residual risk
6 is nothing but an attack on the regulations.

7 JUDGE MILLER: I still think you have argued
8 that before in the area of residual risks, which we've
9 held applicable in other regards as being questioned as
10 to applicability.

11 In fact, I think we ruled peripherally. Let
12 me confer with my colleagues and we will make rulings on
13 these.

14 MR. JONES: Mr. Chairman, one question.

15 JUDGE MILLER: Yes.

16 MR. JONES: The Staff supports the motion of
17 the Applicant.

18 We also had three other areas that we believe
19 should be stricken that weren't brought up in that
20 particular motion.

21 JUDGE MILLER: Well, why don't you let us
22 rule on this motion first, because we now have it in mind
23 and before us, and we've got the responses.

24 The other matters, have you communicated them
25 to Mr. Greenberg?

1 MR. JONES: No, I have not.

2 JUDGE MILLER: You should let him know so that
3 he will have a chance to....

4 I don't know what your timing is on
5 Dr. Cochran. Are you going to run till noon with
6 Dr. Cochran, you think, with your best efforts?

7 MR. EDGAR: Yes.

8 JUDGE MILLER: I suggest that at the noon
9 hour, then, you take it up with other Counsel so that
10 they will be advised, and then we can hear from you
11 briefly and rule on those, too.

12 MR. JONES: I don't think ours involves
13 cross-examination that Mr. Edgar will perform, so that's
14 fine.

15 JUDGE MILLER: Okay.

16 (Bench conference.)

17 JUDGE MILLER: For purposes of procedure we
18 are ruling as a matter of principle, almost -- I won't
19 say generically, but we are not trying to tie it down to
20 particular testimony, because we think the effect of the
21 ruling will be susceptible to handling by Counsel, whatever
22 the nature of the rulings are.

23 If we need any more refinement, it can come as
24 cross-examination proceeds.

25 As to the first, I guess it's Roman I,

5
1 Answer A.9(3), at Page 11, and it does go into questions
2 of water transported irradiated fuel and the like.

3 The Board in its protective order did consider
4 that the transportation of plutonium outside the United
5 States involved other countries, other jurisdictions,
6 other NEPA's or non-NEPA's or matters that it was not
7 necessary for us to get into and we didn't choose to
8 extend unnecessarily.

9 However, there has been a question raised that
10 a portion of that issue and, I assume, testimony (I haven't
11 examined it closely) could be said to cover water
12 transport of irradiated fuel over waterways which are
13 within the territorial limits of the United States, whether
14 it be canal or Great Lakes or possibly intra-coastal.

15 So to that extent we would overrule the
16 motion. However, we do not intend to change our original
17 ruling that we are not going to get into NEPA and
18 environmental matters involving other countries or non-U.S.
19 jurisdiction.

20 The next one is Roman II, the motion, Answer
21 A.13, Pages 13 and 14 of the testimony. On that one,
22 the Board believes that the thrust of the testimony,
23 without probing over the semantics or the particular
24 language, does amount to an assault of one kind or
25 another upon the regulations, the validity or adequacy of

1 the regulations. It will sustain the motion as to
2 Answer A.13 as described.

3 Now, Roman III of the motion, Answer A.21,
4 Pages 20 and 21 of the proposed testimony, relating to
5 the adequacy of safeguards at Clinch River and its
6 supporting fuel cycle.

7 (Bench conference.)

8 JUDGE MILLER: The Board will sustain the
9 objection encompassed in Roman III of the motion on the
10 grounds that the adequacy of safeguards at the DOE, DOD and
11 other installations are indeed beyond the scope of this
12 proceeding and the basis for which Contention 4 was
13 admitted in order to make a NEPA cost-benefit analysis at
14 this time for the purpose of the limited work authorization.

15 The next one is Roman Numeral IV of the
16 motion, which refers to Answer A.26, Pages 26 to 28 of
17 the testimony, the Board will grant the motion to strike
18 as described under Roman Numeral IV, for the reasons that
19 the adequacy of safeguards is beyond the scope as the
20 Board sees it, and that there is also some question about
21 the thrust of the third paragraph described in Page 7 of
22 the motion.

23 It does indeed seem to, in effect at any rate,
24 get to the validity, adequacy and the like of regulations;
25 and in case we haven't ruled explicitly before -- I thought

1 we had, but perhaps not -- we don't believe that the
2 residual risk concept is really applicable to this kind of
3 situation.

4 We have applied it and will apply where
5 regulations such as safety and the like are fully complied
6 with without question, and then despite full compliance
7 there remains a residual risk of some kind which may then
8 and should then be put into the cost/benefit NEPA
9 balancing.

10 That's a more limited application. We don't
11 think it applies to this particular kind of situation.

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1 JUDGE MILLER: The next one is Roman V,
2 Answer A28, Page 30 -- no, I think that's already in
3 effect been ruled upon, hasn't it?

4 Nuclear proliferation, or am I on the wrong
5 page?

6 MR. DGAR: You jumped ahead one.

7 JUDGE MILLER: Okay, I'm sorry. V is A28 of
8 the testimony.

9 That also will be sustained on the grounds set
10 forth previously as dealing with the adequacy of DOE's
11 requirements.

12 It's the next one, Roman VI, yes, which is
13 the Question Q30 and the Answer A30 at Page 32 which
14 does deal with issues of nuclear proliferation upon which
15 we have recently ruled, and consistently with that ruling --
16 or did I understand that that was withdrawn? I'm not
17 sure, Mr. Greenberg.

18 It doesn't matter. We give you the choice.
19 Go ahead.

20 MR. GREENBERG: I haven't withdrawn it,
21 Mr. Chairman.

22 JUDGE MILLER: In that event we will sustain
23 the objection to Answer 30, which is Roman VI of the
24 motion, dealing with the nonproliferation question.

25 Now, let's see, the next one is Roman VII,

1 Answer 31(1), Page 33. It says, "Current Commission
2 material accounting practices are fundamentally flawed."
3 That's a bad start, isn't it?

4 (Laughter.)

5 JUDGE MILLER: The motion will be sustained
6 as a thrust against the Commission's regulations.

7 The next one is Roman VIII, Answer A31(2) and
8 (3), Pages 33 to 35.

9 (Bench conference.)

10 JUDGE MILLER: The motion will be overruled
11 as to Roman Numeral VIII, Answers 31(2) and (3) as I have
12 described it above.

13 The motion will be overruled; therefore the
14 testimony may stand.

15 The next one is Roman IX, A31(6) at Page 39.
16 The motion will be allowed as to Roman IX, dealing with
17 the adequacy of safeguards.

18 Next is Roman X, Exhibit 1. Apparently it
19 deals with the incorporation by reference as Exhibit 1 of
20 Dr. Cochran's testimony; is that correct?

21 MR. EDGAR: Yes.

22 (Bench conference.)

23 JUDGE MILLER: Was this Exhibit 1 previously
24 admitted into evidence? Dr. Linenberger's notes seem to
25 indicate that is the case.

10
1 MR. EDGAR: I don't believe so. I think we
2 may have some confusion on the numbering system, and
3 perhaps Dr. Cochran could explain it, but let me give you
4 my understanding, which is we have the testimony and
5 attached to the testimony --

6 JUDGE MILLER: Whose testimony?

7 MR. EDGAR: Dr. Cochran's.

8 JUDGE MILLER: Previously?

9 MR. EDGAR: No, excuse me. I'm speaking of
10 Dr. Cochran's --

11 JUDGE MILLER: Proposed testimony?

12 MR. EDGAR: -- proposed prefiled written
13 testimony, Part 5.

14 He appended to that five documents which
15 he described as exhibits to his testimony, and they were
16 numbered 1 through 5 consecutively. So there could be
17 a point of confusion as to prior information in the
18 record.

19 THE WITNESS: Let me recommend we change
20 "exhibit" to "attachment." That way --

21 JUDGE MILLER: Now that we've got you to
22 stop practicing law, I think you are right.

23 Okay. "Exhibit 1" will be regarded and
24 referred to as Attachment 1.

25 Now what does that consist of? I haven't had

1 a chance to look at it very carefully, Dr. Cochran?

2 THE WITNESS: That's comments we made on the --
3 that I made on the draft Environmental Impact Statement.

4 JUDGE MILLER: And they were submitted to the
5 Staff as part of someone's comments on the draft
6 Supplement to the FES? Is that what you're talking about?

7 THE WITNESS: The draft or the final. Let
8 me refresh my memory. I mean, the draft or the
9 programmatic. I need to refresh my memory.

10 MR. GREENBERG: I think that's not quite
11 accurate, if I could clarify the record.

12 M₁ recollection is that these were a series
13 of comments on the FES developed in response to answers
14 to interrogatories during the discovery phase of this
15 proceeding.

16 JUDGE MILLER: Would it be, then, the original
17 FES, 1977?

18 MR. GREENBERG: Correct.

19 JUDGE MILLER: And took no cognizance of the
20 draft or final supplement thereto?

21 MR. GREENBERG: These were comments prepared
22 before the release of the draft supplement.

23 JUDGE MILLER: I see. For what purpose were
24 they prepared; do you know?

25 MR. GREENBERG: They were prepared in response

12 1 to interrogatories from the Staff.

2 JUDGE MILLER: So these are then portions of
3 NRDC or Dr. Cochran's answers to interrogatories propounded
4 by Staff?

5 MR. GREENBERG: Correct.

6 JUDGE MILLER: I see. Does Staff concur?

7 MR. JONES: I believe that is correct.

8 JUDGE MILLER: In that event, what is your
9 position on the motion to strike or the admissibility of
10 that portion of the proposed testimony?

11 MR. JONES: I'm sorry, could you repeat your
12 question?

13 JUDGE MILLER: Yes. I say since you have had
14 some participation in that document, at least you
15 triggered it, what is your position now on the motion, in
16 that regard?

17 MR. JONES: Well, we, of course, did ask the
18 question that elicited the answer, but there are portions
19 of the answer, and we do agree with Applicant, that these
20 particular statements, 7.3.2, do constitute an attack on --
21 or rather, constitute an attack on the regulations and
22 should be stricken.

23 JUDGE MILLER: There are two grounds of
24 objections, as I understand them.

25 The first is that Paragraph 7.3.2, Pages 5

and 6, which says something about, "It's not clear whether the phrase 'reasonable assurance' reflects the current requirements of law," that is interpreted by the Applicant to constitute a conclusion of law which is not appropriate for an expert witness to testify one way or the other on.

MR. GREENBERG: Mr. Chairman, we wouldn't object to striking that one sentence.

JUDGE MILLER: All right, strike that.

I think striking that underlined sentence -- and I assume you are all following now what we're saying, so we don't have to --

THE WITNESS: I'm a little behind.

JUDGE MILLER: Look at Page 13 of the motion. Look at the underscoring portion where you use the word "law," and I'm not going to go into whether it was done with any malicious intent to lawyers or not.

That may be stricken, as Mr. Greenberg has indicated. So, therefore, the balance of it may stand.

Now, you get to the next paragraph, 7.3.3.3, Pages 9 to 10, the objection and the motion is with reference to the adequacy of DOE safeguards.

Staff, now, let's see, we didn't let you comment on that matter of law, did we? Do you want to get your name in the record?

MR. JONES: Well, I think I may have stated

1 yesterday in one of my objections that we don't believe
2 the adequacy of safeguards is an appropriate consideration.

3 JUDGE MILLER: That's the second paragraph.

4 MR. JONES: Right.

5 JUDGE MILLER: I didn't let you comment, and
6 I'm sorry, as to the first paragraph.

7 MR. JONES: No, that is fine, the statement
8 withdrawn.

9 I might point out one thing, though, and I was
10 going to bring this up later when we made our motion to
11 strike.

12 These comments attached are on the Section
13 7.3 from the 1976-77 FES, and as is indicated in the
14 Final Supplement to the FES, that section was replaced
15 completely --

16 JUDGE MILLER: Superseded?

17 MR. JONES: "The following discussion of
18 safeguards in Revised Appendix E replaces Section 7.3 and
19 Appendix E of the FES."

20 That therefore makes me question why any of
21 these comments would be relevant to a decision on the
22 adequacy of the present FES.

23
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1 JUDGE MILLER: Mr. Greenberg.

2 MR. GREENBERG: My understanding is that there
3 was a discussion, discussions in the prior FES, the 1977
4 FES, upon which the Staff still relies.

5 There are a number of subject matter areas; we
6 touched on one this morning in terms of risk of clandestine--

7 JUDGE MILLER: Yes, but does theirs precisely?

8 MR. GREENBERG: Well, what I'm suggesting is
9 that there are significant portions of the prior FES which
10 still constitute a basis for the Staff's opinion in
11 this proceeding.

12 JUDGE MILLER: That's true but the question
13 I'm asking is whether or not precisely was the section of
14 the original FES changed and superceded, as the Staff has
15 represented?

16 MR. GREENBERG: I can't contradict what the
17 final supplement itself states, Mr. Chairman.

18 JUDGE MILLER: In that event, I think we will
19 grant the motion to strike on the numbered Paragraph 2 of
20 Page 13 of the motion which relates, as you know, to --

21 MR. GREENBERG: Mr. Chairman, could I ask for
22 one clarification of the Board's ruling?

23 JUDGE MILLER: Yes.

24 MR. GREENBERG: In connection with Paragraph 4.

25 JUDGE MILLER: All right.

1 Paragraph 4. Which one is that? Of the motion?

2 MR. GREENBERG: Paragraph 4, Roman IV, of the
3 motion, Page 9 -- I'm sorry. Page 8

4 The Applicants' identify, really, two separate
5 reasons for striking two separate parts of this testimony
6 and I didn't really understand the nature of the Board's
7 ruling.

8 JUDGE MILLER: Well, the nature of our ruling
9 was that -- the first portion, and I'm not sure -- I think
10 it's probably the first two paragraphs, the Board felt
11 did go into the adequacy of the safeguards at the DOE
12 installations, facility and, as we had previously ruled
13 with reference to that, that was beyond the scope.

14 We, therefore, granted the motion to strike
15 the first two paragraphs.

16 Now, the third, you recall, we raised the
17 question of whether or not this got into challenges to
18 regulations and whether or not the residual risk concept
19 was applicable and upon those two basis, we granted the
20 motion to strike the third paragraph.

21 Any further questions.

22 MR. JONES: Can I get one clarification?

23 On that last ruling, I had raised the issue
24 that the whole Exhibit 1 deals with the old Section 7.3.
25 Was your ruling with respect to that whole exhibit or just

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1 to the motion by Applicants?

2 JUDGE MILLER: The ruling went to the entire
3 exhibit because we raised the question, we didn't have time
4 to analyze it as to whether or not, the subjects contained
5 in the attachments had been superceded substantially, if
6 not wholly, by the subsequently filed final supplement to
7 the original FES , and it appeared to the Board that
8 probably it had and rather than prolong the interrogation
9 of Dr. Cochran, in the consideration of the Board, we
10 deemed it more appropriate to strike the entire attachment.

11 Now, we would say, in fairness, if, in doing
12 so, there were some matters that Counsel deems significant,
13 we would allow them to cover that orally.

14 But they would have to be a showing. It
15 wouldn't be done just to try to get in the back door.

16 All right.

17 Now, anything further?

18 MR. EDGAR: Nothing here.

19 MR. GREENBERG: For the record, I would like to
20 take exception to the Board's ruling with respect to the
21 motion to strike.

22 JUDGE MILLER: Very well.

23 MR. JONES: Nothing further.

24 JUDGE MILLER: Now, where are we?

25 You proffered, I believe, the direct written

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1 testimony for cross-examination? Have you, Mr.
2 Greenberg?

3 MR. GREENBERG: Yes, I have.

4 JUDGE MILLER: And that's your Exhibit 12 and
5 12A?

6 MR. GREENBERG: Yes, it is.

7 JUDGE MILLER: All right.

8 Mr. Edgar?

9 CROSS- EXAMINATION

10 BY MR. EDGAR:

11 Q Dr. Cochran, have you ever participated in
12 the design of a physical security system for a plutonium
13 handling facility?

14 A No, sir.

15 Q Have you ever participated in the design of
16 a material control and accounting system for a plutonium
17 handling facility?

18 A Not beyond my involvement in rule-makings
19 related to those facilities.

20 Q But you have never participated in the design;
21 is that correct?

22 A As I understand the nature of your question,
23 no, I have never been involved with a vendor or a utility
24 or a contractor designing such a system.

25 Q You have never served in a design capacity;

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1 is that a fair statement?

2 A. That's correct.

3 Q. Have you ever participated in a design of a
4 physical security system for a nuclear power reactor?

5 A. No; with the caveats that I mentioned earlier.

6 Q. Have you ever participated in the design of
7 a material control and accounting system for a nuclear
8 power reactor?

9 A. No, I have not.

10 Q. Have you ever reviewed a specific physical
11 security system, security plan for a nuclear power plant?

12 A. No, I have not.

13 Q. Have you ever reviewed a specific physical
14 security system plan for a plutonium handling facility?

15 A. Only in the following respects.

16 I reviewed a physical security plan for the
17 nuclear fuel services plant at Irwin, Tennessee that has,
18 in the past, and I think currently has a license, to
19 possess plutonium but it is not active in that area. They
20 are decontaminating those facilities.

21 Q. So the plant does not presently handle
22 plutonium in bulk quantities; is that correct?

23 A. No, sir. It handles highly enriched uranium,
24 which is SNM but it is not plutonium.

25 Q. Have you ever conducted a physical inspection

1 of a physical security system for a nuclear power plant?

2 A No, I haven't.

3 Q Have you ever conducted a physical inspection
4 of a material control and accounting system for a nuclear
5 power plant?

6 A No, I haven't.

7 Q Have you ever conducted a physical inspection
8 of either a physical security system or material control
9 and accounting system for a plutonium handling facility?

10 A No. It's my -- my involvement is limited to
11 reviews of such inspections.

12 Q Do you have actual firsthand knowledge of the
13 fabrication and assembly of each component of the physical
14 security system for any nuclear power plant?

15 A No.

16 Q Do you have actual firsthand knowledge of the
17 fabrication and assembly of each component of the material
18 control and accounting system for any nuclear power plant?

19 A No.

20 Q Do you have actual firsthand knowledge of the
21 fabrication and assembly of each component of the material
22 control and accounting system for any plutonium handling
23 facility?

24 A Would you repeat that question, please?

25 Q Surely.

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1 Q Do you have actual firsthand knowledge of the
2 fabrication and assembly of each component of the physical
3 security system for any plutonium handling facility?

4 A No, I do not.

5 Q Do you have actual firsthand knowledge of the
6 fabrication and assembly of each component of the material
7 control and accounting system for any plutonium handling
8 facility?

9 A No, I do not.

10 Q Are you familiar with the current state of
11 technology concerning perimeter detection devices?

12 A I have some knowledge on that subject.

13 Q Are you familiar with the current state of
14 technology concerning exterior sensor systems?

15 A I have limited knowledge on that.

16 Q Are you familiar with the current state of
17 technology concerning interior sensor systems?

18 A I have limited knowledge on that.

19 Q Are you familiar with the current state of
20 technology concerning video motion detection devices?

21 A No.

22 Q Are you familiar with the current state of
23 technology concerning interior volumetric sensor systems?

24 A No.

25 Q Are you familiar with the current state of

1 technology concerning special nuclear material detectors?

2 A. I have limited knowledge.

3 Q. Are you familiar with the current state of
4 technology concerning microwave sensors?

5 A. No.

6 Q. Are you familiar with the current state of
7 technology concerning infrared detectors?

8 MR. GREENBERG: Objection, Mr. Chairman. Mr.
9 Edgar could go on all day naming different systems that
10 Mr. Cochran may or may not be familiar with.

11 I think this line of questioning is repetitive.

12 JUDGE MILLER: It's not repetitive in the
13 sense it's getting into each time, different type
14 techniques or states of the art, various detection systems
15 and the like and it does bear upon the expertise.

16 I take it this is still voir dire?

17 MR. EDGAR: Yes, sir.

18 JUDGE MILLER: Voir dire bears upon areas of
19 expertise or non-expertise.

20 MR. EDGAR: If it will ease the situation,
21 I can tell you there is one more question in this line.

22 (Laughter.)

23 JUDGE MILLER: Okay. One more.

24 MR. EDGAR: I think we have a pending question.
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1 BY MR. EDGAR:

2 Q Which is, are you familiar with the current
3 state of technology concerning infrared detectors?

4 JUDGE MILLER: Infrared. Yeah.

5 WITNESS COCHRAN: No.

6 BY MR. EDGAR:

7 Q Are you familiar with the current state of
8 technology concerning devices for non-destructive assay
9 of scrap or waste?

10 A I'm aware of the existence of such devices.
11 I'm -- I wouldn't characterize myself as an expert on their
12 capabilities.

13 Q And is it true that with respect to all areas
14 where, in the preceding line of questions, you disclaim
15 knowledge or indicated limited knowledge, that you would
16 not hold yourself out as an expert in that area?

17 A Well, let me give you an example.

18 The example would be a portal monitor. I'm
19 not an expert on portal monitors but I know what the
20 sensitivity of those -- that piece of equipment is, that's
21 utilized in current facilities today.

22 And my knowledge of these other technologies,
23 varies, but it's certainly at least that limited.

24

25

/ / /

BY MR. EDGAR:

Q In regard to perimeter detection devices where you've indicated that you did have some knowledge, what are the general limitations concerning a microwave perimeter detection system?

MR. GREENBERG: Objection, Mr. Chairman; this is a general question, unrelated to the specific facility in this proceeding.

MR. EDGAR: Let me make it a little more --

JUDGE MILLER: Well, it's cross-examination. He can be either general or precise. Remember, we gave you the same choice when you were the examiner. Proceed.

BY MR. EDGAR:

Q What are the basic physical limitations which are embodied in the capability of a microwave perimeter detection system?

A Well, its line of sight.

Q Okay. And what do you mean by "line of sight"?

A You have to have direct line of sight between the microwave generator and the detector or the reflector in order to identify penetration through that detection system.

Q Let me referyou, please, to Page 7 of your testimony, which is Intervenor's Exhibit 12. I'll be

1 working from Intervenor's Exhibit 12. If I accidentally
2 refer to it as your testimony, I mean consistently Inter-
3 venor's Exhibit 12.

4 A I understand.

5 Q Okay. At the top of Page 7, there is a --
6 It is not a full paragraph, but the top paragraph, last
7 sentence -- or next-to-last sentence. You express your
8 opinion that a CFE -- clandestine fission explosive --
9 could be made.

10 Is it correct that it is your opinion that a
11 clandestine fission explosive could be made with 6 to 12
12 kg's of plutonium?

13 A That's what the testimony states, that's
14 correct. That's my testimony.

15 Q Now, reading down to A7, the first paragraph,
16 the first sentence, you indicate that -- or quote from a
17 report to the effect that it's theoretically possible
18 that a nuclear device could be made directly from fresh
19 LMFBR fuel without the need for chemical separation.

20 Do you agree that in order to create a minimum
21 critical mass from fresh mixed dioxide fuel, you would
22 need many more times than the amount of 6 to 12 kg's?

23 A If I -- I think I can read between the lines
24 of your question --

25 JUDGE MILLER: Now, just answer the question.

10-3

1 We get in trouble when we start reading between the
2 lines.

3 THE WITNESS: To answer your question, I need
4 clarification on whether you're referring to -- "need
5 more kilograms" -- whether you're referring to kilograms
6 of MOX, say, approximately 25 to 30 percent enriched in
7 plutonium?

8 BY MR. EDGAR:

9 Q Well, let's make it CRBR fuel -- fresh fuel
10 assemblies.

11 A Yes.

12 Q The direct conversion to the device.

13 A Well, you would need more than the 6 to 12,
14 or one to two times the number I gave above of MOX,
15 in large measure because the MOX is not a hundred percent
16 enriched in isotopes of plutonium.

17 Q What is the weight of a CRBRP fuel assembly?

18 A I would have to refresh my memory by looking
19 it up in these documents.

20 Q Would you agree that it's more than 400
21 pounds?

22 A I would want to refresh my memory.

23 Q Well, why don't we bypass that, and if you
24 can get a chance to check it.

25 What is the height of a CRBRP fuel assembly?

1 A It's measured in -- In excess of ten feet.

2 Q How many kg's of plutonium are contained in a
3 CRBRP fuel assembly?

4 A I'm not sure of the precise number. I'd have
5 to look that up.

6 You can take the -- I mean it's a rough
7 guess -- take the total core inventory and divide it by
8 several hundred and get the answer. The total inventory
9 is about 1.7 tons.

10 Q All right. I wonder if you could check that
11 when you have a chance.

12 JUDGE MILLER: I don't like to leave too
13 many hanging now. That again is --

14 MR. EDGAR: We'll come back to it.

15 THE WITNESS: All these data are given in
16 tables that you and I both have ready access to. I'm
17 reluctant to accept a number without really checking
18 the tables.

19 I'd be happy to stipulate to the accuracy of
20 the tables in that regard, though.

21 MR. EDGAR: Okay. We'll come back, and we'll
22 do just that.

23 BY MR. EDGAR:

24 Q Do you know how many times more fresh mixed
25 oxide fuel you'd need to fabricate a weapon than the

1 6 to 12 kg's set forth in the portion of your answer at
2 the top of Page 7?

3 A I haven't done a precise calculation. You
4 would need at least something more than the simple
5 division by the concentration of plutonium in the oxide
6 fuel.

7 But you wouldn't need orders of magnitude
8 more. I mean, it's not the --

9 Q Well, would you agree that the plutonium
10 concentration in the oxide fuel is about ten percent?

11 A It depends on which element you're dealing
12 with.

13 Q Well, isn't it approximately ten percent on
14 the average?

15 A Are you including the blanket material?

16 Q Yes.

17 A That sounds like it's in the ballpark.

18 Q Now, exclude the blanket material.

19 A Well, the core material is in the neighborhood
20 of -- I've forgotten the precise figure -- I'd say 25 to
21 30 percent, 33 percent enriched, something in that
22 neighborhood.

23 Q Okay.

24 A So you'd need at least three times -- and then
25 you would need additional beyond that.

1 Q Okay. I wonder if I might refer you -- We'll
2 come back -- We'll confer at the break on these numbers
3 and come back and clean these up.

4 I would refer you to Page 12 of your testimony,
5 in particular Answer 12, which appears at the bottom of
6 Page 12 and extends over to, roughly, half of Page 13.

7 You list a series of examples as empirical
8 evidence supporting your conclusion that successful theft
9 or sabotage is credible.

10 You first make reference in the paragraph,
11 in the second sentence of A12, to the proposition that
12 "This evidence includes possible theft at the NUMEC
13 plant."

14 Assuming possible theft, when did those events
15 occur? What was the time frame of those events?

16 A The early sixties.

17 Q Were the safeguards and security requirements
18 in place for that facility at that time the same as the
19 NRC security requirements are today?

20 A No.

21 Q Is it a fair statement that safeguards and
22 security requirements at that time were virtually non-
23 existent for that facility?

24 A (No immediate response.)

25 Q If you know.

10-7

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1 A. They were certainly inadequate and at that
2 time the -- "virtually" sounds very close to the truth.
3 But I'm not sure I would use that precise word. Maybe
4 I shouldn't say "very close to the truth," but I mean very
5 close to an accurate characterization.

6 Q Reading over onto Page 13, Lines 4 and 5,
7 you refer to a possible theft of uranium at the Wilming-
8 ton, North Carolina facility in January 1979. Does that
9 facility handle only low enriched uranium?

10 A. I believe that's correct.

11 Q Do the same safeguards requirements apply to
12 low enriched uranium as to formula quantities of pluto-
13 nium?

14 A. No, they do not.

15 Q Are the safeguards requirements for formula
16 quantities of plutonium more stringent than those for
17 low enriched uranium?

18 A. Yes.

19 Q Referring to Lines 6 and 7, you refer
20 to sabotage of the VEPCO Surry reactors. In connection
21 with that sabotage, was there any release of radioactivity?

22 A. No. However, that's more a reflection of
23 the intent of the saboteurs -- or at least in part a
24 reflection of the intent.

25 I think -- Well, my purpose in citing that

10-8

1 is that it represents a -- or part of the purpose in
2 citing that particular event is that it represents col-
3 lusion by two employees to sabotage a plant, which is --
4 it's going to get me into a little trouble here.

5 But it's --

6 JUDGE MILLER: So you might just wind it down.

7 THE WITNESS: That happens to be beyond the
8 threat level covered by the Commission's regulations,
9 even though it was a threat that materialized.

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1 BY MR. EDGAR:

2 Q Well, let's go back to your statement -- the
3 intent of the saboteurs. Is it a fair statement to
4 say that the intent of the saboteurs was to cause property
5 damage to the utility and not to cause radiological
6 sabotage?

7 A I think that's a fair inference from the mea-
8 sures that they took.

9 JUDGE LINENBERGER: Excuse me, Mr. Edgar.

10 But, Dr. Cochran, you characterized that as
11 a fair inference. Should I conclude from that characteriza-
12 tion that you do not have first-hand knowledge of the
13 intent of the person or persons involved in that inci-
14 dent?

15 THE WITNESS: I have not talked to the
16 saboteurs, no, sir.

17 JUDGE LINENBERGER: No, sir.

18 THE WITNESS: I do not have first-hand
19 knowledge.

20 JUDGE MILLER: You said that that was a fair
21 inference from the measures that were taken?

22 THE WITNESS: The fact is that they didn't
23 attempt to produce a serious accident --

24 JUDGE MILLER: Oh? The measures taken by
25 the saboteurs?

10-10 1 THE WITNESS: The saboteurs. They simply
2 attempted to contaminate a --

3 JUDGE MILLER: I didn't know whose measures,
4 but I get it now. Thank you.

5 Proceed.

6 BY MR. EDGAR:

7 Q Was the fuel involved low enriched uranium
8 fuel?

9 A Yes.

10 Q Was the fuel stored inside a vital area?

11 A I presume not. I'm not sure.

12 Q When was the Surry reactor security system
13 designed, under what regulations?

14 A I don't know.

15 Q Was the Surry reactor security system designed
16 to meet current NRC regulations for safeguards and
17 security?

18 A Well, there have been some upgrading in the
19 regulations since the time of that event, so I'd think a
20 reasonable conclusion to draw from that is that they
21 at the time did not meet the current requirements.

22 Q Was the Surry security system designed to meet
23 NRC requirements for strategic quantities of special
24 nuclear material?

25 A No, it was not.

10-11

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1 Q Are the NRC requirements for low enriched
2 uranium fuel less stringent than those for strategic
3 quantities of special nuclear material?

4 A Yes.

5 Q Was the fuel, when stored in Surry, under
6 safeguards?

7 A What do you mean by "safeguards" in that
8 respect?

9 Q Were there any safeguards around the fuel at
10 the time of this sabotage?

11 A Well, the fuel was within the perimeter of
12 the -- was in the plant, and there are some physical
13 security measures at the plant.

14 Q Do you know where it was when the sabotage
15 occurred?

16 A It was -- I don't know the precise location
17 in the reactor building, no, I don't.

18 Q Do you know whether it was in the reactor
19 building itself?

20 A No, I do not.

✓ 21 Q Do you know whether Clinch River fuel will be
22 stored within the reactor building?

23 A I think that's beyond the scope of this
24 proceeding.

25 MR. EDGAR: I'd like to move to strike the

10-12

1 answer and to compel an answer.

2 JUDGE MILLER: The answer will be stricken.

3 Answer the question so far as you can. If
4 you can't answer it, say that because -- you know -- to
5 say "I don't know" is a perfectly fair response if that
6 be --

7 THE WITNESS: Well, I don't -- Repeat the
8 question.

9 MR. EDGAR: Right.

10 BY MR. EDGAR:

11 Q Do you know whether the Clinch River fuel
12 will be stored -- fresh fuel will be stored in the reactor
13 building?

14 A I believe that is the case.

15 Q All right. Do you know whether it will be
16 stored within a vital area?

17 A I do not know.

18 Q Do you know whether it will be stored in
19 500 degrees sodium?

20 A It will be stored in sodium of several hundred
21 degrees. I don't know whether it's 400 or 500, but it's
22 in that -- roughly in that ballpark.

23 Q Fine.

24 Now, the next line -- I'll have to count --
25 one, two -- Lines 9 and 10 on Page 13, you refer to

10-13

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1 sabotage of components for the Iraqi, I-r-a-q-i,
2 reactor while under fabrication in France.

3 Do you know whether the facility in which the
4 fabrication was undertaken and that which the sabotage
5 allegedly occurred was a facility which was subject to
6 safeguards?

7 A I don't know. I presume not.

8 Q Okay.

9 A You know, "safeguards" is a fairly broad
10 term.

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1 Q Do you know what the physical security was
2 for that facility?

3 A No, I do not.

4 Q Do you have any reason to believe that the
5 physical security for that facility was as great as those
6 one would associate with the NRC requirements for formula
7 quantities of special nuclear material?

8 A I do not believe it would be.

9 Q Referring back to Page 13, lines 11 and 12,
10 a reference is made to actions of Basques terrorists
11 directed against Spanish nuclear facilities.

12 Were these facilities under construction or
13 under operation?

14 A These were under construction.

15 Q Can you point to any similar acts which have
16 occurred in the United States since 1977?

17 A I would have to review the event summary list
18 to confirm --

19 JUDGE MILLER: The question is, do you know of
20 any. If you do; yes. If you don't; no.

21 WITNESS COCHRAN; Well, you know, I've looked
22 at --

23 JUDGE MILLER: You don't have to apologize for
24 it. Either you do know or you don't know.

25 WITNESS COCHRAN: I don't know, sitting here,

11-2

1 without refreshing my memory.

2 JUDGE MILLER: Okay.

3 BY MR. EDGAR:

4 Q All right.

5 Now, in the next line -- excuse me.

6 In the line following the words "Spanish
7 nuclear facilities", there is then a sentence which talks
8 about a listing of attacks and/or physical security
9 breaches at nuclear facilities from 1966 through 1979 and
10 reference is made to a GAO report.

11 Was that what you meant by reference to event
12 summaries?

13 A That's one of perhaps half a dozen event
14 summaries that one --

15 Q You are familiar with that GAO report in the
16 extent to which you have relied on it in your testimony;
17 is that correct?

18 A Yes.

19 Q And you are familiar with the events listed in
20 that GAO report?

21 A Yes, I'm -- well, I mean, I haven't memorized
22 them. They are several pages long and --

23 Q Let me --

24 MR. EDGAR: I would like to have marked for
25 identification as Applicants Exhibit 40 -- I believe that's

1 the correct number, a copy of the cover page of the GAO
2 report in question, which is entitled By the Comptroller
3 General, Report to the Honorable Gary Hart, United States
4 Senate of the United States, Obstacles to U.S. Ability to
5 Control and Track Weapons-Grade Uranium Supplied Abroad.
6 The identification number is GAO ID-82-21, dated August 2,
7 1982.

8 The portion of that report, which is cited
9 by Dr. Cochran, is the portions or events listed in
10 Appendix 6, that's Roman VI, Pages 64 through 67 and I'd
11 like to furnish all parties with a copy and ask a few
12 questions on that subject, after marking for identification.

13 (The document referred to was
14 marked Applicants Exhibit No. 40
15 for identification.)

16 MR. GREENBERG: Excuse me, Mr. Edgar.

17 Would you mind repeating that number, the
18 exhibit number?

19 MR. EDGAR: Applicants Exhibit 40, marked for
20 identification.

21 MR. GREENBERG: Thank you.

22 WITNESS COCHRAN: Do you mind if I see if I can
23 locate a copy that is a little more readable?

24 MR. EDGAR: No problem.

25 JUDGE MILLER: Sustain your objection to the

1 exhibit, as being partially illegible.

2 MR. EDGAR: I apologize for that .

3 JUDGE MILLER: I realize your problem.
4 Supply us better copies when you can or as you can.

5 BY MR. EDGAR:

6 Q Do you have it in front of you?

7 A Yes, I do.

8 Q And may I make reference to Applicants Exhibit
9 40, the pages enumerated, 64 through 67, which constitute
10 Appendix Roman VI of that report.

11 Is it true, Dr. Cochran, that since January 1,
12 1977, there has been only one incident in the U.S. involving
13 an attack on a nuclear facility and that incident involved
14 an explosive device placed outside the plant gate, causing
15 damage to the visitors' center?

16 A I don't know that one is the precise number
17 but that seems to be within the range of my --

18 Q Would you refer, then, to Page 66 of Exhibit
19 40 and start with the second listing, which is the Trojan
20 Nuclear Plant -- would you please read down through the
21 balance of Page 66 and 67 --

22 A Okay.

23 Q And do you agree that after the incident
24 listed at the Trojan Plant, there have been no attacks
25 listed on nuclear facilities in the United States?

1 MR. GREENBERG: Objection, Mr. Chairman.

2 The question is whether or not -- if the
3 question is, whether or not there are any attacks listed
4 in this report, I think Dr. Cochran can answer that . I
5 don't think he --

6 BY MR. EDGAR:

7 Q That's what I'm asking.

8 Are there any listed in the report?

9 He relied on the document.

10 JUDGE MILLER: We will regard that as being
11 the substance of the question.

12 You may answer it, Doctor.

13 WITNESS COCHRAN: There are none listed in the
14 report for which the last entry is November, '79.

15 There are --

16 JUDGE MILLER: Well, that's a sufficient answer,
17 I think. That's all he asked you.

18 BY MR. EDGAR:

19 Q Now, when were NRC's most recent safeguards
20 regulations issued?

21 A Which ones?

22 Q The ones which are now in effect in 10 CFR,
23 Part 73?

24 A Well, --

25

11-6

1 Q In particular, those which deal with formula
2 quantities of special nuclear material,

3 JUDGE MILLER: What's the question? When?
4 BY MR. EDGAR:

5 Q Yes, When were they issued.

6 JUDGE MILLER: All right.

7 When? If you know.

8 WITNESS COCHRAN: I don't know the precise
9 date. It's within the last few years and the implementation
10 requirements vary with regard to whether you're upgrading
11 for the inside threat or the external threat.

12 JUDGE MILLER: The latter portion will be
13 stricken.

14 The answer as to when is approximately when
15 you indicated.

16 Go ahead.

17 BY MR. EDGAR:

18 Q And it is true, is it not, that the regulations
19 were issued after January 1, 1977?

20 A Definitely.

21 Q May I refer you to Page 14 of your testimony?
22 In particular, Answer 14, first sentence.

23 Just a question, just for the record.

24 Dr. Cochran, Applicants Exhibit 40 is the
25 document you relied upon to support the statement in your

11-7

1 testimony appearing at Page 13, the last sentence of
2 Answer 12; is that true?

3 A Yes.

4 Q All right.

5 Referring you now to Page 14, Answer 14, first
6 sentence of that answer, the statement is made:

7 "In my judgment the CRBR and its
8 supporting fuel cycle facilities
9 are higher risk targets than
10 conventional nuclear facilities."

11 In the sense or context of this sentence, what
12 do you mean by the term "conventional nuclear facilities."?

13 A The lightwater reactors operating on a one to
14 three fuel cycle.

15 Q All right.

16 And is it true that there are more stringent
17 safeguards requirements for facilities using strategic
18 quantities or formula quantities of plutonium as compared
19 with those conventional nuclear facilities?

20 A That is correct.

21 Q Page 15, top of the page, first full paragraph,
22 the last sentence. You discuss an attack at Super-Phenix
23 in France.

24 A Yes.

25 Q Was this an attack on a reactor under

1 construction?

2 A Yes.

3 Q Was there any radiological effect as the
4 result of that attack?

5 A No.

6 Q What was the damage that the facility incurred?

7 A It had some holes from a rocket in the side of
8 the building.

9 Q Did it penetrate the containment?

10 A I don't know. Don't even -- my recollection
11 was that it wasn't -- well, I don't even know whether it
12 was aimed at the building, the containment building.

13 Q Well, is it fair to say you don't know what
14 the damage was as the result of that attack?

15 A No, that's not a fair statement.

16 Q Do you know whether the containment was in any
17 way affected by that attack?

18 A My recollection is that it was not.

19 Q But you don't know?

20 A Well, not without refreshing my memory.

21 Q What is the basis for your information on this
22 subject? Is it the Washington Post?

23 A Primarily. Also the trade press.

24 Q But I see in your testimony here on Page 14,
25 you cite the Washington Post.

1 A Well, in the time periods I was given to
2 prepare my testimony, I didn't have time to search out
3 each document to support every -- that would support every
4 statement I made in my testimony.

5 Q Do you have any firsthand knowledge of the
6 incident at Super-Phenix?

7 A No, I do not.

8 Q So, in fact, your information has all been
9 based on secondary sources, the foremost of which is the
10 Washington Post?

11 Is that true?

12 A Well, I don't -- just a minute ago I said
13 primarily. I don't -- foremost -- primarily -- I cited
14 that particular account because it was a handy reference.

15 There are other accounts that are equally
16 reliable or unreliable --

17 Q Do you believe that account to be reliable?

18 A Well, the -- let me say that with regard to
19 most of the summaries of events of this type, the authors
20 who have put together threat summaries and threat lists,
21 necessarily rely on news accounts and this is not uncommon
22 and --

23 Q I want you to answer my question.

24 JUDGE MILLER: Just a moment, now.

25 MR. EDGAR: I move to strike the answer and

11-10

1 ask that the Board compel an answer.

2 The question is, does Dr. Cochran believe that
3 the Washington Post article he cites is reliable.

4 JUDGE MILLER: That's correct.

5 The previous answer, or a portion of it will
6 be stricken.

7 Can you answer that, Dr. Cochran?

8 WITNESS COCHRAN: Well, I believe it's --

9 JUDGE MILLER: -- reliable or not in your
10 judgment.

11 WITNESS COCHRAN: I don't have firsthand
12 knowledge with regard to the details but with regard to the
13 fact that there was such an event at the Phenix reactor
14 at the time frame it was reported and so forth, I think
15 is reliably -- was reliably reported in that Washington
16 Post and also in other trade press accounts.

17 JUDGE MILLER: The answer then is yes.

18 WITNESS COCHRAN: Yes.

19 BY MR. EDGAR:

20 Q You believe it's reliable?

21 JUDGE MILLER: He's already testified yes.

22 MR. EDGAR: I was just trying to get
23 confirmation.

24 JUDGE MILLER: Well, I'm having trouble with
25 both of you.

11-11 1

2 You ought to try to keep your questions short
3 so the answers may be direct and we'll get along a lot
4 better.

5 BY MR. EDGAR:

6 Q Page 19.

7 I'm sorry. I gave you an incorrect reference.

8 Okay. Would you turn to Page 22?

9 A Okay.

10 Q And in the last paragraph here of Answer 22,
11 you refer to the DRP design and its stage is being
12 characterized as preliminary.

13 Are you familiar with all of the reports which
14 have been published on the DRP design?

15 A No. I'm familiar with a few reports but not --
16 I'm not familiar with all of them because I didn't generate
17 them and I don't know which ones I haven't seen.

18 Q All right.

19 Are you familiar with the tests for advanced
20 process monitoring technology which were conducted at the
21 Barnwell facility?

22 A Not in any -- only to a very limited extent.

23 Q Are you familiar with the tests conducted
24 regarding advanced accounting technology at the Barnwell
25 facility?

A Only to a very, very limited extent.

11-12

1 Q Are you familiar with the advanced physical
2 security technology testing at Barnwell?

3 A The same answer applies.

4 Q May I refer you to Page -- we're moving along --
5 I'd like to just check, for the record.

6 MR. EDGAR: I believe that the Board denied
7 the motion to strike as it related to the materials set
8 forth at Pages 33 to 35 of the testimony. I just want to
9 verify that to make sure we have a correct understanding.

10 JUDGE MILLER: Let us check that. Just a moment.

11 MR. EDGAR: In particular, the motion to strike
12 was at Pages 10 and 11, Roman Number VIII; is that correct?

13 MR. GREENBERG: My understanding is that that
14 material is still part of the testimony.

15 JUDGE LINENBERGER: Which answer?

16 MR. EDGAR: Judge Linenberger, it is Answer
17 A-31(2) and (3).

18 JUDGE LINENBERGER: That was overruled.

19 MR. EDGAR: That's what I wanted to check.

20 BY MR. EDGAR:

21 Q On Page 35 of your testimony, Dr. Cochran, reading
22 up seven lines, you make reference to an IAEA report,
23 entitled Overview Report to the Director General of the
24 IAEA International Working Group, September 1981.

25 Do you see that reference?

11-13

1 A. Yes, I do.

2 Q And you cite in that report for the proposition
3 that there is an uncertainty as to the levels of
4 performance that can be achieved in regard to material
5 control and accounting for the DRP; is that a fair
6 statement?

7 A. Well, I said, See Generally. That's one
8 example.

9 The GAO report would be another.

10 Q What does "See Generally" mean?

11 A. Well, in the context that I've used it, it
12 means that I'm too pushed to put time to put in everything
13 I know and cite that as an example.

14 / / /

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1 Q Are you using "See Generally" as a form of legal
2 citation? There's a specific meaning as to how you use it?

3 A No, I don't know what the legal citation would
4 be.

5 Q Are you familiar with that IAAA report?

6 A Yes, I've read it.

7 Q Does that deal with the international safeguards
8 regime?

9 A Yes.

10 Q Does it deal with an international regime for
11 verification of material control and accounting?

12 A Yes.

13 Q Is it true that the international safeguards
14 regime does not involve physical security?

15 A That's correct.

16 Q And do the conclusions of that report deal
17 with facilities with a through put of greater than 150
18 metric tons per year?

19 A Would you repeat that question?

20 Q Is it true that the conclusions of that report
21 do not address facilities -- excuse me, let me rephrase it.

22 Do the conclusions of that report address
23 facilities with a through put of greater than 150 metric
24 tons per year?

25 A Yes.

2-2

1 Q And is it true that that report in its
2 conclusions does not address facilities with through puts
3 less than 150 metric tons per year?

4 A I don't recall that caveat. I would have to
5 refresh my memory.

6 Q You know they deal with through puts more than
7 150 metric tons per year, right?

8 A Yes.

9 Q Is it a fair statement that the report was
10 addressed to large reprocessing facilities with through
11 puts greater than 150 metric tons per year?

12 A Well, the Tokai plant has a through put not
13 substantially larger than that proposed for the DRP.

14 Q What is the through put of Tokai?

15 A Two hundred.

16 Q It's greater than 150 metric tons per year?

17 A Well, I think 200 is greater than 150. I
18 will stipulate to that.

19 Q Was the report addressed to the Tokai facility?

20 A I believe it was, right.

21 Q Is it true that the report, in reaching its
22 conclusions, does not consider or take account of the
23 presence of physical security systems?

24 A That's correct.

25 Q Is it true that in reaching its conclusions the

2-3

1 report does not consider or take into account advanced
2 material control and accounting systems or techniques, such
3 as near real time accounting?

4 A Well, to the -- yes and no. The authors of
5 the report presume to be aware of such techniques and
6 the fact that they are not employed --

7 JUDGE MILLER: No, the question is whether or
8 not the report takes into account, not what they may or
9 may not have known.

10 THE WITNESS: Well, I would have to refresh
11 my memory.

12 JUDGE MILLER: So you don't know, then, on
13 that?

14 BY MR. EDGAR:

15 Q You don't know?

16 A Well, that's a little misleading to leave it
17 at that.

18 JUDGE MILLER: It's not misleading at all.
19 It's a perfectly fair answer. If you know, say "yes" or
20 "no"; if you don't, just say, "I don't know."

21 It's a perfectly responsive answer,
22 Dr. Cochran. I would like for you to practice it where
23 you really don't know. Don't apologize, because that
24 isn't necessary.

25 Okay. Question.

2-4
↓
1 BY MR. EDGAR:

2 Q On Page 36 --

3 JUDGE MILLER: Hold it.

4 Let's take our lunch hour. We'll have our
5 lunch hour recess. 1:00 o'clock.

6 (Whereupon, at 12:00 noon, the hearing was
7 recessed, to reconvene at 1:00 p.m., the same day.)

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AFTERNOON SESSION

1:00 p.m.

JUDGE MILLER: All right. Are we ready to resume?

MR. EDGAR: Judge Miller, we had one item that came up in cross-examination. Two items were bypassed in the record, one having to do with the number of kg's of plutonium in a fuel assembly; the other was the weight of the fuel assembly.

We have conferred with NRDC counsel and with Dr. Cochran. We have a reference, and we'd just like to go through and establish those two facts for the record.

JUDGE MILLER: Very well.

BY MR. EDGAR:

Q Dr. Cochran, I will hand you Volume II of Staff Exhibit 8, which is the Final Supplement to the Final Environmental Statement. The specific references are, first, Page D-5: and the second reference is Page D-2.

First, with reference to Page D-5, could you tell me what the approximate weight of a Clinch River fuel assembly would be?

A In the neighborhood of 200 to 240 kilograms.

Q All right.

A Depending on which assembly.

13-2

1 Q The second question is -- now referring you
2 to Page D-3 of Staff Exhibit 8 -- how many kilograms of
3 plutonium would one find in a fuel assembly?

4 A Roughly 10 to 12 for the core assembly.

5 Q And none in the blanket assembly, I assume?

6 A Yes, that's correct.

7 I have one very minor correction.

8 JUDGE MILLER: Go ahead.

9 THE WITNESS: I had a chance to look at the
10 IAEA document over lunch and confirm the accuracy of my
11 testimony with regard to whether or not they considered
12 the real time -- near real time upgrades that had been
13 contemplated.

14 My testimony stands uncorrected in that re-
15 gard.

16 JUDGE MILLER: Well, we could even regard it
17 as verified.

18 THE WITNESS: Verified. The written testi-
19 mony. I think there was some confusion in the oral
20 about whether it was authored or used --

21 JUDGE MILLER: We'll have the record reflect
22 that verification that you just described.

23 Please proceed.

24 BY MR. EDGAR:

25 Q Turning to Page 36 of your testimony, the first

13-3

1 full paragraph on the page, below the quoted passage, the
2 first sentence.

3 The statement appears: "The physical security
4 and material control systems must be capable of promptly
5 detecting the diversion of a formula quantity of SNM
6 (2 Kg Pu)."

7 Do you mean to imply by that statement that
8 both the physical security and material control and ac-
9 counting systems in and of themselves or operating
10 independently must be capable of detecting formula
11 quantities?

12 A. No, I do not.

13 Q And in regard to use of the term "must," are
14 you implying that as you make that statement that this
15 is a requirement of NRC regulations?

16 A Well, that language is not explicitly stated
17 in the regulations. The regulations speak of high con-
18 fidence of preventing diversion of materials, and that's
19 my interpretation of what is required for an adequate
20 safeguards program.

21 Q All right. So you're not saying that's a
22 requirement of the regulations, rather that is your
23 opinion?

24 A Well, I'm not a lawyer and am not giving a
25 legal conclusion. I'm just giving my opinion on that.

13-4

Q All right. At Page 36, the paragraph enumerated four -- Let me just bypass that and go to another reference in the testimony.

Page 38, the sentence appears that "DOE suggests that a response to rapidly changing threats might take 'matter of months -- three to four months.'"

You cite the DOE deposition at 39 of Witness Penico.

Did the deponent say that the threats were rapidly changing?

MR. GREENBERG: Objection. It seems to me that the deposition speaks for itself.

MR. EDGAR: It's not in the record --

JUDGE MILLER: This is cross-examination. He is entitled to test the witness' memory and recollection.

You may answer.

THE WITNESS: No, I don't recall him saying that.

BY MR. EDGAR:

Q Was he, in fact, talking about the threat levels that might arise some ten years in the future?

A My recollection is not precise on that point. It was certainly in the future. I don't think that it's ten years or a few years -- That's not a

13-5

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1 particularly relevant distinction to me. I don't remember
2 precisely what his words were.

3 Q Did you check the deposition before you wrote
4 that portion of the testimony?

5 A Yes. But I didn't make the statement in my
6 testimony that you're making at the moment.

7 Q Well, read again the statement in your testi-
8 mony.

9 "DOE suggests that a response to rapidly
10 changing threats might take 'a matter of months -- three
11 to four months.'"

12 Then you cite the DOE deposition at 39.
13 Does the statement that I quoted from your testimony
14 fairly represent the statements appearing at Page 39 of
15 the deposition?

16 A To the best of my recollection. I would have
17 to -- I would want to go back and -- Well, I mean,
18 to the best of my recollection that's correct. That's
19 the way I've testified.

20 MR. EDGAR: I'd like to furnish the witness
21 with a copy of the deposition and read the deposition
22 passage into the record in order --

23 JUDGE MILLER: Is this for impeachment pur-
24 poses?

25 MR. EDGAR: Yes.

13-6

1 JUDGE MILLER: In that event, you may show the
2 witness the deposition, ask whether he was asked this
3 question, made this answer. Read that question and that
4 answer, period.

5 MR. EDGAR: Okay.

6 BY MR. EDGAR:

7 Q Dr. Cochran, I'd like you to read the
8 deposition at Pages 38 through 39.

9 (Pause while witness reads document.)

10 Q Having read that, do you agree that the state-
11 ments made by the witness were dealing with threats ten
12 years hence?

13 JUDGE MILLER: Wait a minute. I just thought
14 you said it was for impeachment.

15 MR. EDGAR: This witness relied on the de-
16 position in his testimony. He relied on the statement
17 of another witness.

18 I would like to have in the record the state-
19 ment in the deposition. I will read it into the record,
20 if necessary.

21 JUDGE MILLER: That's what we want. We want
22 you, or the witness, or both to read into the record the
23 question.

24 Do you recall, Dr. Cochran, when your de-
25 position was taken -- a copy of what you have before you?

13-7

1 MR. GREENBERG: To clarify, Mr. Chairman, this
2 was not the deposition of Dr. Cochran. This was the
3 deposition of witnesses for the Department of Energy.

4 JUDGE MILLER: The DOE deposition?

5 MR. GREENBERG: Correct.

6 JUDGE MILLER: Who was the interrogator?

7 MR. EDGAR: Dr. Cochran.

8 MR. GREENBERG: Dr. Cochran was the inter-
9 rogator.

10 - - - -

13-8

1 BY MR. EDGAR:

2 Q Dr. Cochran, would you read into the record
3 the deposition --

4 A I haven't finished reading the ...

5 JUDGE MILLER: Let me know when you've
6 finished reading it to yourself, Doctor.

7 By the way, what's the name of the witness?
8 Penico? Witness Penico?

9 MR. EDGAR: Yes, sir.

10 JUDGE MILLER: And what page and line is the
11 first question that --

12 MR. EDGAR: The first question is --

13 JUDGE MILLER: Page and line.

14 MR. EDGAR: Page 38, and it runs --

15 JUDGE MILLER: Page 38, line what?

16 MR. EDGAR: Line 1.

17 JUDGE MILLER: Line 1 to?

18 MR. EDGAR: Through Page 39, Line 9.

19 JUDGE MILLER: Page 39, Line 9. Okay.

20 MR. EDGAR: If it would save --

21 JUDGE MILLER: What was the date of the
22 deposition?

23 MR. EDGAR: The date of the deposition, Your
24 Honor, is June 16, 1982.

25 JUDGE MILLER: Have you finished, Dr. Cochran?

13-9

1 THE WITNESS: I've finished.

2 What is the question?

3 JUDGE MILLER: Let me inquire now whether you
4 were present when the deposition of Mr. Penico was taken
5 on June 16, 1982?

6 THE WITNESS: Yes, I was.

7 JUDGE MILLER: Were you the interrogator at
8 that deposition?

9 THE WITNESS: Yes.

10 JUDGE MILLER: All right. Looking, if you
11 will, at Page 38, Line 1, I'll ask you whether the
12 question that's posed at that place was framed by you,
13 and whether the subsequent answer and -- questions and
14 answers extending through Page 39, Line 9, were asked
15 and the answers given by the witness, as you're about
16 to read them into the record.

17 THE WITNESS: That's correct.

18 JUDGE MILLER: Okay. Now will you read those,
19 please. Just as they appear in the deposition.

20 THE WITNESS: There are people better quali-
21 fied to read than I am.

22 "Question" --

23 JUDGE MILLER: By whom?

24 THE WITNESS: By me, I presume.

25 By me.

JUDGE MILLER: Very well.

THE WITNESS: "Question: Can the intelligence community and the police forces and so forth reliably predict the size of the threat that one might anticipate in ten years hence?

"Answer, Witness Penico: Probably not.

"Question: Well, if that is the case, how do you have assurance that your safeguards programs for these facilities that will be built in the future will be I don't want to use the word 'adequate,' because George will jump down my throat. What word can I use, George?

"Mr. Edgar: Tom, I'm not in the business of asking (sic) questions. That's not my pay code."

JUDGE MILLER: Who said that?

THE WITNESS: Mr. Edgar.

(Laughter.)

THE WITNESS: Followed by "(Laughter.)"

(Laughter.)

THE WITNESS: "Mr. Cochran, resuming: How can you have a high degree of assurance that these future safeguard systems will meet the objective of preventing the diversion of trigger quantities of special nuclear materials?

"Answer, Witness Penico: Well, I think you do. You do in all elements of society, you evaluate what

1 you can reasonably see today and maintain the flexibility
2 position that in the future if you see -- or the threat
3 or the indications of that threat change, then your
4 responses to those threats are going to change in the
5 same way.

6 "Question: Is the program flexible enough
7 so that it can respond on a very short time frame, like a
8 matter of days?

9 "Answer, Witness Penico: No, not in a matter
10 of days.

11 "Question: In a matter of weeks?

12 "Answer, Witness Penico: Probably a matter of
13 months -- three to four months."

14 Now, you want my comments on that?

15 JUDGE MILLER: No.

16 MR. EDGAR: No.

17 JUDGE MILLER: You may resume.

18 MR. EDGAR: All right.

19 BY MR. EDGAR:

20 Q Dr. Cochran, may I refer you now to Page 14 --
21 excuse me, strike that.

22 Page 19 of your testimony. In particular, I'd
23 like to call your attention to the discussion appearing
24 in the paragraph which appears at the top of the page.

25 In the last line of that paragraph you refer

13-12

1 to Applicants' Updated Responses to Intervenor's Request
2 for Admissions of August 13, 1976, April 30, 1982, at
3 14, 15.

4 Do you believe that --

5 A. Excuse me. I'm not following you.

6 Q. All right. Let me give you a chance to locate
7 it.

8 If you'd look on Page 19 at the top of the
9 page, the first full sentence starting on the page,
10 starting with "Applicants have conceded," and then
11 followed by a reference to Intervenor's request for
12 admissions.

13 A. Yes.

14 Q. Is the statement that appears on the top of
15 Page 19 exactly what the Applicant said in response to
16 the admissions?

17 A. Well, to the best of my recollection. I
18 wrote this some time ago, and I ... I didn't write it
19 with any intent to make any errors, but I -- So I would
20 stand by it.

21 Q. All right. Let me hand you a copy of the ad-
22 missions.

23 JUDGE MILLER: While we're at it, can we
24 clear up the spelling of "marshall law," please?

25 THE WITNESS: That's what is in force here, isn't it?

1 it?

2 (Laughter.)

3 JUDGE MILLER: Only with a capital "M,"
4 Doctor.

5 BY MR. EDGAR:

6 Q Dr. Cochran, would you take a look at Pages
7 14 and 15 of those responses to admissions.

8 MR. EDGAR: While Dr. Cochran is doing that,
9 just for the record, we handed out over the lunch break
10 an attempt at a glossary for the health effects testi-
11 mony.

12 We've given that to the reporter and all
13 parties. We don't regard it as evidence. We're not
14 offering it as such, but anybody that wants to use it as
15 an aid, it's for what it's worth.

16 JUDGE MILLER: Thank you, Mr. Edgar. We did
17 ask, if you could conveniently, to let us have such
18 definitions. We'd make the same request of all counsel.

19 If you can, without it being too burdensome,
20 from time to time let us have glossaries of definitions
21 of terms that are being used. It is helpful. It is not
22 mandatory, but it's a convenience.

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25

4-1 1 THE WITNESS: Yes.

2 BY MR. EDGAR:

3 Q Do you believe that Applicants have indicated
4 in response to those admissions that they have no reason
5 to believe that the condition set forth and defined at
6 Page 19 of your testimony would occur?

7 A Well, the testimony states that the Applicants
8 concede that these things might occur, and I believe
9 that's a fair representation of the admissions as,
10 presumably what you are referring to, is in two cases the
11 Applicant stated that while they admit that, that it
12 might occur, they have no reason to believe that it will
13 in fact occur, and wasn't implying that in the testimony.

14 Q On Page 10 of your testimony, Answer 10,
15 the last sentence on the page, there is a quotation from
16 a memorandum from Robert B. Minogue, Director, Office of
17 Standards Development, to Ben Huberman, Director, Office
18 of Policy Evaluation, that memorandum being dated January
19 7th, 1977.

20 A Excuse me, I'm lost again.

21 MR. GREENBERG: Page 11.

22 MR. EDGAR: I may have given him the wrong
23 reference.

24 BY MR. EDGAR:

25 Q Page 11, Answer 10, last sentence.

4-2

1 A Yes.

2 Q And the sentence indicates that, "Nuclear
3 power plants are vulnerable to acts of sabotage by a
4 single individual with sufficient personal knowledge or
5 direction and with uncontrolled or unlimited access to
6 vital areas." Is that correct?

7 A Yes.

8 Q Under the existing NRC safeguards requirements,
9 do you believe that any person will have uncontrolled
10 access to vital areas?

11 A I believe that it's a reasonable expectation
12 that senior management officials would have such
13 access. Whether or not that would be forbidden by
14 individual license conditions, I couldn't state.

15 Q Well, is it true that given your understanding
16 of the NRC safeguards requirements, that no person,
17 whether senior management or not, would have uncontrolled
18 access to vital areas?

19 A Well, I don't know the answer to that question.

20 Q All right.

21 Page 5, Answer 5, the second paragraph in
22 Answer 5 on Page 5. In the second sentence of that
23 paragraph you indicate --

24 A I am just now at Page 5. Run through the
25 paragraphs again. That's what my --

4-3

1 Q Sure. Page 5, Answer 5, second paragraph.

2 A Yes.

3 Q The third line in that second paragraph you
4 state that, "Over its lifetime, its..." referring to CRBR
5 "...total plutonium requirement may be as high as 27
6 metric tons."

7 A Yes.

8 Q Does that statement assume that CRBR would
9 operate on a once-through fuel cycle for 30 years?

10 A Yes.

11 Q That is, no recycling?

12 A Yes, I believe that's --

13 Q All right.

14 Page 6, the first full paragraph on the page.

15 A Yes.

16 Q The first full paragraph, in particular the
17 last sentence, it says, "In the proposed Developmental
18 Reprocessing Plant (the 'DRP'), the projected nominal
19 throughput is 500 kilograms of heavy metal per day or
20 approximately 150 metric tons per year."

21 If breeder fuel were being processed in the
22 DRP, what would the throughput of plutonium be per day,
23 as distinct from heavy metal?

24 A I don't remember the precise number. Rephrase
25 the question just to make sure I've got the precise

4-4 1 question.

2 Q All right. Let me just take it quickly.

3 The projected nominal throughput of DRP is 500 kilograms
4 of heavy metal per day.

5 I'm asking you if you assume plutonium
6 throughput by use of CRBR fuel, what does the 500 kg's
7 heavy metal correspond to in terms of plutonium?

8 A Well, the 8 percent that's allocated to the
9 Clinch River would be, you know, roughly the one-ton
10 amount, and what the actual throughput in terms of
11 plutonium would depend on what fuels you are processing
12 at the time in the balance of the plant.

13 Q Would it be considerably less than the
14 heavy metal throughput value; is that right?

15 A You mean considerably less than 150 metric
16 tons?

17 Q Yes.

18 A Oh, very definitely.

19 JUDGE LINENBERGER: Dr. Cochran -- excuse me,
20 Mr. Edgar, but on this point in your testimony where you
21 use the term "heavy metal," has that weight value been
22 corrected to take account of the fact that certain of the
23 heavy metal may be in oxide form, or does it include total
24 oxide weight and make no allowance for oxygen?

25 THE WITNESS: I don't draw a major

14-5 1 distinction, but my recollection is it's strictly the uranium
2 and plutonium, and not the oxide component, but that's not a
3 major difference in terms of the over-all weights.

4 JUDGE LINENBERGER: All right, thank you.

5 BY MR. EDGAR:

6 Q Page 9, A9, first sentence.

7 A In the answer?

8 Q Yes. In the answer you use the word "impossible."
9 How do you define the term "impossible"?

10 A Maybe I'm lost. I've lost you on the line.

11 Q All right. Page 9, A9, in the first sentence of A9
12 and in the third line, you use the term "impossible." What do
13 you mean by the term "impossible"?

14 A Well, I mean it's -- I'm not sure my English is
15 good enough to answer this without putting it back to the
16 snake chasing its tail, as Dr. Linenberger refers to.

17 It's not -- it's possible. It's conceivable. It
18 can be done without attaching significance to the probabilities
19 of whether it can be done.

20 Q Is it fair to say that "impossible" means it would
21 not violate physical laws?

22 A That's a definition that one could use.

23 Q Would you accept that definition here?

24 A Well, I would say the -- my own views are that
25 it's more than just -- I mean, there's more to it than just

14-6

1 not being -- than just it being able to occur without violating
2 physical laws.

3 I mean, I recognize differences of opinion between
4 whether it's likely to occur even with a low probability of
5 occurrence, but I wouldn't put this in the same category as
6 some Maxwell Demon experiments that one could envision where
7 the probabilities are so low as to not be of any interest.

8 Q But as I understand your definition, you just told
9 me a moment ago that "impossible" does not attach any
10 significance to probabilities; is that correct?

11 A Yes. I mean, within reason. I would draw a
12 distinction between 10^{-48} and 10^{-6} , for example, but....

13 Q Okay.

14 MR. EDGAR: We have no further questions,
15 Dr. Cochran, on cross-examination.

16 JUDGE MILLER: Staff?

17 MR. JONES: We have a few questions.

18 CROSS-EXAMINATION

19 BY MR. JONES:

20 Q Dr. Cochran, if you would turn to Page 11 of your
21 testimony, Answer 10, at the bottom of that page is a discussion
22 of vulnerability and you reference a statement which is
23 attributed to a Minogue to Huberman memorandum.

24 Is it not true that the memorandum and the
25 statement it contains entirely predates the effectiveness of

14-7

1 10 CFR 73.55 and the present safeguard regulations?

2 Let me repeat the question.

3 Is it not true that the memorandum that is
4 referenced there and the conclusions contained within it
5 entirely predate the present NRC safeguard regulations in
6 10 CFR 73.55?

7 A Yes, it predates it.

8 Q If you would, turn to Page 13 of your testimony,
9 please. In the carryover paragraph, which is Answer 12, there
10 is a reference three lines down to "The Case of the Missing
11 Uranium."

12 A Yes.

13 Q Does that refer to the Plumbad affair, that
14 particular reference?

15 A Yes, I believe it does.

16 Q Could you tell me what type of material was
17 involved in the Plumbad affair?

18 A Yellowcake.

19 Q Do you know whether that material was at that time
20 under NRC or AEC safeguards?

21 A It was under NEPA.

22 Q Turn to Page 18 and 19 of your testimony, Answer
23 18. It's a carryover answer.

24 A Excuse me. Which page?

25 Q It's Answer 18, which begins on Page 18 and

14-8

1 carries over to the top of Page 19.

2 In that you are discussing certain possible
3 restrictions on civil liberties.

4 My question is do you believe the same potential
5 restrictions that you discuss would be imposed if plutonium not
6 involved in the Clinch River fuel cycle was successfully stolen?

7 A. You mean, for example, from the weapons program?

8 Q. Yes.

9 A. Yes, I do.

10 Q. Are you aware that quantities of plutonium and
11 other special or strategic nuclear material far greater than
12 would be involved in Clinch River are currently being used in
13 support of the military program?

14 A. What do you mean by "far greater"?

15 Q. An order of magnitude greater.

16 A. You mean the cumulative amount that the weapons
17 program has produced?

18 Q. Yes.

19 A. As being an order of magnitude greater than the
20 amounts that might be utilized in the Clinch River reactor?

21 Q. Yes.

22 A. On the basis that the -- I can't give you a yes
23 or no answer.

24 If the number that's utilized in the Clinch River
25 reactor is 27 tons, the amount of plutonium in the weapons program

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1 is not an order of magnitude larger.

2 If the amount of plutonium utilized in the
3 Clinch River program is, say -- well, it would have to be --
4 I can't -- you picked a bad number for me to answer that
5 question.

6 I don't even know that you really want me to
7 answer that.

8 Q Let's see if I can get you a better number.
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1 Q How about if I take away the qualifier "far
2 greater" and just say "greater amounts in the weapons
3 facility, can you answer that? For military programs; can
4 you answer that?

5 A If you're talking cumulative numbers, it would
6 be greater. If you're talking of annual numbers, it's
7 not significantly different than annual numbers. It's
8 greater, but not significantly greater, in my judgment, than
9 annual numbers that flow in the weapons program; in years
10 past. That's going to change.

11 But not in years past.

12 Q Okay.

13 In view of that, do you still believe that the
14 potential restrictions which can be attributed to the CRBR
15 fuel cycle would be significant -- a significant addition
16 to the overall risk of warrantless searches and use of
17 martial law from the weapons facility?

18 A Well, there are two kinds of civil liberties,
19 sort of -- and we keep categorizing the civil liberties
20 implications in sort of two categories.

21 One, those that are imposed from the operation
22 of a program where the safeguards work and those where
23 they don't work.

24 Now, with regard to the failures in the
25 safeguards program, be it in the weapons program or the

15-2

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1 Clinch River program, the civil liberties implications
2 could be comparable. I mean the occurrence of unwarranted
3 -- of search without warrant, area searched, so forth.

4 There are other classes of civil liberty --
5 I mean, other categories of civil liberties infringements
6 that one sees in both programs, even when operated
7 successfully, if you define successfully as meaning without
8 diversion, and those are things like the security
9 clearance procedure, background investigation, the
10 psychological profile --

11 MR. JONES: Mr. Chairman, I'm going to move --

12 JUDGE MILLER: Just one moment, Dr. Cochran.

13 MR. JONES: I move to strike this response.

14 The question was whether or not the CRBR fuel
15 cycle would be a significant addition to the overall risks.

16 That's not the answer --

17 JUDGE MILLER: Would or would not be a
18 significant addition --

19 MR. JONES: -- to the overall risks from martial
20 law or warrantless searches from, say, other areas, such as
21 military programs.

22 JUDGE MILLER: The answer will be stricken.

23 Can you tell us -- first of all, do you have
24 an opinion on that?

25 WITNESS COCHRAN: I've got an opinion on

15-3

1 everything.

2 (Laughter.)

3 JUDGE MILLER: Okay.

4 Do you have an opinion?

5 WITNESS COCHRAN: Yes.

6 JUDGE MILLER: If you don't, all right. And if
7 you do, then tell us -- tersely.

8 WITNESS COCHRAN: The civil liberties
9 implications from the CRBR would be comparable to those in
10 the military program, associated with the military program.

11 The distinction is, do you want -- there is
12 a distinction with regard to some of those.

13 For example, do you want those in commerce?

14 JUDGE MILLER: Let's find out if the
15 interrogator wants them.

16 BY MR. JONES:

17 Q No. I think that answer is sufficient.

18 JUDGE MILLER: All right.

19 BY MR. JONES:

20 Q Dr. Cochran, would you turn to Page 38 of your
21 testimony, please?

22 At the bottom of that page, and I think that's
23 Answer 31, sub part (5), but it is Page 38, you make a
24 statement that the Staff;

25 "Based on past experience has

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1 indicated it may take several
2 years to upgrade safeguards."

3 And the basis for that statement is an NRC
4 deposition; is that correct?

5 A Yes. Well, it's also on the basis of my
6 experience with the upgrade rules but --

7 Q Is that statement also the basis for your
8 statement on Page 28 -- let me be specific --

9 Is that reference to the NRC deposition also
10 the basis for your statement on Page 23, the paragraph that
11 begins:

12 "Fourth, in my judgment, the Staff --"
13 Wait a minute. Let me get the right reference.
14 I'm sorry. Cancel that reference to Page 28.
15 Turn to Page 38, your reference to the
16 deposition.

17 Is it your opinion that the Staff, in that
18 deposition, actually stated that it would take several years
19 to upgrade safeguards?

20 A In my opinion -- the statement is:
21 "The Staff, based on past experience,
22 has indicated it may take several years
23 to upgrade safeguards.",
24 is primarily based on my own interaction with
25 the Staff on these matters and I believe that this

15-5

1 deposition at Pages 90 and 91 support that.

2 MR. JONES: Okay.

3 I would like to give the witness Pages 90 and
4 91 of that deposition.

5 BY MR. JONES:

6 Q I would like you to point, if you could, to
7 the statement on either of those pages that supports your
8 paraphrasing of what the Staff said.

9 A Well, with respect to the physical security
10 upgrade rule on Page 91 -- wait.

11 The question is -- and I believe it's my
12 question --

13 JUDGE MILLER: Let's do it the easy way, Dr.
14 Cochran.

15 You recognize, I take it, that deposition that
16 has been shown to you?

17 WITNESS COCHRAN: Yes.

18 JUDGE MILLER: And would you read that into
19 the record? The totality of Pages 90 and 91, please.

20 WITNESS COCHRAN: You want me to read both
21 pages?

22 JUDGE MILLER: Yes.

23 Since both pages are referenced, we might just
24 as well have the record reflect what it is.

25

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1 WITNESS COCHRAN: Beginning at the top of Page
2 90 -- well, let's see. I don't think we have to go that
3 high.

4 MR. GREENBERG: May I suggest, it may save some
5 time to start at line 10, which I believe is the beginning
6 of this --

7 MR. JONES: Yes.

8 DR. COCHRAN: Beginning at Line 10 on Page 90.

9
10 "MR. JONES: Going back to the
11 threat issue. If sometime in the
12 future the perceived threat increases,
13 how long would it take to upgrade the
14 facilities to meet the new threat?

15 ANSWER (Witness Jones): The NRC has
16 several mechanisms by which it can
17 respond to a change in the threat;
18 one of which is, if a threat is
19 immediate and identifiable, it can
20 issue an immediately effective
21 order requiring the site or sites
22 to make the appropriate changes.
23 If it is a generic type of threat
24 increase, we can then initiate a
25 rule-making change to amend Part 73

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and require additional protection.

QUESTION: Roughly, how long does it
take to go through the second
procedure?

WITNESS JONES: A rule-making change?

QUESTION: Yes.

ANSWER: (Witness Jones) I have no
way of anticipating that.

QUESTION: Well, how long -- what has
been the past history of the NRC
in that regard?

ANSWER: (Witness Jones) Which rule?
I mean, we do them all the time.

QUESTION: Well, let's talk about the
physical security upgrade rule.

ANSWER: (Witness Jones) I don't know
how long that took.

Bob, do you know?

ANSWER: (Witness Dube) It was a few
years, Tom. I'm not sure "

JUDGE MILLER: If he had asked you -- who was
the interrogator?

WITNESS COCHRAN: Well, I have two more lines.

JUDGE MILLER: Okay.

15-8

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1 WITNESS COCHRAN: "QUESTION: And
2 the material control and
3 accounting rule?

4 ANSWER: (Witness Dube) That has
5 been several years."

6 JUDGE MILLER: Is that it?

7 Give the date of the depositions and the
8 interrogator and the witnesses who were in those --

9 WITNESS COCHRAN: The date of the deposition is
10 October 12, 1982 . Deposition of: Robert Dube, John W.
11 Hockert, Harvey B. Jones, Charles E. Gaskin and R. Davis
12 Hurt. And the interrogator in this case is myself.

13 JUDGE MILLER: Very well. Thank you.

14 Okay. Next question.

15 BY MR. JONES:

16 Q Dr. Cochran, in view of what you just read,
17 would it be correct to say that the statement you make on
18 Page 38 refer only to changes in the safeguards rules
19 rather than changes in the safeguards themselves?

20 A It refers to -- yes, principally to the rules.

21 Q Also on Page 38 in about the middle of the
22 page, you state:

23 "However, while there are several
24 disparate efforts, there is no truly
25 systematic coordination in this -- "

1 and referring to a system for continuing review of
2 safeguard threats, and you reference the Staff answers to
3 the 23rd set of interrogatories.

4 See where I'm point to?

5 A. Yes.

6 Q Dr. Cochran, do you have a copy of the
7 answers to those interrogatories?

8 A Not in front of me.

9 We've got to get this previous material so it's
10 not mixed up between the Staff and the Applicants.

11 Or do you care?

12 Some of this is yours and some the Applicants.

13 Q There is a question on Page 2 of that set of
14 interrogatories --

15 First of all, let me, for the Board, make sure
16 it is clearly identified what I'm giving Dr. Cochran.

17 MR. JONES: It is a document entitled The Staff
18 Answers to Intervenor's 23rd Set of Interrogatories and
19 it's dated April 26, 1982.

20 I'm referring to Page 2 of that set of answers
21 and there is a question on that page which appears to be
22 on the subject matter for which you have referenced it.
23 BY MR. JONES:

24 Q I wonder if you read that question and the
25 complete answer, which continues on to the next page?

15-10

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1 A You're referring to Interrogatory 20?

2 Q That's correct,

3 A Beginning at Page 2, Interrogatory 20:

4 "What system, if any, has been developed

5 to provide for continuing timely

6 review of safeguards and physical

7 security requirements to take into

8 account dynamic factors at work

9 in society?

10 If such a system has been developed,

11 explain how it has been applied with

12 reference to events occurring since

13 April 25th, 1977. What does the

14 Staff consider to be a reasonable

15 time in a dynamic system to respond

16 to changes in the nature and scope of

17 the threat to nuclear facilities.

18 RESPONSE: NRC Staff, in fulfillment

19 of its continuing threat assessment

20 mission, maintains working liaison

21 with other Federal agencies to obtain

22 any available information on individuals

23 or groups who could pose a threat to

24 nuclear facilities.

25 In addition, it has performed or

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1 or contracted for the performance
2 of studies to examine historical
3 data relating to a variety of
4 potential threats to the licensed
5 nuclear industry, including terrorists,
6 organized criminals, extremists,
7 protest groups and insiders.

8 Staff also participates with DOE and DOD
9 in an ad hoc working group on threat
10 and safeguards related research.
11 Representatives of DOE and NRC
12 safeguards staffs meet periodically
13 under the aegis of DOE/NRC liaison
14 board to discuss common interests
15 and share the results of research
16 tasks."

17 Do you want me to continue for the next --

18 Q I don't think it's necessary. I think you've
19 read enough.

20 Is that question and answer, then, what you
21 had referenced on Page 38 as the basis for your statement
22 that there is no truly systematic coordination with respect
23 to continuing review of safeguards threats?

24 A Well, there is some coordination. That is a
25 reference to -- that I'm giving to that statement.

15-121

Q That was my only question.

2

JUDGE MILLER: Pardon me.

3

Now, what's the question.

4

MR. JONES: My only question was to make sure that was, in fact, what he was referring to in his testimony, that answer, that part and the answer is yes, I believe.

7

WITNESS COCHRAN: Yes, in part.

8

YBY MR. JONES:

9

Q Now, if you will turn to Page 28, there is a statement midway down the page. The paragraph begins:

10

11

"Fourth, in my judgment --"

12

13

14

and states that the Staff can look and should have looked at how the system would respond to changes in threat levels.

15

16

17

In the description you just read in that answer, to the interrogatory, was that not, in fact, a description of how the Staff responds to changes in threat levels?

18

19

A That's -- yes. That doesn't appear in the environmental impact statement.

20

Q Okay. Fine.

21

MR. JONES: No further questions.

22

JUDGE MILLER: Anything further?

23

Any reason why he cannot be discharged?

24

Have you offered into evidence his testimony?

25

MR. GREENBERG: No. I have one further question

15-13

1 on redirect, if I might, Mr. Chairman.

2 REDIRECT EXAMINATION

3 BY MR. GREENBERG;

4 Q Dr. Cochran, you indicated that over the lunch
5 break you had an opportunity to look at the IAEA report,
6 which is referenced at Pages 35 and 36 of your testimony;
7 is that correct?

8 A That's correct.

9 Q And were the conclusions in that report based
10 on an assessment of reprocessing facilities that would use
11 near real time or real time accounting systems?

12 A That might use those in the future.

13 Q Were the conclusions in that report dependent
14 upon the plant size of the various reprocessing plants
15 under consideration?

16 A The conclusion was that the conclusions -- one
17 of the points made in the report was that the conclusion
18 to the report weren't dependent on plant size.

19 Q Now, in terms of the quantities of plutonium
20 which would be involved in throughput at Tokai, would
21 those quantities be less or more than the quantities of
22 plutonium throughput at the DRP?

23 A I believe they would be less.

24 Q Why would they be less?

25 A The Tokai plant is designed to reprocess spent

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lightwater reactor fuel which contains about one percent plutonium, whereas the DRP is designed to process spent LMFBR fuel which contains, depending on the elements, up to about thirty percent plutonium. On the average. I believe the number was given earlier, around ten percent.

MR. GREENBERG: Thank you. I have no further questions.

JUDGE MILLER: Anything further?

MR. EDGAR: Yes. I have one.

I would like to have marked for identification a document which is -- and I'd like to have it marked for identification as Applicants Exhibit 41, the document in question consists of a cover page and certain relevant pages from the Overview Report to the Director General of the IAEA, International Atomic Energy Agency, No. RC-232.3-3.

That document is the same document which Mr. Greenberg and Dr. Cochran just exchanged questions and answers.

(The document referred to was
was marked Applicant Exhibit
No. 41 for identification.)

MR. EDGAR: I'll hand out copies to all parties and to Dr. Cochran and request that that be marked for identification as Applicants Exhibit 41.

/ / /

RECROSS-EXAMINATION

BY MR. EDGAR:

Q. Dr. Cochran, do you have Applicants' Exhibit 41 before you?

A. Yes, it's not the complete document that I was referring to.

Q. Are you familiar with the complete document which you referenced in your testimony?

A. I am familiar with the summary and conclusions of which this part that you've handed me is a portion of that.

Q. All right.

Now, in regard to the summary and conclusions, would you take a look at the third page in that document I've handed you and let me call your attention to the top paragraph on the page, and let me quote from that: "The group went on to look at the results of a study on near real time accountancy. The study (mentioned in Chapter III) concluded in terms of the probability of the generation of materials accountancy alarms (given that the diversion has taken place), that the application of the technique in addition to conventional safeguards (as described in Chapter II) could enable the Agency guidelines to be met (with improved measurements accuracies) for facilities up to at least 210 MTHM per year. For large-scale facilities the abrupt diversion guidelines could probably be met; however, problems still existed meeting the protracted

16-2

1 diversion guidelines for plutonium in the main process MBA."
2 That's Capital M, Capital B, Capital A.

3 Is that an accurate quotation from the IAEA report
4 conclusions mentioned and referring to in your testimony?

5 A That's an accurate quote and the basis for my
6 statements that you are going to have trouble at the DRP.

7 MR. EDGAR: I move to strike the last part of the
8 answer.

9 JUDGE MILLER: It is stricken.

10 BY MR. EDGAR:

11 Q What is the throughput of the Tokai reprocessing
12 plant expressed in metric tons of heavy metal per year?

13 A The Tokai plant?

14 Q Yes.

15 A If you express it in terms of heavy metal, it's
16 in the neighborhood of 200.

17 Q Do you know?

18 A Well, the actual throughput is a lot less, because
19 they don't meet the design requirements, but if you are talking
20 about the design requirements, it's 200.

21 Q Metric tons of heavy metal per year?

22 A Yes.

23 Q Do you know whether in conjunction with this
24 conclusion which I've quoted the 210 metric tons heavy metal
25 per year value refers to the Tokai plant?

16-3

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1 A I believe it does.

2 MR. EDGAR: We have no further questions.

3 JUDGE MILLER: Anything further?

4 MR. JONES: Yes, Mr. Chairman, I indicated earlier
5 that I had some additional areas the Staff wished to move to be
6 stricken from Dr. Cochran's testimony.

7 I must apologize. I did not discuss that with
8 Mr. Greenberg during the luncheon break. If you wish to take
9 a five-minute break, I will inform him of the areas and the
10 basis so that he has a few minutes.

11 JUDGE MILLER: Well, what's the wish of Counsel?

12 MR. GREENBERG: I would appreciate that, Mr. Chairman.

13 JUDGE MILLER: All right. Five minutes.

14 (Recess taken.)

15 JUDGE MILLER: Mr. Linenberger has a few
16 questions, Dr. Cochran.

17 You may proceed.

18 JUDGE LINENBERGER: A housekeeping question, first.

19 Mr. Edgar, my notes do not indicate that
20 Applicants' Exhibits 40 and 41 marked for identification have
21 been offered or received into evidence; is that correct?

22 MR. EDGAR: That's correct. I'm going to, and
23 I'll do it at this time, offer Applicants' Exhibit 40, subject
24 to a promise to get a clear copy for all parties and the
25 reporter. We are having that done now.

16-4

1 So I'm going to offer Exhibit 40 for the purpose
2 of providing evidence related to the matters addressed in the
3 cross-examination on that document.

4 JUDGE MILLER: Any objections?

5 MR. GREENBERG: No objection.

6 JUDGE MILLER: It may be admitted.

7 (Applicants' Exhibit No. 40 was
8 received in evidence.)

9 MR. EDGAR: And I am not offering Applicants'
10 Exhibit 41. The witness has testified to the accuracy of
11 the quotation.

12 JUDGE LINENBERGER: Thank you.

13 BOARD EXAMINATION

14 BY JUDGE LINENBERGER:

15 Q Perhaps a small point here, Dr. Cochran, but at
16 the beginning of the day when Intervenor's Exhibit 12 was
17 distributed and discussed in an introductory fashion --

18 A Which was 12?

19 Q Your prefiled Part V, Exhibit 12.

20 A Yes.

21 Q I thought I heard it said in some exchange of
22 information that you were responsible for declassifying it; is
23 that correct? Did I hear that?

24 A You may have heard that. That's not correct.
25 Let me run through the procedure.

16-5 1 There was an earlier deposition where there was
2 some classified material inadvertently put in the deposition,
3 and that was cleaned up, and in the process of filing this,
4 primarily because of some material related to the Erwin
5 testimony, which is also classified at this stage, has not
6 cleared classification review, I submitted the entire report
7 to make sure that I had -- I had this classified attachment
8 and I wanted to have it cleared through the NRC that I had
9 done that properly, and in fact under the facility clearance
10 that I have, I can only classify things pending their review.

11 So it was submitted to the security people, and
12 in following the procedure we followed in the Erwin case,
13 the request was that upon completion of the classification review,
14 that it would be sent to the parties.

15 Now, in this particular case it was not cleared
16 by the NRC until Friday, I believe, and that's probably why you
17 didn't get it; but then I talked to the security people. They
18 said that this part was cleared and it was not classified as
19 long as the attachment was not there.

20 Therefore, I scrubbed off the classification
21 stamps that I had placed on this document, since it was no
22 longer a classified document.

23 Q Well, is the fact of the matter, then, that you
24 marked this "Unclassified," based on information given to you
25 by NRC security people?

16-6

1 A Yes, sir.

2 Q All right. Thank you.

3 Referring you to Page 21 of Applicants' Exhibit 12 --
4 I beg your pardon, Intervenor's Exhibit 12.

5 A Page 21?

6 Q Page 21.

7 A Correct me if that's not been struck. I wasn't
8 able to keep up on what was in and out, but my notes indicate
9 21 was struck, but I don't....

10 Q Page 21?

11 MR. EDGAR: We have a record -- Our notes show
12 21 was stricken.

13 JUDGE MILLER: Answer 21 is in part on Page 21.
14 Answer 21 begins on Page 20.

15 JUDGE LINENBERGER: Oh, yes, my notes show the
16 same thing.

17 THE WITNESS: It may be interesting. You may
18 want to ask me anyway.

19 JUDGE MILLER: Does the record show that both
20 Question 21 on Page 20 and Answer 21 on Pages 20 and 21 of
21 Exhibit 12 have been stricken?

22 MR. EDGAR: That's what our notes show.

23 MR. JONES: That's what our notes show.

24 MR. GREENBERG: I believe that's what our notes
25 show.

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MR. MILLER: All right. Just so we will have no confusion.

Now, are you agreeable to withdrawing your potential question then, Mr. Linenberger, on 21?

JUDGE LINENBERGER: Is that a question or an instruction?

(Laughter.)

JUDGE MILLER: It's a question.

JUDGE LINENBERGER: Well, I'm not sure I am agreeable with withdrawing my question because about a third of the way down the page is a statement that I have a problem with in the sense of context in which it's offered.

All right, no. I'll withdraw the question.

JUDGE MILLER: Okay, that's good. The context was negative, anti-matter, whatever, so I'm very relieved.

(Laughter.)

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16-8

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1 BY JUDGE LINENBERGER:

2 Q For the sake of my own education here, you use,
3 for example, on Page 24 the acronym "LEMUF," all caps. My
4 vague recollection is that this is low-enrichment material
5 unaccounted for; is that it?

6 A Limiting error on material unaccountable. Now
7 LEID is the current....

8 Q Okay, thank you.

9 On Page 24, for example, at Answer 24, the first
10 sentence states that, "In many cases, there has been no
11 independent assessment whatsoever by the Staff of DOE's
12 submissions."

13 Now -- and I've read what follows there. On the
14 other hand, I thought I heard Mr. Dube this morning indicate
15 something that may be inconsistent with that statement. I
16 don't know. Mr. Dube or somebody on the Staff's panel.

17 There was a discussion of regular routine reviews
18 performed by the Staff of these kinds of submissions by DOE.
19 Did you hear that? Do you consider that to represent an
20 inconsistency, or can you explain?

21 A I don't recall what the context of his -- I don't
22 recall that or the context of it.

23 Q I see. All right.

24 A There was some discussion by another witness, I
25 recall, that was referring to what will be coming in terms of

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1 licensing review. I believe it was Mr. Gaskin, in terms of
2 the licensing review of the physical security at the CRBR itself
3 and what he would be looking for, but I don't recall Mr. Dube's
4 conversation.

5 Q Well, do you consider that your statement on Page
6 24 is consistent or inconsistent with Mr. Gaskin's comments?

7 A Well, Mr. Gaskin was referring to the process by
8 which the physical security plan for the Clinch River reactor
9 will be reviewed, and I am referring to the capabilities of the
10 DOE facilities that are not -- would not come under licensing
11 review and whether the assessments that DOE represented in the
12 ER with regard to things like the limiting error on the
13 inventory difference, or LEMUF, or LEID, are in fact correct or
14 achievable, and the lack of a Staff review of those claims by
15 the Applicant.

16 Q Is the short answer to my question, then, "no"?

17 A I've forgotten what your question was.

18 (Laughter.)

19 JUDGE MILLER: That's about the shortest answer I've
20 heard in a long time.

21 THE WITNESS: I don't see the contradiction. I
22 don't like to contradict --

23 BY JUDGE LINENBERGER:

24 Q Well, I would like to think occasionally that
25 the answers relate to the questions somehow.

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A. There's no contradiction.

JUDGE MILLER: So much for aspirations.

JUDGE LINENBERGER: Well, I guess you have yourself to thank here somehow, Dr. Cochran, for my not having any more questions because I really didn't get at this document until today.

So we'll leave it at that. No more questions, Mr. Chairman.

JUDGE MILLER: Anything further?

MR. JONES: Now, if I can go through the motion.

JUDGE MILLER: Yes. We'll get to you, but you don't need the witness on the stand, do you?

MR. JONES: No.

JUDGE MILLER: We'll excuse you, Dr. Cochran, but you remain under oath. We might as well just save wear and tear on our oath-giving procedure here, because I know you are going to be testifying subsequently.

(The witness was excused.)

JUDGE MILLER: Proceed.

MR. JONES: Okay. Going through the testimony, I'll try and go in chronological order here and we can follow through.

On Page 9, Answer 9(2), that particular subsection, when you look at the end of the paragraph on Page 10, clearly constitutes an attack on the Commission's threat

6-11

1 definition. Specifically, it is noted that the Department of
2 Defense recognizes a certain threat, and that the DOE and the
3 Commission does not; and further concludes, "I consider these
4 to be credible external threats to nuclear facilities."

5 So those particular statements which are the
6 conclusion of that paragraph are an attack upon the
7 regulations.

8 I would propose striking the whole paragraph.

9 JUDGE MILLER: Intervenors?

10 MR. GREENBERG: Well, Mr. Chairman, it's
11 possible, I suppose, to characterize every reference Dr. Cochran
12 makes as possible threats or risks of safeguards failure as
13 an attack upon the regulations.

14 At the risk of repetition, I don't think every
15 time Dr. Cochran in his testimony refers to kinds of threats or
16 armed attack or what other agencies do or what have you, that's
17 what's going on here.

18 We are trying to look at the kind of analysis that
19 the Commission Staff has conducted of safeguards risks and
20 consequences. Looking at possible scenarios is one way of going
21 about that, and we don't construe that to be an attack upon
22 the regulations.

23 JUDGE MILLER: Applicant?

24 MR. EDGAR: Well, as I read the first sentence, it
25 says, "Under current safeguards, an armed attack by more than

16-12 1 from 6 to 8 highly motivated, well-trained outsiders, possibly
2 aided by one to three insiders," that leads directly into
3 10 CFR 73.1(A), and that specifies one insider rather than
4 one to three.

5 I don't see how you can avoid the conflict.

6 JUDGE MILLER: What was your citation to the
7 regulation? 10 CFR 73?

8 MR. EDGAR: 73.1(A) is the cite.

9 (Bench conference.)

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1 MR. EDGAR: I think if you look under either
2 sabotage or theft, and you look at the criteria with
3 regard to an external threat in coupling with the internal
4 threat, you'd see that that's one insider.

5 And I believe the language is "a knowledge-
6 able individual" in the case of sabotage. And when you
7 look at theft, under theft, it's "inside assistants,"
8 which may include a knowledgeable individual."

9 MR. GREENBERG: If I can make one more
10 point here, Mr. Chairman. We're talking about these
11 threats. I understand the notion of attacking the regu-
12 lations when you're dealing with a facility under
13 license.

14 But we're dealing here as well with non-
15 licensed facilities. We're trying to demonstrate the
16 threats which exist to those facilities, as well as to the
17 CRBR plant itself.

18 It doesn't seem to me that by introducing
19 evidence with respect to the nature of that, we're attack-
20 ing regulations in the context of an assessment of risks
21 to facilities which are not being licensed by the Commis-
22 sion at this time.

23 JUDGE MILLER: Regardless of being licensed,
24 how do you escape from the conclusion that the Commis-
25 sion, which is the highest authority to this and any other

1 Board, has established the frame work within which these
2 matters are to be considered? How would we possibly have
3 any jurisdictional power to go beyond it, even if we
4 wished, licensed or unlicensed?

5 A. GREENBERG: I don't think the Commission
6 has established design threats for other government
7 facilities which are not subject to license. It's out-
8 side the scope of the regulations.

9 JUDGE MILLER: Well, please, before we get
10 to that, let's stick to one that is subject to licensing.
11 That's what we're sitting here for, to determine licens-
12 ing of the Clinch River Breeder Reactor Plant.

13 We've got 73.1, and we're reviewing it again
14 to be sure because you've raised the question several
15 times, but we still can't seem to escape from the belief
16 that the Commission has circumscribed our area of juris-
17 diction.

18 MR. GREENBERG: Well, I appreciate that --

19 JUDGE MILLER: If you want to free us or
20 something, okay. But you've got to show us something --

21 MR. GREENBERG: Well, I think we just have a
22 fundamental difference in approach here. I've tried to
23 explain as clearly as I could how we see our case in
24 terms of focusing on residual risks and analysis of
25 risks.

1 We don't think we are attacking the regula-
2 tions. But if we can't talk about any risks other than
3 those that are in the regulations themselves, then we
4 really are precluded from introducing any evidence with
5 respect to risk.

6 JUDGE MILLER: Well, not any evidence, but
7 any evidence that is inconsistent with that which the
8 Commission has determined is to be taken under considera-
9 tion by the Staff or by the Board.

10 We just don't see it any other way. We've
11 reviewed it again.

12 The fact that you may use the rubric of
13 residual risk, we don't see that concept being applicable
14 here. It doesn't seem to matter that some of the
15 facilities would not be licensed at present, or perhaps
16 never. It doesn't really matter.

17 But we're certainly reviewing a licensed
18 facility which has been discussed up and down by the Com-
19 mission and Congress and everybody else. I think we're
20 just going to have to adhere to our ruling and the basis
21 for it.

22 Consequently, Pages 9 and 10 of the testimony
23 of Dr. Cochran, which is Intervenor's Exhibit 12, numbered
24 paragraph two in parenthesis at the bottom of Page 9
25 and the -- that would be the first two-thirds of Page 10

17-4

1 will be stricken.

2 Did you say you had any other --

3 MR. JONES: Yes. Do you want me to go through
4 the whole list, or shall we go along with each one as
5 we're doing now?

6 JUDGE MILLER: We'll do as we've moving.

7 MR. JONES: Okay.

8 JUDGE LINENBERGER: But with respect to this
9 parenthetical two paragraph, which the Board just ruled
10 on, that includes a reference to an attached exhibit --
11 or Attachment 3.

12 Now, what say you as to the status of that
13 attachment in the context of your motion to strike?

14 MR. JONES: Well, I was going to have to bring
15 it up with respect to this and another exhibit. So let
16 me cover both of those right now.

17 In the --

18 JUDGE MILLER: How could you let stand an
19 exhibit which is attached to a portion that is stricken?

20 MR. JONES: That's my assumption, that it
21 would be stricken also.

22 JUDGE MILLER: I think your assumption must
23 follow as night to day, and that any references contained
24 in the stricken portion likewise fall with it. So you
25 may consider that Exhibit 3, which was attached as --

17-5

1 and since it's incorporated by reference -- has met the
2 same fate.

3 MR. JONES: That will shorten what I need to
4 go through.

5 The next statement is in Answer 9, Subpara-
6 graph (3). I believe the Board's ruling this morning
7 was that that would stand to the extent it talked about
8 transportation over domestic water.

9 My problem is with the first sentence which
10 deals with whether the irradiated fuel is self-protecting.
11 There is a Commission regulation dealing with that,
12 10 CFR 73.6(b), which specifically states that special
13 nuclear material, which is not really separable from
14 other radioactive material and which has a total external
15 radiation dose rate in excess of 100 rems per hour at a
16 distance of three feet from any accessible surface without
17 intervening shielding.

18 If you'll refer back, it is exempt from the
19 safeguards requirements.

20 For that reason, the statement that there
21 is still the hypothetical possibility of theft of ir-
22 radiated fuel in that first sentence would be a challenge
23 to the regulations.

24 JUDGE MILLER: I don't believe we agreed with
25 you on that. It might be, but I don't think it necessarily

17-6

1 is. So we will overrule that objection. The three
2 may stand.

3 MR. JONES: At Page 36, Answer 31, Subparagraph
4 (4) at the bottom of the page. We believe that that is an
5 attack on the Commission's regulations. In fact, the
6 first sentence states, "The threat levels utilized by the
7 Commission in DOE to determine safeguards design may be
8 inadequate," and then it goes on to discuss it.

9 JUDGE MILLER: Yes.

10 (Bench conference.)

11 JUDGE MILLER: Yes. We agree that it does
12 appear to be in the same category as -- it's even more
13 than an implied challenge, I believe, to the Commission's
14 regulations and approach.

15 So we will grant the motion as to Subpara-
16 graph (4), Pages 36 and 37 of Exhibit 12 of the Inter-
17 venors.

18 Any more?

19 MR. JONES: Yes. Finally, if you'll turn to
20 Attachment No. 5 to Dr. Cochran's testimony, Page --
21 first of all, Page 33. That would be the last attach-
22 ment, Paragraph 70.

23 JUDGE MILLER: Yes. Okay.

24 MR. JONES: That deals with the threats deal-
25 ing with diversion by foreign governments and the NRC

17-7

1 regulations at 10 CFR 50.13 specifically state that the
2 NRC regulations do not concern themselves with nation/
3 state adversaries.

4 It seems to me that would be a threat.

5 MR. GREENBERG: Isn't there a question of
6 the meaning of the regulations? What is the citation
7 again of that regulation?

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1 MR. EDGAR: 50.13. The other citation is
2 Segal versus AEC, which is a 1970 D.C. Circuit case.

3 MR. GREENBERG: The Regulation 50.13 refers
4 to an enemy of the United States, whether a foreign govern-
5 ment or other person.

6 It doesn't necessarily exclude the possibility
7 of foreign governments, per se. The issue is whether the
8 government is an enemy.

9 It might be argued in the NUMEC case, for
10 example, that the diversion was not related to an enemy
11 government.

12 MR. JONES: I think what I just heard was
13 that it's possible for a foreign national government to
14 be committing sabotage or theft against a U. S. facility
15 and not be an enemy of the United States.

16 I don't quite follow that logic.

17 JUDGE MILLER: Have you ever heard of an un-
18 declared war?

19 MR. JONES: Well ...

20 JUDGE MILLER: I agree with you. I do believe
21 that we'll strike that.

22 MR. JONES: And finally --

23 JUDGE MILLER: Wait a minute. Let me get it
24 for the record now. That's Paragraph No. 70 of Exhibit --
25 what --

1 MR. JONES: It's Attachment 5.

2 JUDGE MILLER: Attachment 5 to Dr. Cochran's
3 testimony on Part V, which is Intervenors' Exhibit 12,
4 Page 33 of that attachment; is that correct?

5 MR. JONES: That's correct.

6 JUDGE MILLER: That Paragraph No. 70, as thus
7 described, will be stricken.

8 MR. JONES: And then in that same attachment,
9 Paragraph 72 through 78 --

10 JUDGE MILLER: Where is it?

11 MR. JONES: Beginning on Page 34, again a
12 discussion of the threat definition used by the NRC
13 and Dr. Cochran's belief as to why that threat is not
14 appropriate.

15 JUDGE MILLER: Why what threat is not ap-
16 propriate?

17 MR. JONES: This is the design basis threat
18 used in the regulation.

19 JUDGE MILLER: You've moving then to strike
20 what now?

21 MR. JONES: Paragraphs 72 through 78.

22 JUDGE MILLER: Mr. Greenberg, what do you have
23 to say on that?

24 MR. GREENBERG: Well, Mr. Chairman, I don't
25 want to repeat the arguments that I've made before.

17-10

1 JUDGE MILLER: All right. I think the ruling
2 will take recognition of the arguments that have been
3 made before; and the ruling will be the same as made
4 before.

5 So the motion to strike again as to para-
6 graphs numbered 72 through 78 of Attachment 5 to Inter-
7 venors' Exhibit 12 -- is that correct?

8 MR. JONES: Yes.

9 JUDGE MILLER: You're out of exhibits.

10 MR. JONES: Right. I have only one question
11 for clarification.

12 JUDGE MILLER: Go ahead.

13 MR. JONES: This is for clarification.

14 Unfortunately, this isn't dealt with ex-
15 clusively by the statement earlier that if testimony is
16 stricken which refers to an exhibit, that exhibit is
17 stricken. Yesterday, with respect to Paragraph --
18 Answer No. 9, Subparagraph (3) -- Let me get the
19 page for that.

20 That's Page 10. The Board ruled that it was
21 stricken, again only with respect to the extent that it
22 went beyond territorial waters of the U. S. for trans-
23 portation.

24 JUDGE MILLER: Which one are we looking at
25 again?

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1 MR. JONES: I'm sorry. This morning.

2 JUDGE MILLER: I know, but --

3 MR. JONES: Page 10 --

4 JUDGE MILLER: I've got Page 10.

5 MR. JONES: Subparagraph (3) at the bottom.

6 JUDGE MILLER: Paragraph (3). Now what --

7 MR. JONES: This morning the Board ruled
8 that that was stricken with respect to the extent that it
9 went beyond territorial U. S. waters.

10 Now, the reference that is there discusses
11 international transportation and international safe-
12 guards.

13 Would that same --

14 JUDGE MILLER: Let me ask Mr. Greenberg.

15 Does it go into matters that are not
16 included in extra-territorial waters or --

17 MR. GREENBERG: Well, the specific references
18 were with respect to hijacking, which occurred outside
19 of territorial waters.

20 But the same scenario can be imagined inside
21 territorial waters, or in the context of domestic
22 trade. The issue is can you hijack a ship. And the
23 location of that ship doesn't make a great deal of
24 difference in my mind.

25 JUDGE MILLER: But you exhibit does need to

17-12

1 be related --

2 MR. GREENBERG: The exhibit is related to
3 that specific incident.

4 JUDGE MILLER: So it will be stricken. How-
5 ever, your concept is correct; you're certainly entitled
6 to attempt to show or argue that there could be a hi-
7 jacking or otherwise of non-extra-territorial shipping,
8 which we permitted to remain in.

9 Anything further?

10 MR. JONES: That is all I have.

11 JUDGE MILLER: Anyone else?

12 (No response.)

13 JUDGE MILLER: Who's next?

14 MR. GREENBERG: Well, Mr. Chairman, at this
15 time I would like to offer in evidence that part of
16 Dr. Cochran's testimony which remains. I would --
17 I'm afraid it would be difficult for me to run through
18 all of the parts which have been stricken.

19 I think the record will reflect those parts
20 which have been stricken.

21 JUDGE MILLER: Yes.

22 MR. GREENBERG: Let me ask a question. For
23 purposes of the record, will those parts of Dr.
24 Cochran's testimony and exhibits which have been stricken
25 remain in the record as an offer of proof?

1 JUDGE MILLER: They remain in the record,
2 because we do not physically strike. If you wish to have
3 them stand as offers of proof, you may do so.

4 MR. GREENBERG: I'm going to request at this
5 time that they stand as offers of proof.

6 JUDGE MILLER: All right. What does the
7 Staff say to the offers of proof?

8 MR. JONES: Well, for the reasons stated in
9 striking the testimony, we would still argue that that is
10 outside the scope, or otherwise improper.

11 JUDGE MILLER: What is your statement on the
12 record for the offer of proof?

13 MR. JONES: He can make the offer of proof,
14 but we would --

15 JUDGE MILLER: He has made the offer of
16 proof --

17 MR. JONES: -- respond to it the same way.

18 JUDGE MILLER: -- now, what do you say?

19 MR. EDGAR: The Board should deny --

20 JUDGE MILLER: You had darn well better
21 oppose it or --

22 MR. EDGAR: The Board should deny it --

23 MR. JONES: You should deny it for the same
24 reasons we stated before in discussing those portions.

25 JUDGE MILLER: You object to the offer of

17-14

1 proof?

2 MR. JONES: Yes.

3 JUDGE MILLER: Okay. The offer of proof
4 may be made for the record, as we've indicated. The
5 offer of proof will be denied.

6 Now, proceed.

7 MR. GREENBERG: I take exception to that
8 ruling.

9 JUDGE MILLER: Next.

10 MR. GREENBERG: I would also like to offer
11 into evidence Exhibit 12A --

12 JUDGE MILLER: Admitted.

13 12, as modified by Board ruling, and 12A
14 have now just been admitted.

15 (Intervenors' Exhibits Nos. 12
16 and 12A were received in
17 evidence and follow.)

100-443887-1

3887

Before the
UNITED STATES
NUCLEAR REGULATORY COMMISSION
ATOMIC SAFETY AND LICENSING BOARD
Washington, D.C. 20545

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

UNITED STATES DEPARTMENT OF ENERGY
PROJECT MANAGEMENT CORPORATION
TENNESSEE VALLEY AUTHORITY

(Clinch River Breeder Reactor Plant)

Docket No. 50-537

TESTIMONY OF DR. THOMAS B. COCHRAN

Part V

(Intervenors' Contentions 4 and 6 (b)(4))

NUCLEAR REGULATORY COMMISSION

Docket No. 50-537 Official Ex. No. 12
In the matter of Chick River
Staff _____ IDENTIFIED ☒
Applicant _____ RECEIVED ☒
Intervenor ☒ REJECTED _____
Cont'g Off'r _____ DATE 11-17-82
Contractor _____ Witness Cochran
Other _____
Reporter mb

~~Classified By~~

(Original Authority)

~~Pending Classification
Review by NEC
Nov 1, 1982~~

THE UNIVERSITY OF CHICAGO PRESS

A. Witness Qualification

Q1. Please state your name and affiliation and describe your qualifications.

A1. My name is Thomas Brackenridge Cochran. I reside at 4836 North 30th Street, Arlington, Virginia 22207. I am presently a Senior Staff Scientist at Natural Resources Defense Council, Inc. ("NRDC"), and a co-director of the NRDC Nuclear Nonproliferation Project.

I am a member of the Department of Energy's ("DOE") Energy Research and Advisory Board; the Three Mile Island ("TMI") Public Health Fund Advisory Board; the Nuclear Regulatory Commission's (the "Commission") TMI Advisory Board; and the American Nuclear Society.

I have a B.S. degree in electrical engineering and M.S. and Ph.D. degrees in physics, all from Vanderbilt University. I have held the positions of Assistant Professor of Physics, U.S. Naval Postgraduate School, and Senior Research Associate, Resources for the Future.

I have been a consultant to numerous government agencies and testified before Congress on numerous occasions on matters related to nuclear energy generally and liquid metal fast breeder reactors ("LMFBRs") in particular. I was

a member of the LMFBR Review Steering Committee of the Energy Research and Development Administration ("ERDA"). I am the author of The Liquid Metal Fast Breeder Reactor, An Environmental and Economic Critique (Johns Hopkins Univ. Press, 1974).

With respect to safeguards issues, I have been a member of DOE's Nonproliferation Advisory Panel and OTA's Nuclear Proliferation and Safeguards Advisory Panel. In addition, I was actively involved in NRDC's Petition for Adoption of Emergency Safeguard Measures, or Alternatively, for Revocation of Licenses (41 Fed. Reg. 5357-5359 (Feb. 5, 1976)). I have participated in Commission rulemakings concerning material control and accounting and physical security standards. I am also an active participant in the ongoing NFS-Erwin proceeding (Docket No. 70-143).

Additional information concerning my background and expertise relevant to issues discussed herein is presented in my resume which was submitted with previous testimony in this proceeding (Tr. 2870-2871, Cochran).

Q2. Please describe your activities in this case.

A2. I have participated actively in all phases of the Commission's licensing proceedings for the Clinch River Breeder Reactor (the "CRBR") since 1975, including assisting in the preparation of Intervenor's contentions. I prepared

substantial portions of Intervenor's comments on the 1977 CRBR Final Environmental Statement (the "FES") and the 1982 Draft Supplement to the 1977 CRBR Final Environmental Statement (the "DEISS"). I testified before the Advisory Committee on Reactor Safeguards on several occasions regarding the CRBR and related issues. I have attended numerous meetings held by Staff and Applicants to discuss the CRBR licensing review. I have participated actively in discovery proceedings related to the CRBR licensing from 1975-1977, and from March 1982 to the present, including the preparation of interrogatories and responses, and requests for admissions and responses, and have conducted several depositions of witnesses for Applicants and Staff. I have read or examined many of the documents upon which Applicants and Staff purport to rely for their positions on Intervenor's Contentions, including but not limited to the FES, the DEISS, Applicants' Preliminary Safety Analysis Report (the "PSAR") and Applicants' Environmental Report (the "ER").

Q3. In the context of this proceeding, have you prepared any critiques of the Commission's analyses of safeguards risks and consequences? If so, what are they, and do you still rely on them?

A3. We have prepared several critiques of the Staff's analyses. Initially we commented on the Draft Environmental Statement (NUREG-0024). These comments are found at pages

A-59 and A-73--A-81 of the 1977 FES. Since reopening of the licensing, we have updated our critique, noting those specific sections in which the FES inadequately assesses the consequences of programs and measures to prevent acts of sabotage, terrorism and theft. See Intervenor's Answers and Objections to NRC Staff's Fifth Set of Interrogatories, dated March 29, 1982, at 2-11 (copy attached as Exhibit 1). We have also prepared comments, dated September 13, 1982, on the DEISS (pages 82-90 of those comments, relating to safeguards, are attached as Exhibit 2). To the extent the deficiencies identified have not been remedied, I continue to rely upon these critiques, and I incorporate them herein by reference.

Q4. What subject matter does this testimony address?

A4. This testimony addresses Intervenor's Contentions 4 and 6(b)(4). Contention 4 states:

Neither Applicants nor Staff adequately analyze the health and safety consequences of acts of sabotage, terrorism or theft directed against the CRBR or supporting facilities nor do they adequately analyze the programs to prevent such acts or disadvantages of any measures to be used to prevent such acts.

a) Small quantities of plutonium can be converted into a nuclear bomb or plutonium dispersion device which if used could cause widespread death and destruction.

b) Plutonium in an easily usable form will be available in substantial quantities at the CRBR and at supporting fuel cycle facilities.

c) Analyses conducted by the Federal Government of the potential threat from terrorists, saboteurs and thieves demonstrate several credible scenarios which could result in plutonium diversion or releases of radiation (both purposeful and accidental) and against which no adequate safeguards have been proposed by Applicants or Staff.

d) Acts of sabotage or terrorism could be the initiating cause for CDAs or other severe CRBR accidents and the probability of such acts occurring has not been analyzed in predicting the probability of a CDA.

Contention 6(b)(4) states:

The impact of an act of sabotage, terrorism or theft directed against the plutonium in the CRBR fuel cycle, including the plant, is inadequately assessed, [as] is the impact of various measures intended to be used to prevent sabotage, theft or diversion.

B. The CRBR, Its Fuel Cycle, and the Risks of Diversion and Sabotage

Q5. Will there be substantial quantities of plutonium associated with the CRBR and related fuel cycle facilities?

A5. There will be substantial quantities of plutonium at the site of the CRBR and at related fuel cycle facilities.

The Staff projects that the CRBR itself will have an initial loading of approximately 1.7 metric tons of plutonium. DEISS at D-2. Over its lifetime, its total plutonium requirement may be as high as 27 metric tons. At equilibrium, the Staff projects it will utilize approximately .9 metric tons of plutonium in its fuel and blanket assemblies

per year, discharging spent fuel elements containing approximately 1000 kilograms of plutonium per year, DEISS at D-6, of which more than 97% may be recoverable. (Staff Answers to Intervenor's 27th Set of Interrogatories, Oct. 1, 1982, at 5-7.)

Whatever the eventual configuration of the CRBR fuel cycle, similar quantities of plutonium will be found at fuel cycle facilities. The proposed SAF (fabrication) line for the Fuels and Materials Examination Facility (the "FMEF"), for example, is projected to have a capacity of handling approximately 900 kilograms of plutonium per year for the CRBR, or 22% of SAF's projected 4 MTPu/yr capacity (DEISS at D-10). In the proposed Developmental Reprocessing Plant (the "DRP"), the projected nominal throughput is 500 kilograms of heavy metal per day or approximately 150 metric tons per year, of which approximately 8% would be allocated to the CRBR fuel cycle (DEISS at D-1^F3¹³).

Q6. How do the amounts involved compare to the Commission's criterion of "safeguards significance"?

A6. Any amount larger of plutonium than 2 kilograms is a "formula quantity" as defined under 10 CFR §73.2(bb). A formula quantity is a threshold criterion for "safeguards significance," triggering safeguards requirements under the Commission's regulations, 10 CFR pt. 73. One formula

quantity is less than that generally considered necessary to construct a clandestine fission explosive ("CFE"). The "Gadget" tested at Alamogordo, New Mexico and FAT MAN, dropped on Nagasaki, Japan in 1945 were reported to have been constructed with approximately 6.1 Kg of plutonium. Major General Leslie R. Groves, Memorandum for the Secretary of War, 18 July 1945. A CFE could be constructed with one to two times this amount. A high technology nuclear weapon could be made with less than 6 kilograms.

Q7. Is the plutonium which would be found at the CRBR and its supporting fuel cycle facilities weapons-usable?

A7. "It is theoretically possible that a nuclear device could be made directly from fresh LMFBR fuel without the need for chemical separation...." DOE, Nuclear Proliferation and Civilian Nuclear Power (NASAP Report) DOE/NE-0001/2, June 1980, Vol. II, p. 2-43. Once diverted, the plutonium could be turned into a CFE in a matter of weeks or less, depending on the degree of expertise and preparation. Applicants themselves recognize, "A crude CFE could be designed and constructed by a small group of people (perhaps one), none of whom has ever had access to the classified literature, without necessarily using a great deal of technological equipment or conducting any experiments." Applicants' Response to Intervenor's Sixteenth Set of Interrogatories, April 1, 1982, at 10. In my judgment, a CFE or plutonium dispersal device

could be created using equipment, supplies and techniques that would be available in many university chemistry departments, or if the equipment or supplies are not immediately available, it could be obtained commercially or built from scratch at a cost less than \$10,000. In this sense, fresh CRBR mixed oxide fuel is "easily usable" as a crude nuclear weapon.

Q8. Could you describe a plutonium dispersal device that would be fabricated by a terrorist or a saboteur?

A8. A plutonium dispersal device that could be fabricated by a terrorist or saboteur might only involve a few tens of grams, more or less, of mixed oxide fuel. It could be used to produce cancers (principally lung) in humans, and it could be used to contaminate buildings, large areas of land, etc. Such devices have been designed and used for bacteriological and chemical warfare purposes and for research associated with inhalation hazards of material such as plutonium toxicity in research laboratories. See Dr. T. B. Taylor, et al., Utility of Strategic Nuclear Materials for Unauthorized Purposes, (a study by IR&T for the Commission) (draft final report, October 16, 1975).

Q9. Is it possible that plutonium could be diverted from the CRBR and its supporting fuel cycle facilities for

purposes of constructing a CFE or plutonium dispersal device?

A9. Diversion of plutonium from the CRBR and/or its supporting fuel cycle facilities is certainly possible, in the sense of it not being impossible. At least three scenarios can be hypothesized:

(1) The Staff considers a conspiracy between [CLASSIFIED] insiders to constitute a credible threat for diversion. [CLASSIFIED REFERENCE.] Applicants have admitted that two people acting in collusion might be able to divert plutonium from a CRBR bulk handling facility. See Deposition of Edward Penico, et al., June 16, 1982, at 15 (Witness Katz) (hereinafter cited as "DOE Dep."). Further, the Staff is forced to admit that more than [CLASSIFIED] insiders could constitute a credible threat. [CLASSIFIED REFERENCE.] And other experts agree that conspiracies of more than two persons can't be ruled out. See paragraph 2, below, referring to collusion between insiders and outsiders.

(2) Under current safeguards, an armed attack by more than from 6 to 8 highly motivated, well-trained outsiders, possibly aided by one to three insiders, when the attack force is armed with modern weapons that can be obtained illegally from military arsenals (i.e., automatic rifles, machine guns, grenades, small calibre anti-aircraft weapons,

heat-seeking missiles, anti-tank weapons, etc.), and perhaps including air support, might be able successfully to take substantial quantities of plutonium, i.e. 20 to 100 kgs, offsite. See generally, DeLeon, Jenkins, Kellen, and Krofcheck, Attributes of Potential Criminal Adversaries of U.S. Nuclear Programs (Rand, February 1978) (postulating a twenty-person force in collusion with ~~two or more insiders~~ *inside assistants*). The Department of Defense apparently recognizes this threat, whereas, as far as appears from their regulations, neither DOE nor the Commission does. See Letter, dated February 19, 1980, from the General Accounting Office to Senator John Glenn (B-197548), entitled "Assessment of Various Aspects of this Nation's Nuclear Safeguards Programs" (EMD-80-48). I have attached as Exhibit 3 to this testimony an outline, dated April 13, 1978, of what I consider to be credible external threats to nuclear facilities, including the CRBR and its supporting fuel cycle.

(3) While the Commission believes that, after irradiation, the fuel for the CRBR will be "self-protecting" against theft due to its radioactivity, the hypothetical possibility of theft of a irradiated fuel cannot be dismissed. To the extent there is water transport of irradiated fuel over the open ocean, hijacking and subsequent diversion to a national government for reprocessing cannot be ruled out. See Letter, dated February 21, 1979, from DOE to this witness, with enclosures (attached as Exhibit 4).

Q10. Is it also possible that sabotage or terrorism could be the initiating cause for CDAs or other severe CRBR accidents?

A10. Sabotage of the CRBR could be the initiating cause for CDAs or other severe CRBR accidents. While Applicants believe that this is "highly improbable", they nonetheless admit that it is "possible". DOE Dep. at 40-41, 43, 44 (Witness Penico); see also Applicants' Updated Answers to Intervenor's Seventh Set of Interrogatories, dated April 30, 1982, at AB-116; Applicants' Updated Response #3 to Intervenor's Request for Admissions, dated April 30, 1982, at AC-45. For its part, the Staff also admits that radiological sabotage by a single person, including an insider, is possible. Staff Updated Answers to Intervenor's Request for Admissions of Aug. 13, 1976, April 28, 1982, at 5. See also the Staff's treatment of sabotage in evaluating Class 9 accidents. DEISS at J-18. In 1977, in connection with its development of design threat levels for use in regulating the protection of nuclear power reactors against sabotage, the Commission recognized that sabotage is a possibility. As stated in a memorandum of January 9, 1977, from Robert B. Minogue, Director, Office of Standards Development, to Ben Huberman, Director, Office of Policy Evaluation, "Nuclear power plants are vulnerable to acts of sabotage by a single individual with sufficient personal knowledge or direction and with uncontrolled or unlimited access to vital areas." Id. at 18.

In admitting that it cannot quantify the probability of successful acts of sabotage, the Staff has implicitly recognized that the probability is greater than zero. See Updates to Staff Admissions Dated Sept. 16, 1976 (dated April 28, 1982) at 7. At least two scenarios involving sabotage may be postulated. One is that referred to in Answer A.9., that is, a substantial-sized attack force overcoming the CRBR guard force and causing a LOF-initiated CDA. A second would involve collusion of several insiders.

Q11. In referring to "other severe CRBR accidents", what do you mean?

A11. Sodium fires are one distinct possibility. Such fires could be initiated by intentional rupture at sodium storage tanks or reactor systems containing sodium, e.g., steam generators.

Q12. In reaching the judgment that theft or sabotage at the CRBR and its supporting fuel cycle facilities is "possible", do you rely on any empirical evidence?

A12. There is empirical evidence supporting the conclusion that successful theft or sabotage is credible. This evidence includes possible theft at the NUMEC plant, see Office of the Inspector General, NRC, Inquiry Into the Testimony of the Executive Director for Operations (Feb.,

1978); Fialka, "The American Connection: How Israel Got the Bomb," The Washington Monthly, Jan., 1979, at 50; Burnham, "The Case of the Missing Uranium," The Atlantic, Apr. 1979, at 78; 125 Cong. Rec. S.5736-51 (May 14, 1979); possible theft of uranium at Wilmington, N.C. in January, 1979, see 125 Cong. Rec. H.9219 (Oct. 16, 1979); sabotage of VEPCO Surry reactors, see Commonwealth of Virginia v. William E. Kurkendall and James A. Merrill, Jr., Circuit Court, County of Surry (circa 1980); sabotage of components for the Iraqi reactor while under fabrication in France, see Newsweek, 6/18/81, at 25; and actions of Basque terrorists directed against Spanish nuclear facilities. See Energy Daily, 4/10/78; Nucleonics Week, 3/22/78. For a listing of attacks and/or physical security breaches at nuclear facilities from 1966 through 1979, see GAO, Obstacles to U.S. Ability to Control and Track Weapons-Grade Uranium Supplied Abroad 64-67 (ID-82-21, August 2, 1982).

Q13. In considering whether diversion or sabotage is credible, do you take into account current Commission regulations?

A13. In assessing the probability of an act of theft or sabotage, I do take into account current Commission regulations. It is my judgment, that, in certain respects, the Commission regulations may be inadequate. For example, with respect to acts of sabotage, under 10 CFR §73.1(a)(1) the

possibility of an internal conspiracy of more than one insider is not included. See Commonwealth of Virginia v. William E. Kurkendall and James A. Merrill, Jr., Circuit Court, Surry County, Virginia (circa 1980). As for the design basis threat for acts of theft under 10 CFR §73.1(a)(2), the definition excludes collusion ^{among} ~~of~~ more than ~~one~~ ^{the external threat} insider. Further, ~~it~~ does not appear to include the use of suitable weapons larger than handheld weapons, e.g., rocket launchers, and groups larger than small, e.g., ten to twelve, even though such factors, as pointed out in my answer A.9 are credible and the Department of Defense takes such threats into account when establishing its threat levels.

Q14. Is there particular reason to believe that the CRBR and its supporting fuel cycle facilities are high-risk targets for terrorists?

A14. In my judgment, the CRBR and its supporting fuel cycle facilities are higher risk targets than conventional nuclear facilities. First, the plutonium used in the CRBR (particularly the initial loadings of fresh fuel from DOE inventories, if available, and plutonium generated in the CRBR blanket) represents a preferred material for the construction of atomic bombs, as opposed to material that would be extracted from high burnup fuel in conventional lightwater reactors. This is admitted by Applicants and Staff. Applicants' Updated Responses to Intervenors' Request

for Admissions of August 13, 1976, (April 30, 1982) at 17; NRC Dep. at 64 (Witness Jones). Second, the CRBR will involve the first commercial demonstration use of plutonium in the United States. As such, it has both high visibility and a symbolic importance. In such circumstances, the likelihood of threat should increase. This likelihood is borne out by the fact that the Super-Phenix LMFBR facility in France has been the subject of an attack. See The Washington Post, January 20, 1982, at A16.

C. Consequences of Diversion and Sabotage

Q15. If small quantities of plutonium were converted into a nuclear bomb or plutonium dispersion device, what consequences might result?

A15. Small quantities of plutonium, if converted into a nuclear bomb or plutonium dispersion device, could cause widespread death and destruction. By "small quantities," I mean, in terms of bomb size, approximately four to ten kilograms, and, in terms of a dispersion device, less than one kilogram of plutonium. "Widespread death" means anywhere within the range of 100 to 100,000 people killed.

"Widespread destruction", in terms of bomb effects, means something comparable to 0.1 to ten times the destruction experienced at Nagasaki with the detonation of a plutonium device. In addition, plutonium dispersion could result in

widespread contamination, the clean-up of which could be extremely costly, i.e., several hundred million dollars. The effects of nuclear explosives are generally described in U.S. AEC, The Effects of Nuclear Weapons (Glasstone, ed., April, 1962, and subsequent editions). The possible consequences of CFE's and plutonium dispersion devices are described in: Kaul, Estimation of Consequences of Adversary Actions in the Nuclear Power Fuel Cycle (Brookhaven National Laboratory, October 11, 1976); NRC, Division of Safeguards, Office of Nuclear Material Safety and Standards, Safeguarding a Domestic Mixed Oxide Industry Against a Hypothetical Subnational Threat (NUREG-0414, May 1978). There is no question that the effects of these malevolent acts are severe or even catastrophic, NUREG-0414, supra, at 3-35. Indeed, the Staff takes the general position that such consequences are "unacceptable". Staff Updated Responses to Intervenors' Request for Admissions of September 16, 1976, dated April 29, 1982, at 5.

Q16. In hypothesizing a CFE constructed with diverted plutonium from the CRBR and its supporting fuel cycle facilities, what size yield would you consider to be a possibility?

A16. Various size explosives are imaginable. The Staff concedes that construction of a CFE with the equivalent yield of either 100 tons of TNT or 1,000 tons of TNT is a possibility following a successful theft. See Staff's Updated

Response to Intervenor's Request for Admissions of September 16, 1976, dated April 28, 1982, at 7, 8.

Q17. What is your basis for believing that the hazards of a CFE or plutonium dispersal device could be severe?

A17. Obviously the detonation of an explosion of 1000 tons of TNT equivalent is going to have severe effects, both in terms of immediate physical destruction and radiation health hazards. With respect to consequences of plutonium dispersal, it should be noted that the Commission Staff admits that plutonium is toxic and would have serious consequences if dispersed. Staff's Updated Responses to Intervenor's Request for Admissions of September 16, 1976 (April 29, 1982), at 4. In addition, there is much support for a conclusion that the plutonium dispersal hazard is severe. This includes:

- i) The Commission's own regulations prescribing permissible concentrations of plutonium in the air and water in the environment (10 CFR pt. 20 Appendix B) and EPA's "Proposed Guidance on Dose Limits for Persons Exposed to Transuranium Elements in the General Environment," EPA 520/4-77-016, Sept. 1977, which demonstrate that plutonium isotopes are considered among the most toxic radioisotopes;

ii) Morgan's analysis of the risk of plutonium exposure of the bone (Tr. 3139-3142, Morgan);

iii) The work of Martell, et. al. related to polonium exposure of cigarette smokers (Tr. 3083, Cochran); and

v) Theodore B. Taylor, et al., Utility of Strategic Nuclear Materials for Unauthorized Purposes, supra.

DOE (and other government agencies) have made numerous studies of a) the hazards of plutonium dispersal, primarily in relation to single point detonations of nuclear weapons, and nuclear weapons accidents, cf. Langham, et al., Plutonium Dispersal by Accidental or Experimental Low-Order Detonation of Atomic Weapons (LA-1981 Rev. Feb. 1966); and b) efforts required to decontaminate areas such as Enewetak Atoll. Cf. Defense Nuclear Agency, The Radiological Cleanup of Enewetak Atoll (1981).

Q18. In addition to environmental and health effects, are there other consequences which could flow from the successful theft of plutonium at the CRBR and supporting fuel cycle facilities?

A18. The consequences of a successful theft of plutonium from the CRBR or its supporting fuel cycle facilities are not just physical. The Commission, in NUREG-0414, supra,

Chapter 7, outlines in some detail possible restrictions on civil liberties which could flow from such an event. See also NRDC's Comments in the 1977 FES at A-79 -- A-80. Applicants have conceded that search without warrant might occur; that widespread searches could conceivably take place; that arrests might be made without warrant; and that marshall law could even be imposed. See Applicants' Updated Responses to Intervenors' Request for Admissions of August 13, 1976, April 30, 1982, at 14, 15.

Q19. Would the consequences of a postulated act of sabotage be substantially less than the maximum consequences predicted for a CDA?

A19. The consequences of a postulated act of sabotage would not necessarily be substantially less than the maximum consequences predicted for CDA. To the contrary, by careful planning, saboteurs might even be able to produce an event of greater consequence, for example, by insuring there were large breaches in the primary and secondary containment barriers.

D. The Failures of Applicants' and Staff's Safeguards Analysis

Q21. In your judgment, has the Staff had before it sufficient facts to support its analysis of safeguards risks and consequences at the CRBR and its supporting fuel cycle?

A21. I do not believe there is sufficient information in the record to support the Staff's conclusions regarding the adequacy of safeguards at the CRBR and its supporting fuel cycle. The analysis undertaken by Applicants in the ER and by the Staff in the DEISS is essentially hypothetical and conjectural, because there are so many unknowns with respect to the future CRBR fuel cycle. Essentially both Applicants and Staff are speculating as to what systems may or may not be in place ten years hence and how effective they may be. Several examples demonstrate the point. "[T]he exact location and design of the conversion process are not determined at this time." ER 5.7-42. Further, while Applicants believe that fuel will likely be reprocessed at the DRP, this is not necessarily the case, and reprocessing could take place at DOE's Savannah River Plant, at its Purex Plant in Hanford, Washington, or at a small facility that would be built into the FMEF. See NRC Dep. at 111-112 (Witness Hurt). Each of these plants has (or likely would have) markedly different characteristics compared to the proposed DRP, yet the only analysis carried out by the Commission Staff has been with

respect to the DRP. The Staff cannot answer whether figures theoretically achievable at the DRP are "technically reasonable" for other alternatives. NRC Dep. at 116 (Witness Hurt). Even as DRP, "only very preliminary design information is available". Letter, dated March 24, 1982, from John Longenecker to Paul Check at 3. No site has even been selected for the DRP. DOE Dep. at 50 (Witness Yarbrow). In addition, no information whatsoever is available at this time with respect to transportation routes for fresh fuel or irradiated fuel, Applicants' Updated Answers to Intervenor's Eighth Set of Interrogatories, dated April 30, 1982 at 12, 13, and, there is no information with respect to the identity, location, complement or equipment of ground forces that would respond in the case of an emergency during transport. Staff's Updated Answers to Intervenor's Twelfth Set of Interrogatories, dated April 30, 1982 at 2, showing "still applicable and need(ing) no updating", Staff's Response to Intervenor's Twelfth Set of Interrogatories, dated Nov. 15, 1976 at 23, 24. Finally, at the CRBR site itself, the Staff has not reviewed any detailed security or contingency plans, and, indeed, the identity, location, complement and equipment of ground forces have not been specified by Applicants. Staff's Updated Answers to Intervenor's Twelfth Set of Interrogatories, April 30, 1982, at 10.

Q22. With respect to reprocessing of CRBR fuel, in particular, are there any specific problems caused by the lack of detail?

A22. The entire approach of both the Applicants and the Staff to reprocessing for the CRBR leaves the record in an utter state of confusion. While Applicants have indicated that reprocessing could take place elsewhere, Applicants have only provided information with respect to the DRP. NRC Dep. at 112 (Witness Hurt). And, the Staff itself has admitted that it does not know whether projected DRP performance is technically feasible for other possible facilities. NRC Dep. at 116 (Witness Hurt). In point of fact, the Staff has no facts whatsoever with respect to such other facilities. Id. at 119 (Witness Hurt). In such circumstances, any conclusions at all with respect to CRBR reprocessing are cast in doubt. But, even assuming that one were dealing with the DRP only, design is so preliminary that Applicants themselves cannot answer the question whether the DRP would provide assurance against a threat of ten to twelve armed individuals or even some lower threat (i.e., six to eight). DOE Dep. at 17-18 (Witness Katz).

Q23. In addition to informational deficiencies, are there any deficiencies in the criteria which the Staff has used in assessing DOE's proposed safeguards?

A23. In my judgment, there are serious deficiencies in the Staff's safeguards criteria. The Staff has adopted three criteria:

1. Do DOE's proposed safeguards systems provide a potential for deterring attempts at theft or diversion of plutonium and attempts at sabotage of facilities or materials to be used in the CRBR fuel cycle?

2. Are DOE's proposed safeguards systems likely to detect attempts at sabotage, theft, or diversion?

3. Do DOE's proposed systems for responding to attempted theft, diversion, or sabotage provide reasonable assurance that such attempts would not be successful?

DEISS at E-1. These criteria, however, are insufficient under the Commission's own safeguards standards. DOE's and the Commission's safeguards objectives are to provide "high assurance" against diversion. See, e.g., ER-5.7-37; Staff's Updated Answers to Intervenors' Sixth Set of Interrogatories, April 26, 1982, at 1. Detection with "high assurance" is defined by the Staff to mean a detection probability of 90% or more. NRC, Office of Nuclear Material Safety and Safeguards, Report of the Material Control and Material Accounting Task Force S-12 (NUREG-0450, April 1978). DOE has also stated that the goal of the system is to detect diversion attempts "in time to interrupt them." Applicants' Updated Answers to Intervenors' Eighth Set of Interrogatories, dated April 30, 1982 at 36. The criteria applied by the Commission, however, merely call for conclusions with respect to

the "potential" of the system for deterrence, the "likelihood" that attempts will be detected, and "reasonable assurance" that acts would not be successful. The Staff has admitted that a chain link fence and one guard would meet criterion 1. NRC Dep. at 44 (Witness Dube). This is not at all the same thing as "high assurance". Criterion 2 above is the only criterion that bears any relationship to the adequacy of material accounting, which plays the primary safeguards role in accurate assessment of losses or alleged losses. However, this criterion gives no measure of the accuracy of material accounting that must be achieved. But despite their manifest deficiencies, these three criteria were the only criteria used by the Commission Staff in making its judgments. NRC Dep. at 42, 43, 46, 47 (Witness Dube).

Q24. In your judgment has there been an adequate, independent assessment of DOE's submissions by the Staff?

A24. In many cases, there has been no independent assessment whatsoever by the Staff of DOE's submissions. When DOE states, for example, that the LEMUF at the conversion facility will be .5 kg per week, ER-5.7-43, the fuel fabrication facility will be able to detect a diversion of 3 kg. of plutonium per year, ER-5.7-44, or that the DRP will have a LEMUF of 1.4% of throughput per week and .8% per month, ER-5.7-57, these figures are simply accepted by the Commission's Staff at face value. Likewise, the limits of error asserted by DOE

are assumed to be correct. The Staff has not even attempted to attach confidence levels to the figures provided by DOE. NRC Dep. at 144 (Witness Dube). Further, on such critical questions as nuclear weapons technology, i.e., how might a subnational group fashion a CFE out of diverted plutonium and what might the yield be, the Commission Staff defers completely to DOE. See Staff's Updated Responses to Intervenor's Requests for Admissions of September 16, 1976, dated April 29, 1982 at 3. Finally, while apparently the Commission Staff did have a contractor analyze the submissions of DOE concerning the costs of safeguards, the Staff did not double check the contractor's analysis. See NRC Dep. at 141 (Witness Dube).

Q25. Is there any justification for not going beyond DOE's submissions?

A25. I don't believe that the Staff has a valid rationale for limiting its analysis. It has stated simply that it is "not necessary" or "not reasonable" for it to go beyond the information it has. See, e.g., NRC Dep. at 46 (Witness Dube); Staff Answers to Intervenor's Twenty-third Set of Interrogatories, April 26, 1982, at 2. However, no underlying reasoning for these conclusions has been presented.

Q26. Are there additional analytical steps the Staff might have taken?

A26. There are several steps the Staff might have undertaken but didn't.

First, it could have looked at safeguards records at existing facilities and assessed DOE's assertions against current problems. This would have made particular sense in this proceeding, since reprocessing, for example, may take place at either Savannah River or Hanford. Moreover, the Purex plant site at Hanford is the only candidate identified for plutonium conversion. Yet none of the Staff's safeguards experts is familiar with these existing facilities, NRC Dep. at 84, 116, and no information was developed by the Staff concerning current regulatory compliance by DOE. NRC Dep. at 51-52 (Witness Hurt).

Second, it could have examined various critiques of existing safeguards at DOE facilities which have been prepared by the General Accounting Office. These critiques are numerous, e.g.:

- "Improvements Needed in the Programs for the Protection of Special Nuclear Material" (11/7/73)
- "Protecting Special Nuclear Material In Transit: Improvement Made and Existing Problems" (4/12/74)

- "Shortcomings in the Systems Used to Control and Protect Highly Dangerous Nuclear Material" (7/22/76)
- "Safety and Transportation Safeguards at Rocky Flats Nuclear Weapons Plant" (1/11/77)
- Letter to Chairman, John Dingell, U.S. House of Representatives, Re: unaccounted for nuclear material (5/5/78)
- "States of Physical Security Improvements to ERDA Special Nuclear Material Facilities" (9/8/77)
- "Federal Actions are Needed to Improve Safety and Security of Nuclear Materials Transportation" (5/7/79)
- "U.S. Nuclear Safeguards -- A National Strategy is Needed" (2/19/80)
- "Nuclear Fuel Reprocessing and the Problems of Safeguarding Against the Spread of Nuclear Weapons" (3/18/80)
- Letter to Rep. Tim Wirth, Re: Alleged missing material from DOE's Rocky Flats weapons production plant (10/1/80)
- "Nuclear Diversion in the U.S.? 13 Years of Contradiction and Confusion" (12/18/78)

Yet the Staff did not rely on or refer to them in its assessment of DOE safeguards. NRC Dep. at 57 (Witness Dube).

Third, in conducting its safeguards analysis, the Staff only assumed "current conditions", NRC Dep. at 80 (Witness Jones), and its approach was simply to judge the safeguards proposed by DOE against existing regulatory requirements such as those found in 10 CFR Part 73. See Staff's Updated Answers to Intervenors' Sixth Set of Interrogatories,

April 29, 1982, at 5. In other words, the Commission Staff did not analyze the extent to which proposed safeguards would meet threats different than those specified. NRC Dep. at 78 (Witness Dube). This results in ignoring "residual risks," and is particularly questionable at the present time, when the Commission is considering upgrading its MC&A rules for some facilities. See 46 Fed. Reg. 45144 (Sept. 10, 1981).

Fourth, in my judgment, for purposes of its environmental analysis, the Staff can look and should have looked at how the system would respond to changes in threat levels.

Fifth, the Staff could have examined all reasonably likely CRBR fuel cycles instead of just considering the alternatives submitted by Applicants. It did not. DEISS at E-2; NRC Dep. at 88 (Witness Hurt). Thus, even though other facilities might well be used in the fuel cycle, i.e., Savannah River rather than the DRP, the Staff ignored the real risks associated with those alternatives. Indeed, by focusing on the DRP, a "model" facility, it effectively only considered a "best case" for purposes of assessing safeguards effectiveness. In my judgment, this was unwarranted and misleading.

Q27. Are there particular reasons for believing that the safeguards analysis with respect to the DRP is flawed?

A27. The DEISS simply makes a leap of faith to conclude that future safeguards will be effective. It states:

The MC&A system for this facility is expected to be designed to assure that plutonium losses or diversion would be detected in a timely manner. To achieve the accountability measurement capability stated by DOE would require a sophisticated MC&A system with a level of performance not yet demonstrated in a larger reprocessing plant. However, significant progress in MC&A technology has been made through research and development on reprocessing safeguards. Thus, the staff believes that, in the time frame of design and construction of the DRP, the safeguards system, as described by the DOE, can meet the assessment criteria.

DEISS at E-13. In my judgment, one cannot so easily leap from an undemonstrated technology through R&D to a system that can meet even the Staff's limited assessment criteria. Indeed, there is substantial evidence to the contrary. Adequate protective measures may not in fact be available or developed in the foreseeable future. As stated by the General Accounting Office in its report, Nuclear Fuel Reprocessing and the Problems of Safeguarding Against the Spread of Nuclear Weapons (EMD-80-38) (March 18, 1980), at 10:

While the upgrade work may improve the safeguards effectiveness at these [reprocessing] facilities, it is uncertain how much the diversion risks will be reduced. DOE has not identified the limitations of existing safeguards systems or developed an approach to provide for as much safeguards protection as may be needed.

Q28. How do you assess the Staff's approach to determining that there would be future compliance by DOE with its safeguards criteria?

A28. ~~The word "approach" is something of a misnomer; the~~ Staff just seems to have made a horseback judgment. In fact, there are at least two major flaws in its "approach." First, it did not, as noted earlier, look at current compliance and attempt to project future compliance based on present, empirical experience. In fact, questions have been raised with respect to the adequacy of DOE's compliance with its current safeguards requirements. See GAO reports cited in my Answer A25. Most recently, it has been reported that, in a "black hat" exercise, seven counter-terrorist experts were able to demonstrate the lack of effectiveness of physical security at DOE's Savannah River nuclear weapons plant. Albright, "Crashing A Nuclear Plant," Atlanta Constitution, October 3, 1982, at 1A. If these problems exist today, it cannot be concluded that similar or greater problems will not exist in ~~the future.~~ Second, it did not endeavor to develop any specific criteria to assess the prospects of future compliance. A "commitment" to comply was deemed satisfactory. In my judgment, specific criteria taking into account past experience, possible threat level changes and the like should have been developed and applied in this assessment.

Q29. In your judgment, has the Staff properly assessed safeguards costs?

A29. No. The costs which the Staff looks at and presents in the DEISS are simply initial investment, plus annual operating costs at current levels of safeguards. See letter, dated March 24, 1982, from John Longenecker to Paul Check. It does not assign any dollar costs to socio-economic effects of safeguards, NRC Dep. at 138 (Witness Hurt). In my judgment, these are fundamental deficiencies. Significant safeguards upgrades, coupled with possible civil liberties restrictions, see, e.g., Ayres "Policing Plutonium: The Civil Liberties Fallout," 10 Harv. Civ. Lib. L. Rev. 369 (1975), must be taken into account. Further, safeguards failure, followed by a successful CFE detonation or disposition of a plutonium dispersal device, must be factored into the analysis. Finally, the costs used are based upon assumptions with respect to threat levels which may be proved wrong in the future, and there is no analysis of costs under potentially different future scenarios. In order to understand the true costs of the CRBR and its supporting fuel cycle facilities, all relevant costs -- technical, economic, social and environmental -- must be taken into account by the agency. This simply has not been done, and thus the costs of safeguards, as set out in the DEISS, cannot be considered complete or realistic.

Q30. Could construction and operation of the CRBR and its supporting fuel cycle have an impact on nuclear proliferation?

A30. ~~One important omission of the Commission in its~~ analysis is its refusal to regard the construction and operation of the CRBR as impacting on proliferation problems. See Staff's Answers to Intervenors' Twentieth Set of Interrogatories, dated April 30, 1982, at 46. As pointed out by Dr. Theodore Taylor during the Commission's July 29, 1982 hearing on Applicant's Section 50.12 exemption request, see Transcript of July 29, 1982 hearing, at 205-210, the construction and operation of this plant may well stimulate breeder development elsewhere and, as a consequence, exacerbate proliferation risks. See also Letter, dated January 13, 1982, from ~~Frank von Hippel of Princeton University to the Commission.~~

E. Safeguards Systems Failure.

Q31. In addition to the failures of analysis just outlined, do you also believe that there are failures in the proposed safeguards systems themselves?

A31. I believe that there are a number of failures in the proposed safeguards systems for the CRBR and its supporting fuel cycle facilities. They are as follows:

(1) Current Commission material accounting practices are fundamentally flawed. The Staff indeed concludes that the timeliness of detection depends entirely on physical security, NRC Dep. at 104 (Witness Dube), i.e., that MC&A standing alone won't do the job, and DOE as well appears to be of the view that MC&A and physical security need not be independently effective. DOE Dep. at 14 (Witness Katz). These flaws cannot be offset by enhancing physical security, and, considering physical security separately, the design basis threat cannot be justified. I have set forth these views extensively in testimony submitted in the NFS-Erwin proceeding (Docket No. 70-143). A copy of my testimony at that proceeding, dated October 12, 1982, at pages 28-37, in which I explain the basis for these conclusions, is attached as Exhibit 5. In my judgment, the same failures which affect the Erwin facility also affect the CRBR and its supporting fuel cycle.

(2) The Commission exercises no regulatory authority over DOE's fuel cycle facilities, NRC Dep. at 50 (Witness Dube), and it has no real assurance that safeguards will be applied at such facilities or that, if applied, they will be effective. The Staff has no knowledge at this time whether DOE meets its own standards, NRC Dep. at 72 (Witness Jones); admits that it is "possible" that current safeguards don't meet current regulations at some CRBR fuel cycle facilities, NRC Dep. at 35 (Witness Dube); and concedes that, if DOE commitments relative to fuel cycle safeguards are not imple-

mented, there is nothing the Commission can do about it. NRC Dep. at 134 (Witness Dube). The Staff in fact does not even have criteria for concluding that there is a reasonable assurance that DOE will comply with applicable safeguards regulations. NRC Dep. at 46-47 (Witness Dube). In reaching the conclusion that DOE will comply with its own orders, the Staff has simply accepted DOE's "commitments". NRC Dep. at 48 (Witness Dube). The entire safeguards system upon which which the Staff pins its reliance, therefore, is nothing more than a handshake and a hypothetical to which no particular probabilities have been (or perhaps can be) attached. But, given the history of safeguards problems, see Answers A.26 and A.28, above, it is difficult to be sanguine about prospects for effective safeguarding.

(3) There are good reasons to believe that certain of these hypothetical "commitments" will not be realized. This is particularly the case with respect to material accounting at the CRBR reprocessing facility. As noted above, the General Accounting Office has questioned the effectiveness of current systems and expressed doubt as to how much diversion risks can be reduced by improved safeguards. GAO, Nuclear Fuel Reprocessing and the Problems of Safeguarding Against the Spread of Nuclear Weapons 10 (EMD-80-38, March 18, 1980). In its words:

Safeguards systems used by DOE at Federal reprocessing plants cannot assure that diversions of weapons-usable material for non-authorized purposes can be detected in a timely manner. Diversion or theft of materials sufficient to construct a nuclear weapon is possible and could go undetected.

- Material control and accountability systems are unable to account for weapons-usable material in a timely manner.
- Physical security systems cannot assure the theft of weapons-usable material will be prevented.

Id. Projected LEMUFs, i.e., 1.4% of throughput per week at the DRP, may or may not be able to be realized. ER 5.7-⁵⁷~~58~~. It has been projected, for example, that 2% a week is the best that might be achieved, McSweeney, et al., Improved Material Accounting for Plutonium Processing Facilities and a 235U-HTGR Fuel Fabrication Facility (Battelle Pacific Northwest Laboratories, October, 1975), and the Staff at some points has suggested 2% may be more accurate, NRC Dep. at 130 (Witness Hurt), DEISS at E-12, but, in any event, there is substantial uncertainty about just what levels of performance any system can achieve. See generally IAEA, International Working Group on Reprocessing Plant Safeguards, Overview Report to the Director General of the IAEA International Working Group 86-102 (Sept. 1981). Moreover, even if the 1.4% level could be achieved, it may not be adequate. The IAEA Working Group has suggested that, assuming surveillance and containment were improved over today's levels and near

real-time accountancy instituted, long-term diversion would still remain a problem:

For large scale facilities the abrupt diversion guidelines could probably be met; however, problems still existed meeting the protracted diversion guidelines for plutonium accountability in the main process MBA.

11. at 89.

The physical security and material control systems must be capable of promptly detecting the diversion of a formula quantity of SNM (2 Kg Pu). Material accounting, i.e. a material balance based on measured physical inventory, provides the only means for assuring that the physical protection and material control systems are effective and that no significant losses or diversions have gone undetected. Consequently, material accounting must achieve confidence limits on inventories that are comparable to or smaller than the requirements of the physical security material control system, i.e. detecting with high confidence the diversion of a formula quantity (2 kg Pu). But 1.4% of the DRP throughput exceeds the formula amount.

(4) The threat levels utilized by the Commission and DOE to determine safeguards design may be inadequate. They are based on "likely threats" rather than the "maximum credible threats." See NUREG-0414, supra, at 5-10. The problem with the "likely threat" approach is that it unjustifiably discounts larger threats. Intervenors, Staff

and Applicants all agree that one cannot reliably predict deliberate, malevolent human acts such as theft and sabotage. See Staff's Updated Answers to Intervenors' Fourteenth Set of Interrogatories, April 30, 1982, at 2; Applicants' Updated Answers to Intervenors' Seventh Set of Interrogatories, April 30, 1982 at AB-115. Several conclusions inescapably flow from this lack of predictive capability. First, it is impossible to rule out the potential for such acts occurring. Second, uncertainties in estimates of the probability of these acts occurring are such as to make probability estimates virtually irrelevant. Third, because the potential for theft and sabotage exists and probability estimates are not terribly useful, it is essential to design safeguards systems to protect against the "maximum credible threat" rather than just "likely threats." This is particularly true because it appears that "adversaries determine group size for a given action upon their perception of the number required to optimize the chance of success, consistent with security requirements and payoff." Stewart, et al., Generic Adversary Characteristics Summary Report 42 (NUREG-0459, March 1979). Failure to identify (and quantify) threats (including maximum threats) that various knowledgeable people would consider credible and to design the CRBR and its supporting fuel cycle to meet those threats means that there is not the "high degree of assurance" -- which both Staff and Applicants agree is necessary -- to prevent theft of plutonium or sabotage.

(5) Both DOE and the Staff recognize that there are "dynamic factors in society" which have implications for the level of safeguards required. Neither DOE nor the Staff believes that future threats can be reliably predicted. DOE Dep. at 38 (Witness Penico); NRC Dep. at 62, 76 (Witness Jones). They also admit the threat could be greater in the 1990's. NRC Dep. at 79 (Witness Jones). In such circumstances, it would appear necessary for both DOE and the Commission to have a system for continuing review for safeguard threats to take into account possible changes in the level of threat. However, while there are several disparate efforts, there is no truly systematic coordination to this end. Applicants' Answers to Intervenor's Seventeenth Set of Interrogatories, April 9, 1982, at 7-8; Staff Answers to Intervenor's Twenty-third Set of Interrogatories, April 26, 1982, at 2. In addition, there is no assurance that DOE and the Commission can respond with sufficient speed should threat levels change and an upgrade be needed. DOE suggests that a response to rapidly changing threats might take "a matter of months -- three to four months." DOE Dep. at 39 (Witness Penico). The Staff, based on past experience, has indicated that it may take several years to upgrade safeguards. NRC Dep. at 90-91 (Witnesses Jones and Dube). But whether an upgrade within that time frame would be rapid enough to counter the changed threats is problematical. In this regard, the intelligence community cannot provide the Commission or DOE with assurance of prior detection of

adversary groups unless group size becomes very large, i.e., "army" size. Mattson, et al., Task Force Report to the Commission on Allegations by James H. Conran 4-18, 19 (April 29, 1977). Applicants agree that threats cannot generally be identified before the action takes place for group sizes smaller than 9 or 10 people. DOE Dep. at 37 (Witness Penico).

(6) There are serious questions about the adequacy of guard forces. See generally General Accounting Office, Security at Nuclear Power Plants -- At Best Inadequate (EMD-77-32, April 7, 1977); Testimony of Monte Canfield before the Energy and Environment Subcommittee of the House Committee on Interior and Insular Affairs, 97th Cong., 1st Sess. (May 5, 1977). The human element is a major weakness in the current system. It is likely to remain so. But it is never addressed by the Staff or Applicants.

(7) Finally, the Commission simply may not have reliable data upon which to judge the effectiveness of MC&A. See letter, dated May 5, 1978, from Elmer Staats, U.S. Comptroller General, to Congressman John Dingell (EMD-78-58, B-157767). In other words, if the LEMUF at DOE facilities is higher than actually reported, no one will know anything about it, much less be able to do anything about it.

F. Concluding Question.

Q32. In light of the deficiencies of analysis and systems which you have outlined, what is your overall judgment as to both the risks to be encountered by the CRBR and its supporting fuel cycle facilities and the measures designed to overcome such risks?

A32. It is my judgment that the Staff and Applicants have substantially understated the risks and overstated the effectiveness of proposed safeguards. I cannot conclude, based on the evidence presented in the record to date, that there would be "high assurance" or even "reasonable assurance" that plutonium could be effectively safeguarded at the CRBR and its supporting fuel cycle facilities or that the proposed safeguards measures would otherwise meet the Commission's present or future regulatory requirements.

Before the
UNITED STATES NUCLEAR REGULATORY COMMISSION
ATOMIC SAFETY AND LICENSING BOARD
Washington, D.C. 20545

In the Matter of)
)
)

UNITED STATES DEPARTMENT OF ENERGY)
PROJECT MANAGEMENT CORPORATION)
TENNESSEE VALLEY AUTHORITY)


) Docket No. 50-537
)
)

(Clinch River Breeder Reactor Plant))
-----)

AFFIDAVIT OF DR. THOMAS B. COCHRAN

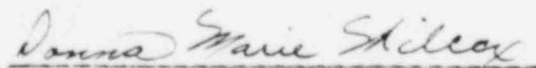
City of Washington)
) ss:
District of Columbia)

I, Dr. Thomas B. Cochran, being duly sworn, depose
and say that the foregoing testimony is true and correct to
the best of my knowledge and belief.



Dr. Thomas B. Cochran

Subscribed and sworn to
before me this 1st day of
November, 1982.



Notary Public

My Commission Expires July 31, 1987

respect to safeguards and security systems at the CRBR plant site, it refers the reader to the PSAR, Section 13.7. With respect to safeguards and security systems throughout the CRBR fuel cycle, it states, without analysis, that they are "expected to be effective in accounting for and protecting the SNM,". Id.

The PSAR, Section 13.7, is basically an outline of measures. To the extent there is any assessment of effectiveness of the system, it is purely conclusory. Thus, while the PSAR states that the physical security design will have certain effects, e.g., detection of unauthorized penetrations or apprehension in a timely manner of unauthorized persons, see PSAR, Section 13.7.2, the foundation for these conclusions is not presented, and no confidence levels are attached.

In the FES, the following "consequences" are inadequately considered:

- Section 7.3 - This section does not discuss the nature of the threat; does not explain how the threat levels are established which are used to judge the adequacy of physical security; does not set forth any basis for determining residual environmental risk; and ignores evidence of prior sabotage and theft. These inadequacies are reflected in the failure to consider and evaluate

theft at the NUMEC plant, see Office of the Inspector General, NRC, Inquiry Into the Testimony of the Executive Director for Operations (Feb., 1978); Fialka, "The American Connection: How Israel Got the Bomb," The Washington Monthly, Jan., 1978, at 50; Burnham, "The Case of the Missing Uranium," The Atlantic, Apr., 1979, at 78; 125 Cong. Rec. S.5736-51 (May 14, 1979); theft of uranium at Wilmington, N.C. in January, 1979, see 125 Cong. Rec. H.9219 (Oct. 16, 1979); sabotage of VEPCO Surry reactors, see Commonwealth of Virginia v. William E. Kurkendall and James A. Merrill, Jr., Circuit Court, County of Surry (circa 1980); sabotage of components for the Iraqi reactor while under fabrication in France, see Newsweek, 6/28/81, at 25; actions of Basque terrorists directed against Spanish nuclear facilities, see Energy Daily, 4/10/78; Nucleonics Week, 3/22/78; and the attack on the Super Phenix facility in France, see The Washington Post, 1/20/82, at A16. See generally, letter dated April 13, 1978, from Dr. Thomas Cochran to Senator John Glenn, Chairman, Subcommittee on Energy Nuclear Proliferation and Federal Services, Senate Committee on Governmental Affairs, with enclosures (copy attached at Tab A).

Further review and analysis of the following may result in the identification of additional incidents supporting Intervenors' conclusion: NRC, Preliminary Notification of Safeguards Events (through 1981); NRC, Summary Listings of Threats to Licensed Nuclear Facilities and Transport and Other Nuclear Threats (through 1981); DOE, Threats of Violence and Acts of Violence to Unlicensed Nuclear Facilities (through 1981).

The statement in the first paragraph on page 7-13 that "the NRC has no indication of any threat to domestic nuclear facilities that would endanger the public and safety", is inconsistent with the incidents cited, supra, pages 2-4, and our own analysis. See Tab A.

The statement in the first paragraph on page 7-14 that "historical evidence and current 'intelligence' fail to reveal any substantive threat" is factually incorrect. See incidents cited supra, pages 2-4.

The second paragraph on page 7-14 is no longer accurate because new NRC regulations have been issued. See 10 CFR pt. 73, as amended.

The third paragraph on page 7-14 is conclusory. It does not indicate what an adequate threat level would be, nor does it state what

additional requirements might be appropriate if threat levels changed. Finally, it does not mention that fuel cycle facilities may not be subject to NRC regulations.

- 7.3.1 - There is no explanation of the basis for the view that various functional elements will assure "effective implementation" of a safeguards program. Further, the discussion makes no reference to the fact that fuel facilities, at least initially, will not be subject to NRC regulatory requirements. Finally, this section does not describe residual risks, nor does it provide support for the proposition that residual risks would be minimal.

- 7.3.1.1 - Requirements summarized in Appendix E have been revised since release of the FES and consequently Appendix E must be updated.

7.3.2 - The statement that "compliance provides reasonable assurance that there will be no significant increase in the overall risk to the public from acts of sabotage, theft or diversion at a reactor site" is both vague and conclusory. No evidence is provided to support this statement. No effort is made to define what constitutes "reasonable assurance". Further, it is not clear

whether the phrase "reasonable assurance" reflects the current requirements of law. Lastly, the Staff does not indicate what a "significant" increase in risk would be.

- 7.3.2.1 - The conclusion in the first full paragraph on page 7-13 that acts of sabotage causing "substantial core damage and release of radioactive materials . . . while possible, are highly improbable" is vague. The basis for the judgment is not given, nor are any confidence levels attached to the judgment.

The statement in the carryover paragraph on page 7-16 that multiple barriers and backup safety systems "when combined with an appropriate safeguards program, provide adequate protection against the occurrence or effects of sabotage" is conclusory and unsupported. No definition is provided of an "appropriate" safeguards program. No effort is made to define what "adequate protection" is, or why, if it is the standard, chosen by the staff, it was so chosen and how it relates to other standards referred to in the FES, e.g., "reasonable assurance", "high level of protection".

The discussion of regulatory requirements in the second and third paragraphs on page 7-16 does not reflect changes in regulations. Threat levels referred to are no longer valid and have been upgraded. See 10 CFR §§ 73.1, 73.55, as amended.

The statement in the last paragraph on page 7-16 that technology and systems developed for current reactors can "in large part, be translated to the CRBRP" needs explanation. Are there elements that cannot be transferred? Does the possibility of initiating an explosion make the CRBR a more attractive target? Does the quantity of plutonium present at the CRBR make it a more attractive target?

The summary paragraph on page 7-17 is unjustified. No effort has been made to define what "minimal" means. Further, a determination cannot be made that a threat is "minimal" solely based upon absence of evidence "at this time". It is equally, if not more, important to determine what threat is likely to materialize in the future, see Mitre Corp., The Threat to Licensed Nuclear Facilities 91-97 (MTR-7022) (Sept. 1975), yet there is no discussion whatsoever of this issue.

- 7.3.2.2 - The discussion in this section sows confusion with respect to the kind of safeguards system the NRC Staff feels must be applied and the kind of assurance that system must provide. References in this section are to a "high degree" of protection, where as, elsewhere, as noted above, there are references to "reasonable protection" or "adequate protection".

The conclusion in the summary paragraph that "the potential environmental impacts due to theft or diversion of SNM from the CRBR site are minimal" is conclusory. The process by which the judgment is reached is not explained.

- 7.3.3 - Since release of the FES, a considerably clearer picture has developed with respect to both the supply of fuel for the CRBR and the processing and disposition of spent fuel: DOE will likely provide both fuel and processing services. See Answer to Interrogatory No. 6, infra. Consequently, there are a limited number of facilities which need to be analyzed in order to determine fuel cycle safeguards impacts. The Staff should discuss, as it has not done, those specific facilities and determine the adequacy of safeguards at them.

- 7.3.3.1 - The discussion of fuel cycle activities fails to set out current views of the GAO and others regarding the safeguardability of bulk handling facilities. See General Accounting Office, Nuclear Fuel Reprocessing and the Problems of Safeguarding Against the Spread of Nuclear Weapons (EMD-80-38) (March 18, 1980); IAEA, Special Safeguards Implementation Report (1977). Further, the discussion of fuel loads is based on the homogeneous, rather than a heterogeneous reactor core. Finally, the Staff has not distinguished among fuel grade and reactor grade materials which may be obtained from DOE, as well as materials which might be obtained, at some point, from commercial sources.
- 7.3.3.2 - Determinations made in connection with safeguardability in GESMO proceeding in 1975 must be updated to reflect new developments. See General Accounting Office, Nuclear Fuel Reprocessing and the Problems of Safeguarding Against the Spread of Nuclear Weapons (EMD-80-38) (March 18, 1980).
- 7.3.3.3 - In the discussion of these programs, the Staff has not judged the adequacy of DOE safeguards

(both materials accounting and physical security). It has not identified inventory differences at a facilities likely to be utilized and the effect of such differences on assurances that safeguards are effective. And, it has failed to discuss current criticisms of DOE safeguards by other organizations, such as the GAO. See GAO, Nuclear Fuel Reprocessing and the Problems of Safeguarding Against the Spread of Nuclear Weapons (EMD-80-38) (March 18, 1980).

7.3.4.1.1 - This section neither reflects the fact that NRC requirements have been upgraded since 1977, nor the fact that NRC requirements are different from DOE requirements.

- 7.3.4.2.1 - The conclusion that there are "no known technical, logistic or societal impediments to producing a transit protection system that would be essentially undefeatable" is unsupported. There is no discussion of what the technical, logistic or societal impediments might be. Nor is there any discussion of who might operate such a transit protection system.

- 7.3.4.1.3 - The Staff cannot dismiss without discussion irradiated fuel as an attractive target

for theft. See answer to Interrogatory No. 4, infra.

- 7.3.4.2.4 - There is no basis shown for the conclusion on page 7-22, third paragraph from the bottom, that it is "highly unlikely" that individuals with the right combination of motivation and skills would attempt to steal nuclear material, fabricate an explosive device, and use or threaten to use it.
- 7.3.6 - The conclusions reflect a combination of all the inadequacies discussed above - failure to explain the basis for judgments; failure to use consistent terminology with respect to needed level of assurance; failure to analyze safeguards at likely DOE facilities; failure to acknowledge criticism of safeguards by the General Accounting Office and others; and failure to present an analysis applicable to projected future situations.

R2. Does NRDC presently believe that a "design basis threat" must include a specific number of attackers as part of that threat?

No. A range, rather than a single number, may make more sense.

a.) If answer is yes, does NRDC agree that this number must be kept classified in order to assure the maximum security for the CRBR facility?

Terminating 10/2/1982
105-534

Natural Resources Defense Council, Inc.

3939

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WASHINGTON, D.C. 20006
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New York Office
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September 13, 1982

Mr. Cecil O. Thomas
Acting Director
Clinch River Breeder Reactor
Program Office
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Re: Draft Supplement to Final Environmental Statement
related to construction and operation of Clinch River
Breeder Reactor Plant, NUREG-0139, Supplement No. 1
Draft Report (July 1982)

Dear Mr. Thomas:

Enclosed are the comments of the Natural Resources
Defense Council, Inc., on the above-referenced draft supplement
to the CRBR final environmental statement.

Sincerely,

Barbara A. Finamore
Barbara A. Finamore
Attorney

Thomas B. Cochran
Thomas B. Cochran
Staff Scientist

enclosure

NRDC COMMENTS ON THE DRAFT SUPPLEMENT TO THE
FINAL ENVIRONMENTAL STATEMENT RELATED TO
CONSTRUCTION AND OPERATION OF THE
CLINCH RIVER BREEDER REACTOR PLANT (NUREG-0139,
SUPPLEMENT NO. 1 DRAFT REPORT, DOCKET NO. 50-537)

SECTION 1.3, Status of the Project

The last two paragraphs on page 1-1 should be updated to reflect the current licensing status of the CRBRP. The last paragraph on page 1-1 should be updated to reflect the latest schedule for CRBR construction, reactor criticality, and demonstration. The Staff should discuss whether this schedule is consistent with recent experience with schedule slippages for the construction and operation of commercial power reactors.

SECTION 2.1, The Site and Environs, General Description

In the second full paragraph on page 2-1, the possible construction on the Oak Ridge Reservation of the Tennessee Synfuels Associates Coal-to-Gasoline Facility should be included. The Staff should discuss the potential effects on the CRBR and on the environment of construction of the nearby synfuels plant. In particular, the Staff should discuss the impact of an accident at one plant upon operations at the other plant, and should discuss the synergistic effect of carcinogenic emissions from the synfuels plant and radioactive emissions from the CRBRP. The Staff should also indicate that

failed to recognize, however, that the cooling period for LMFBF spent fuels is necessarily shorter than the cooling period for light water reactor fuels. Otherwise the LMFBF would fail to achieve its purpose of a short fuel doubling time. With the shorter spent fuel cooling periods associated with CRBRP fuel, the radiological consequences would be larger. Third, the Staff has indicated that it has not analyzed accidents associated with sodium as the cask coolant because the Applicant has not yet proposed the use of such casks. Since this is a reasonably foreseeable application, the Staff must analyze the consequences of an accident involving sodium as a cask coolant. Again, it is well recognized that in order to achieve short fuel doubling times the out-of-reactor plutonium inventory must be minimized; consequently, the spent fuel shipped after a short cooling period would in turn necessitate the use of sodium as a cask coolant.

SECTION 7.3, Safeguards Consideration

This section should be modified to reflect our comments on Appendix E.

SECTION 8, Need for the Proposed Facility

SECTION 8.3, The Ability of CRBRP to Meet Its Objectives

It is clear that the CRBRP cannot meet its programmatic objectives without having adequate fuel supply to enable it to operate throughout its five-year demonstration period. In the

September 9, 1982, hearings on the Administration's plutonium policy, before the Subcommittee on Energy Nuclear Proliferation and Government Processes of the Senate Committee on Government Affairs, the following exchange took place:

SENATOR GLENN: Do we not now have enough plutonium stockpiled to run Clinch River if it is built?

MR. KENNETH DAVIS: No, sir.

It is clear from this and other exchanges by Deputy Secretary of Energy W. Kenneth Davis and Under Secretary of State Richard T. Kennedy that there is currently an inadequate supply of plutonium to operate the Clinch River Reactor. Furthermore, Mr. Davis has indicated that the Barnwell reprocessing plant must be operating to meet the plutonium needs for the Clinch River Reactor and the FFTF. The Staff must discuss the adequacy of fuel supplies for the Clinch River Breeder Reactor and whether or not sufficient fuel will be available to enable the CRBRP to meet its programmatic objectives.

SECTION 9.2, Alternative Sites

On April 9, 1977, NRDC and the Sierra Club filed a "Motion to Declare that the CRBR FES is Not a Legally Sufficient FES and to Require that the Aforesaid Document be Circulated for Comment as a Draft" in response to the Staff's addition of a substantial amount of new material on alternative sites in Chapter 9 and 11.9 when the final FES was published.

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APPENDIX E, Safeguards Related to CFBRP Fuel Cycle and
Transportation of Radioactive Materials

SECTION E.1, Introduction

To begin with, NRDC does not believe that the Staff is applying the appropriate criteria to judge the adequacy of safeguards systems at the CRBR and its fuel site. Safeguards measures are of two types, physical security and material control and accounting. Physical security measures are essentially preventative. Their specific purpose, as set forth in 10 CFR 73, is to provide a high degree of assurance that there will be no theft or diversion of material or sabotage of the facility at which the material is used. The appropriate criterion in this regard is a high degree of assurance, not reasonable assurance as suggested by the Staff on page E-1 under its general safeguards criterion number 3.

The primary role of material control and accounting (MC&A) should be to provide continual cognizance of the status of nuclear material in a facility. Material control should provide a timely detection capability that activates the physical protection system to prevent a covert theft or diversion of nuclear material or that initiates response forces if theft or diversion has already occurred. Material control plays a primary safeguard role in rapid assessment of losses or alleged losses. Material control also should provide assurance

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concerning the safeguard status of material during the interval between physical inventories.

The primary role of material accounting is to provide long-term assurance that material is present in assigned locations and in correct amounts. Through its measurement records and statistical analysis, material accounting should provide a loss detection capability to complement the more timely detection capability provided by material control and physical protection. Material accounting plays a primary safeguards role in the accurate assessment of losses or alleged losses. Thus effective material control and accounting is an essential component of the safeguards program designed, in part, to deter and detect diversion.

Effective material control and accounting procedures are necessary to provide assurance that physical protection systems have been effective in preventing theft or diversion. This assurance cannot be provided by the physical security system alone. In sum, to be effective, safeguards, among other things, must be capable of providing both timely and accurate information on the status of nuclear material and facilities. This cannot be provided without an adequate material accounting and control program as well as an adequate physical security program. Physical security is not a substitute for an inadequate material accounting program. Both adequate physical security and adequate MC&A are essential. The Staff is in

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error in asserting the second general safeguards criterion on page E-2 that a proposed safeguards system is adequate if it is only "likely to detect attempts at sabotage, theft or diversion."

SECTION E.2, Safeguards Design Basis Threat

SECTION E.2.1 NRC-DOE Threat Comparisons

The NRC Staff has incorrectly stated that the NRC and DOE design basis threats are similar. The NRC internal threat, for example, allows for a conspiracy of insiders. This is significantly larger than the design basis threat assumed by DOE, which does not provide for collusion with regard to internal threat. More importantly, both the NRC and DOE design basis threats with regard to the external threat are smaller than that assumed by DOD for protection of nuclear weapons and nuclear weapons material. The Staff must explain in detail the similarities and differences between the NRC, DOE, and DOD threat definitions and the significance of the differences.

SECTION E.2.2, Summary of NRC Design Basis Threats

Again, the NRC Staff has understated the criterion for judging the adequacy of a physical security system by leaving out the phrase "with a high degree of assurance" in the third from the last line on page E-3 and in the third line on page E-4.

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SECTION E.3, DOE Safeguards for Plutonium ConversionSECTION E.3.1, Physical Security System Description

In the second paragraph under this section, on page E-4, the Staff states that "during the first five years of CRBRP operation, plutonium for the core fuel would be obtained from DOE stockpiles." This statement is not true, as discussed in our comments above on Appendix D, Introduction. Again we refer the Staff to the testimony of DOE Deputy Secretary W. Kenneth Davis and Under Secretary of State Richard T. Kennedy before the Senate Committee on Government Affairs, on September 9, 1982. Furthermore, in this section the Staff has failed to analyze the adequacy of the safeguards systems at the existing DOE facilities that may be involved in the CRBR fuel cycle. There is ample evidence, for example, in GAO assessments of these facilities that the safeguards programs at these DOE facilities are not adequate. A resurrection of the general types of intrusion detection systems (defenses and security clearances) does not assure that the appropriate physical security criterion is being met. The Staff cannot rely on assurances by the Applicants that the physical protection system at these DOE facilities is adequate any more than they can rely on the PSAR for assurance that the CRBRP will be built safely. The Staff must make its own independent analysis of the adequacy of these physical security systems. The Staff should identify in this section each of the independent analyses of the DOE physical protection systems including the

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analyses by the Staff and discuss the types of problems that these facilities have experienced. In particular, the Staff should focus on the GAO critiques of the safeguards programs at the DOE facilities.

SECTION E.3.2, Material Control and Accounting System
Description

The Staff asserts on page E-5 that "the MC&A system, in conjunction with the physical security system, would provide capability to detect and deter the illicit diversion of plutonium and would provide assurance that no diversion has occurred." The Staff has provided no supporting analysis which could serve as a basis for this conclusion. Furthermore, as indicated above, NRDC and, we might add, the NRC Staff believes that material control and accounting must be adequate in its own right and that one cannot rely on physical security as a substitute for material control and accounting, and vice versa. At page E-5 and E-6 the Staff states that physical inventories would be performed on a bi-monthly basis. DOE stated that the limit of error on a one-month material balance for facilities of this type would be about .5 % of throughput and that the limit of error for a two-month balance should be a slightly lower percentage of throughput. The Staff has provided no supporting evidence or evaluation to serve as a basis for accepting the DOE conclusion. DOE's conclusion may

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be in error by a factor of 10 or more. Even if DOE's estimate were found to be correct, the Staff has provided no basis for a view that these inventory differences are adequate in light of the primary role of material accounting to provide long-term assurance that material is present in assigned locations and in correct amounts. Furthermore, there is no discussion and no basis for assuming that the material control procedures at this facility are sufficient to ensure timely detection of the theft or loss of special nuclear materials. On page E-6 the Staff states that "safeguards for the conversion facility would include a prompt accounting system . . ." There is no discussion of the feasibility of implementing such a system at the conversion facility and, equally important, no discussion of whether such an accounting system would in fact be provided. With regard to the first, it is not enough simply to note that R&D is being conducted; and with regard to the last, it should be noted that there have been studies by DOE consultants, for example by Pacific Sierra Research, that indicates that most advanced safeguards systems that have been developed by DOE and others are simply never put in place in DOE facilities due to lack of funding or desire to improve the safeguards at the DOE facilities.

SECTION E.3.4, NRC Assessment of Plutonium Conversion Safeguards

This discussion is conclusory in nature and lacks any analysis to support the conclusions. Furthermore, as discussed

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above, the wrong criterion is applied, i.e., "reasonable assurance" instead of a high degree of assurance, and there are no criteria set forth that define whether the detection occurs in a "timely manner". The Staff also states that the communication systems would enable onsite and offsite forces to respond in a fashion to deter and prevent attempted adversary actions. The inference here is that the Staff believes it is acceptable to rely on the response of outside forces for determining the adequacy of a physical security system. Surely this is not the case at either Hanford or the Savannah River Plant. The Staff asserts that the safeguards systems at this facility could assure that risks from the design basis threat are no greater than at other currently operated U.S. nuclear facilities handling significant quantities of SNM. The Staff should provide a basis for this conclusion and, if it is true, a basis for the underlying assumption that the safeguards at the existing facilities, for example at the Savannah River Plant, are currently adequate. NRDC, and apparently GAO, believes that they are not adequate.

SECTION E.4, DOE Safeguard System for Fuel Fabrication Facilities

The same comments made with regard to the DOE safeguard system for plutonium conversion apply here as well and will not be repeated.

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SECTION E.6, DOE Safeguard System for Reprocessing

Again the same general comments made previously about plutonium conversion apply to the reprocessing operations and will not be repeated here. On page E-12 it is stated that "for a yearly material balance, the accounting system limit of error is stated to be in the range of 0.7 % of the throughput of the DRP. This is equivalent to seven kilograms of plutonium per year based on the annual CRBRP discharge rate of one thousand kilograms of plutonium. First, it should be noted that the use of a limit of error based on a percent of throughput is not a statistically valid basis for a material control and accounting program. We are surprised that the NRC Staff has accepted this in light of the analyses that precipitated the ongoing nuclear material control and accounting rulemaking currently in progress at the NRC. Second, recording the cumulative inventory difference on a yearly basis when the inventory period is monthly, bimonthly, or semiannually, is also an invalid measure of the material accounting uncertainty. Third, the Savannah River Plant in the first half of FY 1981 had a plutonium material inventory difference of 13.8 kg, which greatly exceeds the .7 % throughput limit referenced here. Finally, as noted previously, the Staff has provided no basis for the conclusion that a prompt accounting system will actually work, that it will be put in place by DOE, or that it will meet the requirements of an adequate material control and accounting system and provide timely detection.

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SECTION E.6.4, NRC Assessment of Reprocessing Safeguards

As noted previously with regard to plutonium conversion safeguards, the NRC Staff must provide an analysis of how they reached the conclusions presented here.

As a separate matter, the DRP is not scheduled to operate until 1995. The plutonium required for the initial loading and 5-year demonstration period of the CRBR cannot be provided by the DRP or the existing DOE stockpile. The Staff has provided no basis for a conclusion that a prompt accounting system will be operating and in place in time to provide adequate accounting of the fuel needed to fuel the Clinch River Breeder Reactor during its initial five-year operating period.

SECTION E.8, Transportation Safeguards

The Staff has failed to discuss the differences between the safeguards implemented by DOE and those required of NRC licensees. The Staff should discuss these differences and indicate whether the CRBR fuel cycle will be required to meet the requirements of NRC licensees.

External Threats to Nuclear Facilities

"It is generally recognized that the character of potential adversaries, i.e., the threat, is a major consideration in arriving at a benchmark for design and evaluation of safeguards systems." 1/

In April 1974 an independent review of the US AEC's safeguards program for licensed facilities was carried out for the US AEC's Director of Licensing by a group of consultants headed by Dr. David Rosenbaum. The authors of this report stated:

"THE THREAT

Our estimate of the maximum credible threat to any facility or element of transportation handling special nuclear materials is fifteen highly trained men, no more than three of which work within the facility or transportation company from which the material is to be taken..." 2/

Because of the importance of the subject matter, the US AEC's Director of Licensing requested that the Rosenbaum Report be reviewed promptly by the staffs of the three regulatory directorates to assess its findings and recommendations. A May 9, 1974 Memorandum to the Director of Licensing from the three directorates contains the staff's evaluation. This memorandum states in part:

"STAFF COMMENT:

We agree that the concept of design basis incidents can and should be applied to material protection. In analogy with reactor safety, design basis incidents pose a range of threats such that a system designed to cope with design basis threats will by its nature protect against the lesser postulated threats." 3/

In early 1975, the NRC's Office of Special Studies commissioned the Mitre and BDM Corporations to do threat analysis studies. Shortly thereafter (in the summer of 1975) the Office of

1/ US Nuclear Regulatory Commission, Report of Task Force on Allegations by James H. Conran, April 29, 1977, p. 4-25.

2/ US Atomic Energy Commission, Special Safeguards Study, by David M. Rosenbaum, John N. Googin, Robert M. Jefferson, David J. Kleitman, William C. Sullivan, 1974.

3/ US Atomic Energy Commission, Review of "Special Safeguards Study", by Donald F. Knuth, Director of Regulatory Operations; John F. O'Leary, Director of Licensing; and Lester Rogers, Director of Regulatory Standards, sent to L. Manning Muntzing, May 9, 1974.

Special Studies was merged into the Nuclear Material Safety and Safeguards (NMSS). In the fall of 1975, NMSS contracted with Colonel Willard Shankle 4/ to review the special studies' threat analyses and other relevant information and to produce the design threat position for the Special Safeguards Study. Shankle's Report, "Consideration of the Threat and Potential Threat to the U.S. Nuclear Power Industry" was also to provide input to the GESMO effort. While the design basis threat numbers in the Shankle report itself are still classified, they have been declassified in a recent US NRC Task Force established to review a number of allegations made by James H. Conran, an employee of the Division of Safeguards in the US NRC. One of Mr. Conran's allegations was that the design basis threat used by the US NRC 5/ was not conservative. The Task Force after conducting its review concluded:

Mr. Conran is concerned that threats of terrorist, criminal or foreign groups, of up to 12-15 people, as well as disgruntled employees acting alone or possibly in collusion with other insiders or external groups, must be considered credible threat possibilities.

The Task Force finds, principally on the basis of reference 64, that external threats up to 12 persons are sufficiently credible to warrant consideration in the development of safeguards acceptance criteria. Review of past actions of the NRC staff reveals that such threats have in fact been considered (34 and 64, for example), but the record is not sufficiently complete to demonstrate how such threats factored into the staff's ultimate recommendations on group size (91, 105, 106), although it is generally acknowledged that the selection of an appropriately conservative design basis threat is a highly judgmental process.

The Task Force finds that the preliminary paper (64) prepared by an NRC consultant summarizing several studies in the Special Safeguards Study is relevant to this concern. That paper states, in part, that:

"... a group of 10-12 dedicated, well trained and well equipped fanatics with light weapons and explosives appears to be the level of terrorist capabilities which should be considered when establishing day-to-day security requirements for the nuclear power in industry,.... [in addition, an internal threat] of disgruntled or defective employees [should be considered].

4/ A noted authority with many years of experience in the Nuclear Weapon Protection Program and principal advisor to DOD on such matters.

5/ Memorandum from Carl H. Builder, Director, Division of Safeguards to Ronald A. Brightsen, Assistant Director of Licensing, Division of Safeguards, Jan. 19, 1976.

The NRC provided these conclusions for comment to the Federal Bureau of Investigation, Central Intelligence Agency, Department of State, and Defense Intelligence Agency in October 1975. The response from those agencies lead the Task Force to conclude that these threat characteristics are sufficiently credible to warrant further consideration. Additionally the Task Force finds that there can be no assurance or detection of this level of threat prior to an attempted malevolent act on the basis of reference 64." 6/

The quotation from reference 64, "... a group of 10-12 dedicated, well trained and well equipped fanatics, etc." in the above quote is taken from the Shankle Report.

The last point, "... that there can be no assurance of detection of this level of threat [by a group of 10-12 dedicated, well trained and well equipped fanatics] prior to an attempted malevolent act..." is based on the US intelligence community view, 'that the intelligence community can provide no assurance or prior detection of adversary groups, unless group sizes become very large, that is "army size".' " 7/

It is perhaps worth noting here that the adversaries, i.e. the external threat, are conceded to have any of the following equipment: hand guns, semi-automatic and automatic rifles, shotguns, sub-machine guns, machine guns up to 50 caliber, hand grenades, dynamite, plastic explosives, shaped charges, light mortars, light anti-tank weapons, hand-held air-defense weapons, tear gas, mace, special purpose vehicles, fixed wing aircraft, helicopters, two-way radios (walkie-talkies) and citizens band radios.

In the fall of 1975, the NRC sent the Shankle Report to the FBI, CIA, State and DIA for review. The DIA response was as follows:

This Agency concurs with the conclusions and recommendations set forth in the Shankle Report -- specifically that:

- a. The capabilities of terrorist groups must be considered in establishing security systems for the nuclear power industry;
- b. A minimum security system which will provide adequate protection against an adversary group comprised of approximately 12 dedicated, well-trained, well-armed personnel is an appropriate standard;

6/ US NRC Report of Task Force on Allegations by James H. Conran, Op. Cit. pp. 4-25, 4-26.

7/ Ibid. pp. 4-18, 4-19.

- c. Close liaison must be continually maintained by installation security managers with law enforcement and intelligence agencies regarding terrorist matters.^{8/}

None of the other agencies (CIA, FBI, State) indicated that the threat levels proposed by Shankle were too large as evidenced from Transcripts of a 1977 meeting of the Task Force on Allegations of James H. Conran.^{9/} Mark Elliott, of the NRC Staff and a Task Force member, stated, "Certainly none of those responses from the intelligence community [CIA, FBI, DOS, DIA] said the threat was too high." ^{10/}

The 12 man threat is apparently the design basis threat used to judge the adequacy of safeguards at military facilities handling nuclear weapons. This can be seen from the following exchange between Roger Mattson, Chairman of the Task Force on Allegations of James H. Conran and James A. Powers of the NRC's Division of Safeguards. It would also be consistent with Shankle's experience as a principal advisor to DOD on matters related to nuclear weapons protection. Although the threat levels have been deleted from the unclassified, sanitized transcript (the deletions are indicated by the brackets []) it is evident from the Conran Task Force report and DIA letter which refer respectively to a 10-12 man and a 12 man threat level that Mr. Mattson in the following quotation is referring to this threat level.

Mr. Powers: [] armed, dedicated violent commando-type could probably take over most ERDA or NRC facilities in the country.

Mr. Mattson: Let me follow up on that. I am led to believe, in fact from these very same memos, the one from the Defense Intelligence Agency, that I would call a design threat at ERDA weapons facilities is [] well trained, dedicated lunatic types.

I am also led to believe from that DIA classified memorandum that those characteristics and that level of threat were picked from a systematic approach to intelligence information and intelligence indicators of the type conducted by the Special Safeguard Study, namely BDM, MITRE, that kind of work. In fact, DIA goes on to encourage near the end of their letter, that this kind of work should be done.

Accepting at face value that this is true -- I read it in the Washington Post and I read it in the DIA classified memorandum,

^{8/} Dec. 1975 Memorandum to US NRC, Attn: Mr. Lee V. Gossick, re letter of 29 October 1975 from Richard L. Cary, Colonel, USA, Assistant Deputy Director for Counterintelligence and Security.

^{9/} Transcript of Proceeding, Meeting of Task Force on Allegations of James H. Conran, April 13, 1977.

^{10/} Ibid., p. 257.

and given those two sources I will accept for the moment that [] is the design threat for ERDA weapons facilities. That is to protect weapons, fabricated weapons. Did you just -- I think you just said that [] dedicated, well-armed lunatic guys seven-feet tall, could defeat the ERDA facilities. Did you mean against that [] even though [] design threat is in place?

Mr. Powers: Yes.

Mr. Elliott: Just because there is a design threat in there doesn't mean that the facilities are protected to that level. But, did you mean to imply -- did you mean weapons as well as fuel facilities when you made your statement?

Mr. Powers: Licenses as well as ERDA facilities. 11/

Under the Energy Reorganization Act of 1974 which split the US AEC into the NRC and the ERDA, the US Congress requested that NRC prepare a study to determine the need for and feasibility of establishing a Security Agency for the protection of special nuclear materials. A 1975 draft of the Executive Summary of this Security Agency Study prepared by the US NRC stated:

Congressional concern for adequate safeguards was heightened as a result of a special safeguards study done for the Atomic Energy Commission in 1974. That study, by David Rosenbaum and others, ... described a variety of potential problems and shortcomings in the area of nuclear safeguards and made recommendations for their solution...

The Rosenbaum report expressed concern about the adequacy of protection afforded SNM by the private industrial security systems of licensees. One aspect of concern was the level of threat to facilities and SNM. The authors postulated a maximum credible threat consisting of 15 highly trained men, three of whom might be "insiders", employed by the licensee target firm.

* * * * *

Threats to nuclear facilities and material can come from external or internal sources. External threats would include overt acts of theft and sabotage. They span a scale ranging from mischief and minor nuisance through coordinated attacks, which at some point would take on the character of a civil war. Internal threats are most often postulated as being covert and might involve diversion of material, the perpetration of hoaxes and, perhaps, sabo-

11/ Transcript of Proceeding, Meeting of Task Force on Allegations of James H. Conran, April 13, 1977, p. 259.

tage. They span a scale from minor pilferage by individuals, through collusion, all the way through revolutionary conspiracies, in which entire plants might be covertly controlled.

* * * * *

"To estimate the credible threat, the office of Nuclear Materials Safety and Safeguards researched 19 relevant studies and conducted 9 interviews with individuals and groups of professional analysts from the FBI, the intelligence community, the Department of Defense and State and local law enforcement agencies.

"What emerged from this was a consensus estimate that an external threat group will probably number about 6-8 persons and very likely not exceed 12 persons . . .

"Interviews and studies yielded less upon which to base estimates of threats internal to the industry. In general, the internal threat was characterized as follows:

- o One person operating alone will probably remain undetected.
- o Instances of collusion involving 2-3 persons have been encountered in industry.
- o Most hijackings involve internal collusion.
- o Key internal persons can be influenced by threats against their families or other forms of blackmail.

As a result, a credible internal threat, for safeguards purposes, is estimated to consist of 2-3 persons in collusion." 12/

Similarly, a January 19, 1976 memorandum of Carl H. Builder, Director, Division of Safeguards, to Ronald A. Brightsen, Assistant Director for Licensing, Division of Safeguards, states:

"The design threats in the safeguards supplement to GESMO are divided into an internal (diversion) and an external (assault) threat. Many parameters or considerations must be taken into account in describing or specifying such threats. To simplify these descriptions, we have assumed that all of these parameters (e.g. motivation, training, arms, equipment, employment position, etc.) are fixed at worst-case values with respect to safeguards, and that the only remaining variable is the number of people involved in the threat. For a nominal or baseline threat, as a point of departure, we have assumed that the internal and external threats are two and six persons, respectively. The range of

12/ Draft, Executive Summary of Security Agency Study, pp. 1, 2, 5, 6.

numbers suggested by threat researchers, expert opinion, and partisan comments generally lie within a factor of two, up and down, from this baseline specification. 13/

The US OTA in Nuclear Proliferation and Safeguards made the following assessment of the threat level in 1977:

Current research at the RAND Corporation which involves a number of adversary events selected to be analogous to potential nuclear theft or sabotage shows that groups of 3 to 6 are common, that larger groups do appear, that a group size of 12 does appear to be somewhat of an upper boundary although there are a few cases in modern industrialized societies in which larger groups have been involved. More importantly, the RAND researchers argue that one must be extremely cautious in interpreting historical data regarding the number of attackers since the figures represent for the most part what the perpetrators, criminals or terrorists, perceived to be necessary to accomplish their mission, and in most cases what turned out to be sufficient. In other words, they came with as many as they needed to do the job, and no more. The fact that most came with a handful of persons, 3 to 6, thus does not represent an upper limit on their capacity to mobilize people. The upper limit would appear to be higher.

Although the historical data are useful as a guide, an estimate of the number of attackers is inescapably a matter of judgment. Without speaking in terms of a "maximum" threat, the RAND studies suggest a range of anywhere from 7 or 8 to about 15 as a prudent estimate.

Again although it is judgmental, military men and law enforcement officials would argue that more than this number might even be counter-productive. It is no mere coincidence that after 5,000 years of military history, the smallest operational unit of almost all armies is a squad composed of 9 to 13 men. Even 10 or 12 attackers would stretch to the limit the capacity of most known violent political extremist groups in this country. Moreover, although no one has attempted to determine precisely how many persons must be in a conspiracy to commit a serious crime before it is no longer a secret, the probability of discovery must increase rapidly in the higher ranges. The fear of leaks appears to be a principal consideration and constraint in assembling the personnel for a task force crime. 14/

This OTA assessment is based on the RAND Corporation report included as Appendix III-A in the OTA Report.

13/ Builder Memorandum, Op. Cit., p. 3.

14/ US Congress, Office of Technology Assessment, Nuclear Proliferation and Safeguards, July 1977, Chapter VIII, "Control of Proliferation" p. 197.



Department of Energy
Washington, D.C. 20545

FEB 21 1979

*Exhibit 4 To Cochran
Testimony Nov. 1, 1978
Doc. No. 5-534*

Mr. Thomas B. Cochran
Natural Resources Council, Inc.
917 15th Street, N.W.
Washington, DC 20005

Dear Mr. Cochran:

This is in response to your Freedom of Information Act (FOIA) request to the Department of State (DOS #810679), your reference NRDC/TBC/78-19 dated March 6, 1978.

A total of nine (9) Department of Energy (DOE) originated documents were referred to us by the DOS for direct response to you. These documents are numbered 8, 9, 10 and 11 and include enclosures. We have reviewed the documents and determined that the following letters and/or memorandums are unclassified.

Enclosure #8 - C. J. Zoblocki from L. R. Kojoin, 2/6/76
C. J. Zoblocki from A. D. Starbird, 1/13/76

Enclosure #9 - J. Poor from R. Marble, 12/23/75

Enclosure #10 - Chairman Seaborg etc. from M. B. Kratzer, 1/27/70
To Files from M. B. Kratzer, 1/27/70

Enclosure #11 - Chairman Seaborg etc. from M. B. Kratzer, 12/23/69
M. B. Kratzer from R. G. Bradley, 12/19/69
Chairman Seaborg etc. from D. L. Crowson, 12/11/69

The questions and answers enclosed with the letter listed below contain a DOE deletion on page 3.

Enclosure #9 - Ray Marble from James G. Poor, 2/5/75

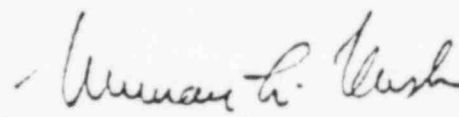
The information is being withheld pursuant to Exemption 3 of the Freedom of Information Act (5 USC 552(b)(3)) and DOE Regulations 10 CFR Part 1004.10(b)(3) and 1004.6. The legal basis for this exemption is the Atomic Energy Act

- 2 -

of 1954, as amended. I am the denying official.

If you disagree with the action that has been taken, you may file an FOIA appeal. You should appeal by submitting a written notice to the Office of Hearings and Appeals, DOE Headquarters, Washington, DC 20461, within 30 calendar days after receipt of this letter. The appeal should contain a concise statement of the grounds upon which it is brought and a description of the relief sought. A copy of the DOE letter that is the subject of the appeal should also be submitted with the appeal. Both the envelope and your letter must clearly identify that a Freedom of Information Appeal is being made (see 10 CFR 1004.8, Appeals from Initial Denials for DOE FOIA Regulations).

Sincerely,

for 
John A. Griffin, Director
Office of Classification

Enclosures:

1. As stated
2. DOS Ltr - Treanor/Spruell, 3/30/73

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CC

NET

February 6, 1976

~~Devine~~

HK 3/21

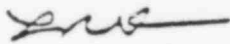
Honorable Clement J. Zablocki
Chairman
Subcommittee on International Security
and Scientific Affairs
2177 Rayburn House Office Building
Washington, D. C. 20515

Dear Mr. Chairman:

I regret for the delay in responding to your request
for the enclosed material.

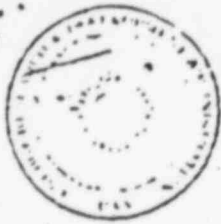
I hope the material meets your needs. If I can be
of further assistance, please feel free to call.

Sincerely,


Leonard R. Kohn
Assistant Director for
National Security/Controller
Office of Congressional Relations

Enclosure

cc: G. Helfrich
H. Lyon
✓ M. Kratzer
JCAE



CONFIDENTIAL

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9

UNITED STATES
ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION
WASHINGTON, D.C. 20545
December 23, 1975

MEMORANDUM

TO: James Poor, Director
Division of International Security Affairs

FROM: Ray Marble, Deputy Director *RM*
Office of Congressional Relations

SUBJECT: Meeting with Consultants of Subcommittee on International Security and Scientific Affairs

Request for information, from Chairman, Subcommittee on International Security and Scientific Affairs, House International Relations Committee, on alleged loss of 200 tons of uranium oxide in 1968, was made.

A meeting was held recently between Mr. George R. Berdes, Majority Staff Consultant, Mr. Donald Fortier, Minority Staff Consultant, (House Subcommittee on International Security and Scientific Affairs), and Mr. Len R. Kojm, OCR, at which alleged loss of Uranium Oxide during transport from Belgium to Italy was discussed. However, the real purpose of the meeting was to submit the following questions to EPRC for answers:

1. How and when did the loss take place?
2. When and how did the United States learn about it?
3. What did the United States do about it?
4. What could the United States have done about it?
5. What did Italy and/or Belgium do about it?
6. What was the significance of the loss of such a large quantity of uranium oxide at that time?

The Committee still is aware of the classification and sensitivity of the subject.



EXEMPT FROM GENERAL DECLASSIFICATION SCHEDULE
EXEMPTION AUTHORITY: 25 USC 552(a)(1)
EXEMPTION CODE: 25X

NATIONAL SECURITY
INFORMATION

Unauthorized Disclosure Subject to
Penalties

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01050

Honorable Clement J. Zablocki
Chairman, Subcommittee on International
Security and Scientific Affairs
Foreign Affairs Committee
House of Representatives

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Dear Mr. Chairman:

The enclosure to this letter responds to a request from Mr. George R. Bardes of your staff for information on an alleged loss of uranium oxide in 1963.

We have advised the Department of State, Bureau of Consular and International Environmental and Scientific Affairs, of your interest in this information because of their concern in the formulation of policy with respect to these matters. We have also advised the local representatives of the Polish Community.

Retyped to respond to
Director's Transmittal
Handwritten
NATIONAL SECURITY INFORMATION

Sincerely,

Alfred D. Starbird
Assistant Administrator
for National Security

Enclosure:

Cy 1B of Responses to Questions
(5/131)

bcc: ~~A. D. Starbird, AMS, w/cy 2B encl~~
~~E. B. Giller, DARS, w/cy 3B encl~~
M. E. Kratzer, w/cy 4B encl
H. E. Lyon, DSS, w/cy 5B encl
G. F. Helfrich, OIPI, w/cy 6B encl
J. G. Poor, ISA, w/cy 7B encl

ANS
ADStarbird

OCR

1/ /76

1/ /76

AC
PMGA

OFFICE	ISA:IANA	ISA:RDR/IANA	ISA:DIR	ISA:DIR	OIPI	
ADMINISTRATIVE	W. J. Henson	F. J. Henson	J. G. Poor	H. E. Lyon	G. F. Helfrich	1/
DATE	1/13/76	1/14/76	1/ /76	1/ /76	1/ /76	1/

~~SECRET~~

3861 9

UNITED STATES
ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION
WASHINGTON, D.C. 20545

FEB 5 1976

Ray Marble, Deputy Director
Office of Congressional Relations

SPECIAL REQUEST, SUBCOMMITTEE ON INTERNATIONAL SECURITY AND SCIENTIFIC AFFAIRS

The answers to your questions submitted on December 23, 1975, are provided in the attachment.

We had delayed our answer in anticipation of some additional information concerning final action on the part of either or all of the foreign countries involved. A response to our inquiry may still be forthcoming; however, rather than delay further, we indicated in the attached that we will provide anything significant that we might obtain as a result of our inquiry.

I hope that George Berdes will understand that our delay was in his interest in the hope that more complete information could have been provided.

James G. Poor
James G. Poor, Director
Division of International
Security Affairs

Enclosure:
As stated

When separated from enclosures, handle this document

23 ~~UNCLASSIFIED~~
(Indicate proper classification)

Document Transmitted
Herewith Contains
NATIONAL SECURITY INFORMATION



SECRET

Questions concerning the disappearance of Source Material
from the EURATOM safeguards control system in late 1968

1. How and when did the loss take place?

EURATOM officials indicated that in November 1968, 200 tons of natural uranium were shipped by a German firm from Antwerp by ship consigned to Genoa for ultimate non-nuclear use as a chemical catalyst in the petro-chemical industry. The natural uranium involved was from the Belgian Congo and had been bought from a firm in Belgium prior to the shipment. EURATOM security control was duly notified of the shipment in December 1968. When, after five months (as required by regulations at the time), no notification of receipt was received, an investigation was begun. The circumstances apparently involved a transfer of the material to another consignee by the ship's captain pursuant to instructions received while at sea. The ship did not call at Genoa and there were several changes in crew, ship's officers, and even ship registration around this time. When the ship next arrived at a European Community port, that portion of the ship's log covering the period in question was missing. It was concluded by EURATOM security control that the material probably had been transshipped to Israel.

2. When and how did the United States learn about it?

Representatives of the AEC, ERDA's predecessor, were orally informed of the matter on December 9, 1969, by the EURATOM representative in Washington, requesting that we treat the information as Confidential and Sensitive. It should be noted that since the material was not of US origin, EURATOM authorities really had no obligation to inform us of the matter, but did so in the spirit of cooperation which exists between EURATOM and the US. We had already been alerted to the incident and provided some of the details by way of an intelligence report received about the middle of November 1969.

3. What did the United States do about it?

- a. The U.S. action was limited to expressing to EURATOM strong concern and to urging that corrective measures be taken to apply appropriate penalties against the violators.
- b. Additionally, although the safeguards system had, in fact, performed its function of detecting a disappearance, the U.S. urged EURATOM to review its procedures, particularly with respect to improving the time schedule on which its safeguards function.

4. What could the United States have done about it?

Since it was an internal EURATOM matter, did not involve material of US origin, and involved only source material of relatively low strategic significance, any positive action in response to the incident did not appear appropriate. The US has worked and continues to work with EURATOM on safeguards policy and procedures with the goal of making them more effective.

5. What did Italy and/or Belgium do about it?

We have no information other than the statement that investigations were being conducted to establish a basis for possible criminal proceedings by the member states. EURATOM actions included:

- a. The Commission sent letters to each of the member States proposing the development and harmonization of adequate national legislation to provide appropriate legal sanction against offenses of this sort.
- b. The Commission's Legal Services examined the possibilities of legal recourse under the Treaty in this case. They concluded that such recourse was not available to the Commission. Moreover, there was a serious question based on the results of the investigation that a persuasive case could be developed against the principals identified even if legal recourse had been available under the Treaty.
- c. EURATOM reviewed its regulations to determine what modifications would be appropriate to safeguard more effectively nuclear material in transit. In a related action, EURATOM requested a meeting of the US-EURATOM Joint Technical Working Group on Safeguards specifically to discuss transportation problems.

We are seeking additional information as to the final outcome and will provide anything significant to you.

6. What was the significance of the loss of such a large quantity of uranium oxide at that time?

This was the first known disappearance of tonnage quantities of safeguarded source material, but it was detected through standard follow-up procedures for such material transfers within EURATOM. The material in question was uranium oxide with an elemental uranium metal potential of about 168 tons. If the material did go to Israel as suspected, it was probably obtained for use in the nominal 26 MWt reactor at Dimona, which

is fueled with natural uranium. A single core loading requires 8-9 tons of uranium metal. Core life under normal research operation would be 2-3 years. ~~_____~~
~~_____~~

It is possible that Israel, even without this shipment, would have had ample natural uranium from domestic or other sources for the operation of the Dimona reactor.



~~SECRET~~

UNITED STATES
ATOMIC ENERGY COMMISSION
WASHINGTON, D.C. 20545

January 27, 1970

3968

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*Country
File*

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Chairman Seaborg
Commissioner Ramey
Commissioner Thompson
Commissioner Johnson
Commissioner Larson

LIMITED DISTRIBUTION

IRREGULARITIES IN TRANSFER OF NATURAL URANIUM

Attached is a memorandum to the files reporting on conversations in Brussels with individuals who provided additional information on the disappearance of natural uranium of Belgian origin. This matter was reported to you originally by my memorandum of December 23, 1969.

Myron B. Kratzer
Myron B. Kratzer
Assistant General Manager for
International Activities

Attachment:
Memorandum to the files, 1/27/70

cc: Mr. Hollingsworth, G4
Dr. Reichardt, D/I
Mr. Crowson, D/SM4

GROUP 1
Excluded from automatic
downgrading and
declassification

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This material contains information affecting the national defense of the United States within the meaning of the espionage laws, Title 18, U.S.C., Secs. 793 and 794, the transmission or revelation of which in any manner to an unauthorized person is prohibited by law.

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3969

UNITED STATES
ATOMIC ENERGY COMMISSION
WASHINGTON, D.C. 20545

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January 27, 1970

Willi

To the Files

On January 15th, I had discussions with Mr. Willi Schlieder concerning the disappearance of 200 tons of Euratom natural uranium. These discussions were undertaken at the direct authorization of Commissioner Haferkamp, who informed me earlier in the day, immediately before leaving the city, that he had asked Schlieder to provide me with all possible information on this subject.

On January 16th further discussion, including both Schlieder and Mr. Jacchia, Director of Safeguards for Euratom, was held on this subject.

Most of the information obtained during these discussions was by way of confirmation of that already received. However, the following additional details came up:

1. Schlieder offered to supply the names of all firms involved in the arrangements. The names which he provided confirmed the identifications previously obtained through intelligence sources.
2. The shipment which led to the disappearance of the material took place in 1968. Before this time, however, the Belgian shipper had consulted with Euratom's Supply Agency concerning an export license to a Moroccan firm and had been discouraged as to the possibility of obtaining such a license on the ground that the export of material to Morocco would not be in the best interest of Euratom and its Member States. Thereafter, the firm developed the arrangement for processing of the material in Italy, which, since it did not involve an export from the Community, was approved. Schlieder did not clarify whether, in connection with their application for this transfer, the Belgian firm had identified that the material, after treatment, would be reexported to Morocco.
3. The Italian firm which was to have converted the material to a catalyst form has close business connections with the Belgian firm. Schlieder stated that while nothing could be proved, it is his opinion that the Belgian firm might not have been entirely innocent of the ultimate destination of the material. He also noted that the Italian firm concerned had, in fact, never produced catalyst of the type which was supposed to be produced in this instance.

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- 2 -

4. On the question of the actual destination of the material, Schlieder said that while they had no documentary evidence, they had essentially no doubt that the material had been delivered to Israel, although he was still unable to disclose to us all of their basis for reaching this conclusion. He did, however, make several interesting observations which at least partially answered this question, although there is apparently evidence of a more specific nature that he was not free to disclose:

- a. The German firm which purchased the material for transfer to Italy and subsequent sale to a Moroccan company was owned by a Jewish family. Schlieder said that the owners were elderly people who quite possibly genuinely did not understand the significance of what they had done.
- b. Schlieder said Commissioner Haferkamp had recently been informed by a high official in the Cabinet of Chancellor Willy Brandt that an Embassy representative in Bonn had called upon this official and asked whether it would be possible for Euratom to be called off from its continuing investigation of this matter. Schlieder said that while he was not so informed by Haferkamp, he had good reason to know that the Ambassador in question was the Israeli Ambassador.
- c. Some time after the disappearance, and after Euratom investigations had begun, Commissioner Haferkamp received a call which he referred to Schlieder, from a German attorney in Wiesbaden whose name was Von Preusschen, who stated that while he would like to provide information on the whereabouts of the material, his principals felt that it was unwise to do so because of the possibility of a leak of the information. Nevertheless, he did want to provide assurances (a) that the material was not in Eastern Europe, and (b) that it was being used only for peaceful uses of atomic energy. Schlieder said that he attempted to persuade this attorney to go beyond his statements and disclose the whereabouts of the material by assuring him that Euratom had tight security control of sensitive information. (In the course of describing this, Schlieder explained to me for the first time that Euratom has a classification and security system for sensitive information to which only a few personnel, including Euratom inspectors, have access). He said that this security and classification system is normally employed only for classified patent applications disclosed to Euratom and for information from France

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- 3 -

regarding the amount of material withdrawn from Euratom safeguards control for the French military program. He said that for this reason, Euratom safeguards records at Luxembourg were under a tight security control under the supervision not only of Euratom itself but of the French Deuxieme Bureau. However, although the attorney stated that he would consider this matter and return in a week to provide the additional information on the whereabouts of the material, he has never done so. Schlieder said that he had the impression, but was not certain that the attorney might also be Jewish.

5. Schlieder said that a further attempt to divert material was made in July 1969. This involved 232 kilograms of natural uranium bought by the same German firm from Nukem. The transfer was quickly identified by the Euratom safeguards staff and an investigation of it was immediately undertaken. According to Jacchia, in the course of this investigation which he participated in personally, "pressure" - including threats of imprisonment - which was not strictly legal, was brought on the owner of the firm. The owner became extremely emotional and concerned, and promised to return the material within three days and did so. Euratom believes that this material had actually left the country and had been returned. We discussed the obvious point that, after the successful diversion of 200 tons of material, the diversion of an additional 232 kilograms made no sense. While agreeing that this was so, Euratom had no explanation for the matter.

6. The Belgian owners of the 200 tons of uranium have a total quantity of approximately 4,000 tons on hand, representing the final production of their mine in the Belgian Congo, which was not purchased by the United States. This figure is commercially secret information which the firm involved considers extremely sensitive, since they believe knowledge of it might have an effect on the market price of uranium in Europe.

7. Schlieder said that Euratom has been searching assiduously for a means to apply sanctions, i.e., penalties to those responsible for the diversion but that they so far had been unable to do so. He explained that, in general, while Euratom had the responsibility for the operation of a safeguards system for the detection of diversion, the responsibility for criminal penalties against violators rested with the national governments. He made a point of noting that a similar situation applies as well to the IAEA. Moreover,

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- 4 -

he said that the disappearance had been extremely cleverly planned for a period of more than a year before it actually was executed and that they faced the problem of lack of proof that any of the parties under Euratom jurisdiction were implicated in the ultimate diversion of the material. He also pointed out that the key parties in the diversion of the material were German nationals and that he regarded this as a deliberate element of the plant, since politically, it would be very difficult for Germany to take official action against Israel. He made this comment in response to my question as to whether the German Government should not consider whether, notwithstanding whether it had legally adequate proof, it should protest to the Israeli Government an obvious attempt to circumvent the spirit of German and Euratom laws and policies.

8. Notwithstanding the difficulties they are encountering on finding a basis for the application of penalties, Haferkamp is still anxious that there be some official action taken on this case. (While Haferkamp might hold this view, I got the distinct impression that it was not shared by the German Government.) In the meantime, Euratom, even though it has no charter to do so, is taking the initiative in working with the Member States to develop new criminal statutes and penalties for handling instances of this type. This is in addition to steps they have already taken with respect to tightening regulation for the transportation of material.

9. Schlieder and Jacchia also stressed, as they have in other conversations, that knowledge of this diversion and the investigative steps that followed came about only as a result of Euratom's safeguards systems, which had therefore accomplished its primary function of detecting diversions. Jacchia said that the investigations carried out by Euratom, which of course has no intelligence service as such, were extremely exhaustive and went well beyond, in many respects, Euratom's strictly legal powers.

Myron B. Kratzer

Myron B. Kratzer
Assistant General Manager for
International Activities

SECRET

December 23, 1969

Chairman Seaborg
Commissioner Ramey
Commissioner Thompson
Commissioner Johnson
Commissioner Larson

IRREGULARITIES IN TRANSFER OF NATURAL URANIUM

Attached is a report from our Brussels office providing further details on the disappearance of natural uranium of Belgian origin which was reported to the Commission on December 12.

Original signed by
Myron E. Kratzer
Myron E. Kratzer
Assistant General Manager
for International Activities

Attachment:
Bradley ltr to Kratzer
dtd December 19, 1969

cc:
Mr. Hollingsworth, GM
Dr. Reichardt, Dir., I
Brig. Gen. Crowson, Dir., SMM

DIST: Chairman Seaborg, CY 1A
Commissioner Ramey, CY 2A
Commissioner Thompson, CY 3A
Commissioner Johnson, CY 4A
Commissioner Larson, CY 5A
Mr. Hollingsworth, CY 6A
Dr. Reichardt, CY 7A
Brig. Gen. Crowson, CY 8A

OFFICE >	MBKRATZER/GMS				
SURNAME >	AGMIA - CY 9A				
DATE >	12/ /69				

BRUSSELS OF SECRET
U. S. ATOMIC ENERGY COMMISSION

3974

U. S. MISSION TO THE EUROPEAN COMMUNITIES

25, AVENUE DES ARTS
BRUSSELS, BELGIUM

December 19, 1969

with

Mr. Myron E. Kratzer
Assistant General Manager
for International Activities
U. S. Atomic Energy Commission
Washington, D. C. 20545

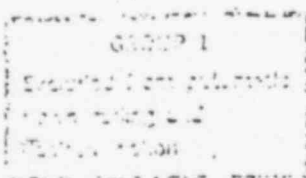
LIMITED DISTRIBUTION

Dear Myron:

On December 18 Robert Kaufman and I met with W. Schlieder, Commissioner Haferkamp's Chef de Cabinet, in response to his expressed willingness to elaborate on the details of the illegal disposition of natural uranium which was of Belgian origin. Mr. Schlieder indicated that, the material being of non-U.S. origin, Euratom was under no obligation to make disclosures of this case. However, in a spirit of cooperation for which there existed a long history of working closely together on matters pertaining to the development and implementation of effective controls for nuclear materials, the European Commission wanted its U.S. counterpart to have the benefit of its experience in this case, recognizing that the incident could have occurred any place, including the U.S. Euratom is taking steps promptly which it hopes will minimize the probability of a recurrence of this sort. In this connection, Euratom hopes it can count on cooperation with the U.S. in assessing the problems associated with safeguarding nuclear materials in transit. The objective would be to modify existing Community regulations on these matters, particularly as they pertain to source material. Mr. Schlieder stressed that while in this frame of reference Commissioner Haferkamp was prepared to discuss this particular case with the U.S. Government, he must insist that it proceed under a cloak of strictest secrecy due to the highly sensitive problems in the case.

As to the details of the case which Mr. Schlieder revealed:

1. The natural uranium came from the stockpile of Societe Generale Miniere (SGM), a Belgian firm which has been a uranium supplier for many years. In accordance with the Community regulation, SGM filed an appropriate report of the shipment with Euratom. This regulation also stipulates that the consignee will file a report on receipt of the material within



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Myron B. Kratzer

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December 19, 1969

five months of the date of its shipment. The absence of this report on the required time schedule is what triggered an inquiry by Euratom's safeguards group and its subsequent investigation upon learning that the material had not arrived at its intended destination.

2. The material was ordered by a German firm (Schlieder did not identify) who was acting as an agent for another party, reportedly a petroleum processor in Morocco. The latter is of such meager holdings that it seems unlikely it was being purchased for its own use. The German firm had been viewed as a reputable one, at least up to about one year ago when it was dropped as a NATO contractor. The material was consigned to an Italian firm in Milan for processing. This firm has a business affiliation with SOG.
3. SOG had received an export license from the Belgian Government and had evidence that Italy had issued an import license. Moreover, SOG received payment for the material from a Swiss bank prior to actual shipment of the material. The transport of the material to Antwerp was arranged by SOG with, according to Schlieder, a very reputable firm.
4. The consignor, the German firm ordering the material, reportedly received specific shipping instructions including the necessary paper work from the party on whose behalf they were acting. Those instructions stipulated that the material would be taken aboard a German ship at Antwerp which was enroute to that port from Hamburg. Euratom learned that ownership of this vessel changed hands while it was enroute from Hamburg to Antwerp and that within one hour after its arrival in Antwerp its registry was changed and it went under a Liberian flag. Moreover, there was a complete change of crew shortly upon its arrival in Antwerp. The new captain requested labels on the shipping drums which simply indicated that the contained material was said to be chemicals.
5. When this ship next made call at a Community port it was returning from Romania and had still a different crew. That portion of the ship's log covering its earlier trip from Antwerp was missing.
6. Early in its investigation Euratom called in the Ambassadors from Belgium, Italy and W. Germany and solicited their help in uncovering the facts of this case. Schlieder at one point indicated the Dutch Government was quite concerned about a leak in this case which was the only indication that another Member State had been brought in on the case. This apparently resulted from the fact that the ship made a call at a Dutch port after leaving Antwerp.

Myron D. Kratzer

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7. In an effort to avoid a recurrence of a situation of this type Euratom is taking the following action:
- a. The Commission has approved sending letters to each of the Member States proposing the development and harmonization of adequate national legislation to provide appropriate legal sanctions against offenses of this sort.
 - b. The Commission's Legal Service has been examining the possibilities of legal recourse under the Treaty for the current case and its decision is expected soon. However, the results to date are not encouraging that such recourse is available to the Commission. Moreover, there is serious question based on the investigation to date that a persuasive case could be developed against the principals identified thus far even if legal recourse were available under the Treaty.
 - c. Euratom has its regulations under review to determine what modifications may be appropriate to more effectively safeguard nuclear material in transit. In a related action, Euratom has requested a meeting of the U.S.-Euratom Joint Technical Working Group on Safeguards to discuss transportation problems. Euratom representatives would hope to be prepared for such a meeting by mid-January.
 - d. Schlieder promised to keep us advised of any further developments in this case including any legal actions which the Commission or any Member States may undertake. At the moment it would appear that the greatest possibility for such action rests with the FRG, but it will be very difficult for the German Government to decide on specific action, if any, to take in view of the apparently deficient juridical basis and factual evidence on which to institute criminal legal proceedings. Moreover, there are serious political implications which could arise vis-a-vis the Soviets and Arab states in this situation.

Sincerely,



R. Glenn Bradley
Senior AEC Representative

P.S. Schlieder requested an overview of how closely this matter is being held by the state that this additional detail will be helpful. ~~_____~~ as to the Reichstag.



UNITED STATES

ATOMIC ENERGY COMMISSION

WASHINGTON, D.C. 20545

DEC 11 1959

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Chairman Seaborg
Commissioner Ramey
Commissioner Johnson
Commissioner Thompson
Commissioner Larson

THRU General Manager

Howard C. Brown, Jr.

LOSS OF EURATOM SOURCE MATERIAL

In response to his request for an opportunity to brief the writers regarding a Euratom safeguards matter, Mr. Curt Heidenreich, Washington representative of Euratom, met with Myron Kratzer and Leonard Brenner (representing Delmar Crowson) at H Street on December 9. Mr. Heidenreich, Director, Commission of European Communities Washington Liaison Office, was accompanied by Mr. Felix Oboussier, Chief, Division of General Affairs and Internal Administration, Supply Agency, Commission of the European Communities, who was in Washington on other business. Mr. Heidenreich stated that he was under instructions to report to us on this matter from Commissioner Haferkamp, who is responsible for safeguards in the European Community Commission.

Mr. Heidenreich reported that 200 tons of source material (natural uranium) were shipped by boat from Antwerp to Genoa for ultimate non-nuclear use (chemical catalyst in the petro chemical industry) in Italy. The contract involved source material from the Belgian Congo, then located in Belgium. U.S. material was not involved. He added that Euratom safeguards personnel, in the normal course of their function, attempted to verify receipt of the shipment by the consignee in Italy and found it had not arrived. Euratom thus feels that the detection of the loss and possible diversion has been a significant demonstration of the effectiveness of their safeguard system, whose objective is to detect diversion since the loss might not otherwise have been discovered.

An investigation was initiated and is still in process by Euratom and its Member States. Heidenreich stated that Euratom would have preferred to advise us of the loss earlier, but was requested to withhold notification by its Member States pending completion of investigation. They have now decided to inform us, but requested that we treat the entire matter as sensitive and confidential. He also stated that if the loss had involved U.S. material, the U.S. would have been notified at once. Heidenreich indicated that we were under no restriction as to whom this information could be made available on a confidential basis, including the JCAE.

This report contains information affecting the national defense of the United States within the meaning of the espionage laws, Title 18, U.S.C. Sec. 793 and 794, the transmission or revelation of which in any manner to an unauthorized person is prohibited by law.

GROUP 3
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downgrading and
declassification
S288

The Commission

In response to questions, Heidenreich speculated that detection of the loss occurred around June, approximately three months after shipment, but he was not certain regarding the date of discovery or the identification of the diverters. Mr. Oboussier responded that the ship captain delivered the 200-ton shipment to another consignee pursuant to alleged instructions received at sea. The ship captain would not identify the consignee or country. Sanctions against Euratom Member State citizens involved are now under consideration as part of the continuing investigation.

Mr. Heidenreich further pointed out that Euratom is critically reviewing its safeguard procedures with respect to transportation, and is anxious to consult on this question with AEC.

The information provided by the Euratom representatives is generally consistent with information obtained through intelligence sources. The intelligence information, however, goes further than the Euratom disclosure in reporting speculation that the possible recipient of the missing material was Israel. There is no confirmation of this speculation nor evidence to support it at this time.

The U.S. participants noted that if indeed the loss reported represents a sale or diversion of material it would to our knowledge be the first such credible instance of this nature, and it was desirable that the U.S., the U.K., Canada, and all of the IAEA member nations be informed of the details as rapidly as possible since prudent safeguards actions on all our parts would indicate extra precautions, particularly oriented at the possible diverter in this instance. Heidenreich responded that this seemed like a sound point and indicated that he would bring this matter to the attention of the appropriate authorities in Euratom promptly. We also encouraged Euratom to consider whether their best interests would not be served by taking the initiative in disclosing this loss as soon as possible, since they would inevitably be put on the defensive if the information leaked.

In view of the circumstances, the writers propose to visit with members of the Joint Committee staff early in the week of December 15 to orally brief them on this matter.

Original signed by
Myron B. Kratzer

Myron B. Kratzer
Assistant General Manager
for International Activities

Delmar L. Crowson, Director
Office of Safeguards and
Materials Management

bcc: HBrown, GM
CREichardt, I

OGM (2)
Secv. (2)

AGMIA
DLCrowson, OSMM

LMBrenner, OSMM

OFFICE	OSMM/SA/D	OSMM:D	AGMIA	EAGM	DGM	
	LMBrenner/vlh	DLCrowson	(Fe-write) MBKratzer/plg			
SURNAME	12/10/69	12/ /69	12/11/69	12/ /69	12/ /69	12/
DATE						

Exhibit 8 (private communication, Robert Burnett to Thomas B. Cochran, September 1980).

56. Finally, we are already beginning to see the effect of the new, relaxed material accounting and control requirements at NFS-Erwin. As indicated in paragraphs 40-44 above, the bimonthly inventories taken since the January 21, 1980, Order provide evidence that MC&A at NFS-Erwin is ineffective despite the heightened awareness of the problem and efforts to improve material control.

B. Effective Material Accounting Cannot Be Implemented At NFS-Erwin Because Current NRC Material Accounting Practices Are Fundamentally Flawed

57. The Commission was briefed by the NRC Staff on March 31, 1980, on deficiencies in the current regulatory practices for nuclear material accounting (Exhibit 15a). Dr. Lurie of the Applied Statistics Branch, Office of Management and Program Analysis (MPA) of the NRC reviewed six specific deficiencies (Exhibit 15a, cf., p. 22 and accompanying slide; Exhibit 15b), including the fact that there is no uniformity in the definition of LEID, the present LEID-Limits for licensed facilities have no valid statistical basis, and the ID is improperly interpreted and in any case represents a questionable criterion for protecting against diversion. I agree with Dr. Lurie's assessment.

58. As a result of this briefing, John Ahearne, then Chairman of the NRC, ordered the Staff to provide a paper "talking about the statistical treatment whether one can make it at least a valid statistical treatment, ... because the way I end up from listening to your briefing is that the current system is terrible and that a revised system needs a lot of work before it can be useful, we have got to do something in between." (Exhibit 15a, pp. 50-51.)

59. As a result of this request, MPA and NMSS prepared a paper, "Staff Report on Possible Changes in the Statistical Treatment of Inventory Differences in Nuclear Material Accounting" (SECY-80-514) (Exhibit 16). This report identified additional discrepancies in the current NRC material accounting procedures. Subsequently, the Commission initiated a Rulemaking to improve MC&A. However, as of this date, the Commission is still relying upon the same flawed methodology characterized by Dr. Lurie (Exhibits 15a, 15b) and the MPA/NMSS report (SECY-80-514) (Exhibit 16).

60. Despite these flaws, the solution in this case is not to further weaken the existing system by relaxing the material accounting requirements at NFS-Erwin. Rather, I believe, it is all the more important under the circumstances that material control and accounting requirements be strictly set and enforced.

C. Flaws in Material Control and Accounting Cannot Be Offset By Enhancing Physical Security

61. In consideration of the disastrous consequences of a detonation of an atomic bomb, safeguards measures must be designed to deter, prevent, detect, and respond to the unauthorized possession of significant quantities of weapons usable materials through theft or diversion.

62. Safeguards measures are of two types, physical security and material control and accounting. Physical security measures are essentially preventive. Their purpose is to provide high assurance that there will be no theft or diversion of material or sabotage of the facility at which the material is used (Exhibit 9, ¶¶4-5).

63. An NRC Staff Task Force has defined the role of material control and accounting in safeguards as follows:

The primary role of material control in safeguards should be to provide continual cognizance of the status of nuclear material in a facility. Material control should provide a timely detection capability that activates the physical protection system to prevent a covert theft or diversion of nuclear material or that initiates response forces if theft or diversion has already occurred. Material control plays a primary safeguards role in rapid assessment of losses or alleged losses. Material control also should provide assurance concerning the safeguards status of material during the interval between physical inventories.

The primary role of material accounting is to

provide long-term assurance that material is present in approved locations and in correct amounts. Through its measurements, records, and statistical analyses, material accounting should provide a loss detection capability to complement the more timely detection capabilities provided by material control and physical protection. Material accounting plays a primary safeguards role in the accurate assessment of losses or alleged losses.

Exhibit 17, pp. 2-3.

64. Thus, effective material control and accounting are essential components of a safeguards programs designed, in part, to deter and detect diversion. Effective material control and accounting procedures are necessary to provide assurance that the physical protection systems have been effective in preventing theft or diversion. This assurance cannot be provided by the physical security system alone.

65. In sum, to be effective, safeguards, among other things, must be capable of providing both timely and accurate information on the status of nuclear material and facilities. This cannot be provided without an adequate material accounting and control program. In this regard, physical security is not a substitute for inadequate material accounting. Both adequate physical security and adequate material accounting and control are essential.

66. This view is clearly recognized in NRC's Regulatory Guide 5.13 (Conduct of Nuclear Material Physical Inventories, p. 5.13-3), which states:

Assurance against undetected loss or diversion of special nuclear material can be achieved only by a measured physical inventory. Various systems of physical protection can be employed to protect against, deter, or detect theft or diversion of special nuclear material. Various systems of material control and accounting can be employed to account for material. However, a material balance based on a measured physical inventory that provides conclusive evidence of the physical presence of the material is the only means for assuring that the physical protection and material control and accountability systems have been effective and that no significant losses or diversions have gone undetected. [Emphasis added.]

67. This same view also appears to be shared by Commissioner Gilinsky, who "believes that increasing physical security requirements at the facility [NFS-Erwin] does not compensate adequately for a deficient material control and accounting system."

D. Considering Physical Security Separately, The Design Basis Threat Cannot Be Justified

68. The new physical security requirements for NFS-Erwin under the License Amendments required by the Commission in its January 21, 1980, Order (Exhibit 8, Attachment A) purport to be sufficient for NFS-Erwin to meet the NRC's Safeguards Upgrade Rule (44 Fed. Reg. 68184-99, November 28, 1979). NRDC has not been able to obtain through the Freedom of Information Act all of

the documentation utilized by the NRC Staff and the Commission in this rulemaking. Under the circumstances, I am unable to provide supporting evidence that the new license conditions, if followed by NFS, would be adequate to meet this Rule.

69. Nevertheless, an NRC inspection of NFS-Erwin conducted on November 26-30, 1979, some two and a half months after the 22-kilogram ID was reported to the NRC, at a time when one would expect NFS's concerns about security to be the greatest, indicated that NFS-Erwin was not in compliance with NRC's physical security regulations pertaining to prevention of unauthorized access to protected areas (Exhibit 18).

70. In any event, even if it could be shown that NFS-Erwin currently meets the new physical security requirements, this would not provide a high degree of assurance that diversion of significant quantities of HEU can be prevented, considering the full range of threats currently considered credible by safeguards experts. These threats include but are not limited to diversion by foreign governments (e.g., a threat comparable to that which allegedly materialized in the early 1960s at NUMEC).

71. Under NRC requirements for physical protection of plants and materials set forth in 10 CFR 73.1(a)(2) -- which, I understand, are currently applied to NFS-Erwin -- the facility

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must have the capability of protecting (with high assurance) against the following design basis threats:

External Threat

A determined, violent, external assault, attack by stealth, or deceptive actions, by a small group with the following attributes, assistance and equipment: (A) Well-trained (including military training and skills) and dedicated individuals, (B) inside assistance which may include a knowledgeable individual who attempts to participate in a passive role (e.g., provide informations), an active role (e.g., facilitate entrance and exit, disable alarms and communications, participate in violent attack), or both, (C) suitable weapons, up to and including hand-held automatic weapons, equipped with silencers and having effective long range accuracy, (D) hand-carried equipment, including incapacitating agents and explosives for use as tools of entry or for otherwise destroying reactor, facility, transporter or container integrity or features of the safeguards system, and (E) the ability to operate as two or more teams.

Internal Threat

A conspiracy between individuals in any position who may have: (A) Access to and detailed knowledge of the facilities or (B) items that could facilitate theft of special nuclear material (e.g., small tools, substitute material, false documents, etc.) or both.

With regard to the external threat, it is my understanding that "a small group" represents about 6 persons as the regulations are currently implemented. Similarly, the "conspiracy between individuals" in the Internal Threat definition means two people.

72. In what was to become the basic supporting record for

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the Staff view regarding the characteristics of the threat and consequently the underlying bases for NRC current physical security regulations (10 CFR 73.1(a)), the Staff prepared a report "Generic Adversary Characteristics" (classified SECRET). The unclassified summary report notes with regard to the external threat:

The number of adversaries involved in a given criminal act most frequently ranged from one to six persons. Those crimes that involved some instances in which more than six persons participated were organized crime capers, labor disorders, mass/violent demonstrations of a political protest nature, and overseas terrorist incidents. No upper limit was observed on the number of participants in either a violent labor disorder or an extremist protest demonstration. Approximately 95% of all terrorist incidents involved six or fewer action cadre. Almost all incidents of terrorism in which more than six perpetrators were involved occurred outside the United States, generally in Latin America, the Middle East, and Europe. In most incidents carried out by members of traditional organized crime groups, the number of individuals involved ranged from two to six.¹⁵

73. At first glance, the above finding may appear comforting since the NRC regulations are meant to cover 95% of the incidents. The 95% figure, however, is composed of a relatively large number of less serious events involving one or two people. When these are discounted, the frequency of groups

¹⁵ John B. Stewart, et al., "Generic Adversary Characteristics Summary Report," NUREG-0459 (March 1979), p. 41.

with more than 6 perpetrators becomes much larger and, in any case -- regardless of percentage -- this subset of events must be taken seriously.

74. In the note "External Threats to Nuclear Facilities" (Enclosure 19), I demonstrate that a sizable body of professional opinion believes that terrorists and criminal and foreign groups of up to 10-15 people represent credible threats to U.S. nuclear facilities.

75. As a further matter, one should take little comfort in the NRC's threat definition in light of the Staff conclusion that "it would appear that such adversaries determined group size for a given action based upon their perception of the number required to optimize the chance of success, consistent with security requirements and payoff."¹⁶

76. In sum, the NRC's physical security requirements are not designed to protect with a high degree of assurance against an attack by more than 6 dedicated, well armed terrorists, even though such an attack must be deemed credible in the U.S. today.

77. With regard to the NRC's internal threat definition, in

¹⁶ NUREG-0459, op. cit., p. 42.

light of credible interpretations of what may have transpired at the NUMEC facility in the 1950s, I do not believe that the design basis internal threat, limited to only two conspirators, provides a high assurance against diversion of SNM at NRC-licensed facilities.

78. And, as a final matter relating to physical security, the intelligence community cannot provide the NRC with assurance of prior detection of adversary groups unless group size becomes very large, that is "army size" (Exhibit 19, footnote 7). The NRC's policy of judging the physical security at the NFS-Erwin facility using design basis threats that are smaller than other credible threats simply because the intelligence community cannot identify larger threats at this time is unsound and inadequate.

Natural Resources Defense Council, Inc.

3989

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November 1, 1982

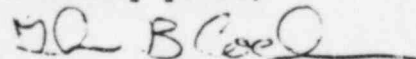
Scott W. Stucky
Docketing and Service Board
Office of the Secretary
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

In The Matter of United States Department
of Energy, Project Management Corporation,
Tennessee Valley Authority, (Clinch River
Breeder Reactor Plant), Docket No. 50-537

Dear Mr. Stucky:

I am enclosing for filing the original of my testimony, dated today's date, on Contentions 4 and 6(b)(4) in the above proceeding. One page of this testimony, which is separately attached, contains classified inserts. It is possible that the testimony may contain additional information that the Commission may wish to protect from public disclosure. Accordingly, we are not serving the testimony on other parties at this time. Instead, we have enclosed in a separate package two copies of the testimony addressed to Raymond J. Brady, Director of the Division of Security, Office of the Administration, for classification review. In addition, we have enclosed separate mailing labels for the service list, to be used by the Commission in forwarding copies of the testimony following classification review.

Sincerely yours,



Dr. Thomas B. Cochran
Senior Staff Scientist

cc: Service List

'82 NOV 12 P5:42

SERVICE

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)

Docket No. 50-537

SUPPLEMENT TO
TESTIMONY OF THOMAS B. COCHRAN
PART V

(Intervenors' Contentions 4 and 6(b)(4)
~~1, 2, and 3~~)

BASED UPON THE FINAL SUPPLEMENT TO THE
CRBR ENVIRONMENTAL IMPACT STATEMENT

NUCLEAR REGULATORY COMMISSION

Docket No. 50-537 Official Ex. No. 12A
In the matter of Clinch River
Staff _____ IDENTIFIED ☒
Applicant _____ RECEIVED ☒
Intervenor ☒ REJECTED _____
Cont'g Off'r _____
Contractor _____ DATE 11-17-82
Other _____ Witness Cochran
Reporter mtb

DATED; NOVEMBER 12, 1982

The only changes to Dr. Cochran's Testimony, Part V, based on the Final Supplement to the CRBR Environmental Impact Statement are as follows:

1. Change all references to the "Draft Supplement to Final Environmental Statement" ("DEISS") to the Final Supplement to Final Environmental Statement ("FSFES").
2. At page 6, line 13, change "D-10" to "D-11".
3. At page 6, line 17, change "D-11" to "D-13".
4. At page 2, end of second full paragraph, add the following sentence: "Additional information on my background and qualifications is included as Exhibit 1, Testimony of Cochran, Part IV.

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

In the Matter of

UNITED STATES DEPARTMENT OF ENERGY
PROJECT MANAGMENT CORPORATION
TENNESSEE VALLEY AUTHORITY


(Clinch River Breeder Reactor Plant)

AFFIDAVIT OF DR. THOMAS B. COCHRAN

City of Washington)
) ss:
District of Columbia)

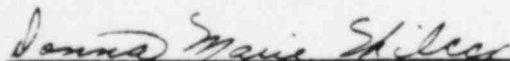
DR. THOMAS B. COCHRAN hereby deposes and says:

The foregoing testimony prepared by me and dated November 12, 1982, is true and correct to the best of my knowledge and belief.



Dr. Thomas B. Cochran

Signed and sworn to before me
this 12th day of November 1982.



Notary Public

My Commission Expires July 31, 1987

1 JUDGE MILLER: Anything further?

2 MR. GREENBERG: That concludes our presenta-
3 tion with respect to these contentions, Mr. Chairman.

4 JUDGE MILLER: Thank you.

5 Next.

6 MR. EDGAR: Our health effects panel is
7 next.

8 I would like to take care of one logistics
9 item, which is distribute clear copies of Applicants'
10 Exhibit 40.

11 JUDGE MILLER: Fine, you may do so and get
12 your panel underway.

13 MR. EDGAR: Applicants call to the witness
14 stand Dr. Roger McClellan, Mr. John Healy, Dr. Roy
15 Thompson and Dr. Julian Preston.

16 Dr. McClellan, Dr. Thompson and Mr. Healy
17 have previously testified and were sworn. Dr. Preston
18 has not.

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18-1 1 JUDGE MILLER: The oath will remain.

ged 2 Who has not been sworn? Dr. Preston.

3 Whereupon,

4 R. JULIAN PRESTON

5 was called as a witness by and on behalf of the Applicants and,
6 having first been duly sworn, was examined and testified as
7 follows:

8 Whereupon,

9 ROGER O. McClellan

10 JOHN W. HEALY

11 ROY C. THOMPSON

12 were recalled as witnesses by and on behalf of the Applicants
13 and, having been previously duly sworn, were examined and
14 testified further as follows:

15 JUDGE MILLER: The oath remains as to the
16 other gentlemen. You recognize you have been previously sworn.
17 You may proceed.

18 MR. EDGAR: I have before me "Applicants' Direct
19 Testimony Concerning NRDC Contentions 11(b) and (c)." This
20 is the written prefiled testimony on Contentions 11(b) and (c),
21 too, which was filed on November 1, 1982.

22 In addition, the version that I've handed out and
23 I'll furnish to all parties and the Board, for the convenience
24 of all parties, has several handwritten or pen-and-ink
25 corrections showing the original text to reflect the errata that

18-2 1 was filed by Applicants.

2 I ask that that document, "Applicants' Direct
3 Testimony Concerning NRDC Contentions 11(b) and 11(c)," be
4 marked for identification as Applicants' Exhibit 42.

5 JUDGE MILLER: It may be marked.

6 (Applicants' Exhibit No. 42 was
7 marked for identification.)

8 MR. EDGAR: Applicants are proffering this
9 witness panel for the purpose of sponsoring testimony concerning
10 NRDC Contentions 11(b) and (c), relating to genetic and somatic
11 health effects.

12 Dr. McClellan and Mr. Healy and Dr. Thompson,
13 whose statements of professional qualifications appear
14 respectively at Pages 31 through 33, Pages 34 through 35, and
15 Pages 36 through 37 of Applicants' Exhibit 42, are proffered as
16 experts in radiation protection and somatic health effects.

17 Dr. Julian Preston, whose statement of professional
18 qualifications appears at Page 30 of Applicants' Exhibit 42, is
19 proffered as an expert in the genetic effects of radiation.

20 This testimony represents a collegial effort of
21 the witness panel, with Dr. Preston taking the lead
22 responsibility in the area of genetics.

23 DIRECT EXAMINATION

24 BY MR. EDGAR:

25 Q At this time I would like to ask the panel several

18-3

1 questions.

2 The first is: Panel, do you have any corrections
3 to make to your testimony?

4 The first question is: Would you state your names
5 and addresses for the record?

6 BY WITNESS PRESTON:

7 A. My name is Julian Preston, and I'm a member of
8 the Biology Division of the Oak Ridge National Lab.

9 BY WITNESS McCLELLAN:

10 A. I'm Dr. Roger McClellan, the Lovelace Biomedical
11 and Environmental Research Institute, Albuquerque, New Mexico.

12 BY WITNESS THOMPSON:

13 A. My name is Roy Thompson. I am a member of the
14 Pacific Northwest Laboratory, Richland, Washington.

15 BY WITNESS HEALY:

16 A. I am Jack Healy, and I work at the Los Alamos
17 National Laboratory.

18 Q. Do you have any corrections to make -- additional
19 corrections to make to the testimony at this time?

20 BY WITNESS McCLELLAN:

21 A. Yes, we do. On Page 4 of the testimony, we have
22 been advised that the values shown for exposure of the general
23 population is 0.1 man-rem rather than the 2 man-rem that is
24 shown.

25 This change in the value serves to -- as a

18-4

300 7TH STREET, S.W., REPORTERS BUILDING, WASHINGTON, D.C. 20024 (202) 554-2345

1 result of that change, the effects that we have estimated for
2 the general population are reduced by a factor of 20 from that
3 which is shown in the testimony.

4 Q To the panel, are the opinions expressed in this
5 testimony your own opinions?

6 BY WITNESS McCLELLAN:

7 A Yes, they are.

8 BY MR. HEALY:

9 A Yes.

10 BY WITNESS PRESTON:

11 A Yes.

12 BY WITNESS THOMPSON:

13 A Yes.

14 Q And to the best of your information and belief,
15 are the statements and opinions expressed in the testimony
16 true and correct?

17 BY WITNESS McCLELLAN:

18 A Yes, they are.

19 BY WITNESS PRESTON:

20 A Yes.

21 BY WITNESS HEALY:

22 A Yes.

23 BY WITNESS THOMPSON:

24 A Yes.

25 Q And do each of you adopt this Applicants' Exhibit

1 42 as your testimony in this proceeding?

2 BY WITNESS McCLELLAN:

3 A I do.

4 BY WITNESS PRESTON:

5 A Yes.

6 BY WITNESS THOMPSON:

7 A Yes.

8 BY WITNESS HEALY:

9 A Yes.

10 MR. EDGAR: At this time, Mr. Chairman, we would
11 offer Applicants' Exhibit 42 into evidence, and the panel is
12 available for cross-examination.

13 JUDGE MILLER: Very well. You may cross-examine.

14 CROSS-EXAMINATION

15 BY MS. FINAMORE:

16 Q Dr. McClellan, you just stated that you had an
17 incorrect estimate of a dose to the general population on Page 4
18 of your testimony; is that correct?

19 BY WITNESS McCLELLAN:

20 A I indicated that the value which we had been
21 provided for the general population has been revised from 2 man-rem
22 to 0.1 man-rem in the Supplement to the Final Statement.

23 Q Is it your understanding that that was the number
24 in the Final Supplement to the Final Environmental Statement,
25 the new number that you just provided?

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1 BY WITNESS McCLELLAN:

2 A The new number that we just provided, 0.1, is the
3 number which shows in the Supplement.

4 Q And the number provided previously was the number
5 in the Draft Supplement; was that correct?

6 BY WITNESS McCLELLAN:

7 A The number which was shown here, I believe, was a
8 number in earlier draft material that was provided to us.

9 Q You also stated that other estimates in your
10 testimony should now be reduced by a factor of 20.

11 Would you tell me specifically which estimates you
12 were referring to?

13 BY WITNESS McCLELLAN:

14 A The two values shown on Page 11, the upper
15 estimate and the lower estimate, will be reduced by a factor
16 of 20.

17 Q I'm sorry, I don't know which specific numbers
18 you are referring to.

19 BY WITNESS McCLELLAN:

20 A If we move to Page 11, the lower portion of the
21 page, the line showing "Upper estimate," that value will be
22 reduced by a factor of 20, divided by 20.

23 The value shown for "Lower estimate" will be
24 likewise reduced by a factor of 20.

25 Q Will you read the particular sentence to me that

18-7

1 you are referring to? I still don't see what -- where you say
2 higher and lower estimates.

3 Did you change the numbers on your testimony?

4 BY WITNESS McCLELLAN:

5 A. Perhaps I can ask for a point of clarification.
6 If you choose to -- I have not, we have not in the testimony
7 here proceeded to go through each number and reduce it by a
8 factor of 20. If that is chosen to do, I would like to have a
9 few minutes to accomplish that so that I can be certain it is
10 done in an orderly fashion without introducing any ambiguities.

11 JUDGE MILLER: You better make the changes.

12 WITNESS McCLELLAN: Okay.

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1 JUDGE MILLER: How long will that take,
2 approximately?

3 WITNESS McCLELLAN: I would say perhaps five
4 minutes.

5 JUDGE MILLER: Five minutes.

6 (Recess taken.)

7 JUDGE MILLER: All right. We will resume, please.

8 MR. EDGAR: While we were off the record, I had
9 an opportunity to confer with Counsel for NRDC. The witness
10 panel is prepared to read the reduced values for the table at
11 the top of Page 24, which are genetic calculations for public
12 dose, and then later a value given for somatic on Page 28.

13 There may be some intermediate calculations of
14 detail prior to Page 24, but the bottom line or the answers, the
15 summary table, is on Page 24 and they have those values
16 corrected, and NRDC has advised that they could go ahead with
17 cross on that basis.

18 We will verify the other intermediate step
19 calculations.

20 JUDGE MILLER: Very well.

21 MS. FINAMORE: It's my understanding that those
22 intermediate numbers would be provided before the testimony is
23 admitted into evidence, but I won't hold up cross-examination
24 while they are calculating.

25 MR. EDGAR: Dr. McClellan, could you read the

1 revised values for Page 24 and then the revised values for
2 Page 28?

3 WITNESS McCLELLAN: Yes. The two values on the
4 line "Autosomal dominants" would be changed from "2.4" to "0.12."

5 The next column or "Lower Limit," would be
6 changed from "0.8" to "0.04."

7 The next line down, "Recessive disorders," no
8 change.

9 The next line, "Chromosome alterations," the
10 "6.0" is now changed to " 0.3×10^{-4} ."

11 The "Lower Limit" value is changed from
12 " 6.0×10^{-4} " to " 0.3×10^{-4} ."

13 The line "Irregularly inherited diseases" is
14 changed from " 5.4×10^{-2} " to " 0.27×10^{-2} ."

15 The next column, "Lower Limit," is changed
16 from " 1.4×10^{-4} " to " 0.07×10^{-4} ."

17 The line "Total (per million liveborn)" is
18 changed from " 5.7×10^{-2} " to " 0.28×10^{-2} ."

19 The next column, "Lower Limit," is changed
20 from " 1.2×10^{-3} " to " 0.06×10^{-3} ."

21 Let me make certain that there was no confusion
22 with regard to the first line on the "Autosomal dominants."
23 The value there corrected is " 0.12×10^{-3} " under "Upper Limit,"
24 and under "Lower Limit," " 0.04×10^{-4} ."

25 On Page 28, Line 8, the full sentence would now

18-10

1 read, "The estimated effects calculated using these doses
2 are 0.000015-0.00005 cancers among the public," and as stated.

3 MS. FINAMORE: Thank you.

4 BY MS. FINAMORE:

5 Q Dr. Preston, am I correct that you were primarily
6 responsible for preparing the genetic portion of this
7 testimony?

8 BY WITNESS PRESTON:

9 A Yes, that is correct.

10 Q And am I correct that you used as a basis for your
11 testimony information regarding CRBR releases and dose
12 estimates that were provided to you?

13 BY WITNESS PRESTON:

14 A That is correct.

15 Q Am I correct that you had no independent basis for
16 judging whether or not those dose estimates were correct or
17 reasonable?

18 BY WITNESS PRESTON:

19 A That is correct.

20 Q Is it not also true, Dr. Preston, that you did
21 not calculate the genetic impact to the public that might occur
22 from the fuel cycle associated with the Clinch River Breeder
23 Reactor?

24 MR. EDGAR: Objection. The question goes beyond
25 the scope of the contention.

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1 If you read the contention, and may I call the
2 Board's attention to Pages 2 and 3 of Applicants' Exhibit 42,
3 which is a quotation of the contention, and you look at the
4 contention itself under "11" on Page 2, it says, "The health
5 and safety consequences to the public and plant employees which
6 may occur if the CRBR merely complies with current NRC
7 standards for radiation protection of the public."

8 This contention does not relate to fuel cycle
9 facilities. It is explicit to CRBR, and it talks of genetic
10 effects to the general population from the plant employee
11 exposure, and it talks about the induction of cancer from the
12 exposure of plant employees and the public.

13 The question, therefore, goes beyond the scope of
14 the contention and the testimony.

15 MS. FINAMORE: Judge Miller, I believe it's a
16 matter of interpretation what the scope of the contention is.
17 I was merely trying to establish that that's the interpretation
18 given in the testimony by the witnesses who have not attempted
19 to discuss genetic effects from fuel cycle, but merely from the
20 plant itself.

21 JUDGE MILLER: I'm not sure I understand you.
22 You say there is no difference between your interpretation of
23 that and Mr. Edgar's? You are both talking about the genetic
24 effects and consequences to the public or to employees of the
25 plant?

18-12 1 If I understood you correctly, you said that's
2 what you were asking the witnesses and that the witnesses were
3 responding, and that is consistent with Mr. Edgar. So far there
4 is no dispute between you or among you.

5 MS. FINAMORE: Well, I've been informed that our
6 original intent in providing this contention was to discuss
7 genetic and somatic impacts from CRBR and its fuel cycle.

8 JUDGE MILLER: Well, I don't know of any such
9 indication of that. You'll have to refresh my memory if you
10 claim that something else does it.

11 None of the Board recalls that. It certainly is
12 not contained within the contention that we did admit,
13 Contentions 11(b) and (c), and I'm looking now at the ones
14 that were admitted in the order.

15 MS. FINAMORE: If you notice in the Final
16 Environmental Impact Statement Supplement the Staff has in
17 fact calculated the genetic and somatic effects from both
18 the CRBR plant and its associated fuel cycle.

19 Applicants, however, have only discussed the
20 genetic and somatic effects from the plant itself.

21 MR. EDGAR: Well, the Staff in the FES is not
22 confined to the scope of contentions. It has broader
23 considerations. What we are talking about is the --

24 JUDGE MILLER: Even if there were no contentions,
25 the Staff would have the responsibility of submitting -- putting

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1 into the record their NEPA documents.

2 MS. FINAMORE: Well, the testimony of the Staff
3 witnesses, as well, deals with the genetic and somatic effects
4 of both the plant and its fuel cycle, and they state it is in
5 response to Contentions 11(b) and (c) of Intervenors.

6 JUDGE MILLER: Well, we'll hear from the Staff. You
7 mean in testimony yet to be presented by the Staff's witnesses?

8 MS. FINAMORE: That's correct.

9 JUDGE MILLER: Staff, what do you say?

10 Let me be clear now, the Board's memory, as well
11 as examination of the order admitting contentions, is consistent
12 with Mr. Edgar's interpretation of it; so if you are going to
13 try to bring anything else in, you be thinking about it while
14 the Staff is conferring. I guess they have conferred.

15 Is that correct, Mr. Swanson?

16 MR. SWANSON: First of all, of course, it is
17 correct that the FES did address the environmental effects of
18 not only the plant, but the field cycle.

19 The general effects of the entire population,
20 genetic effects to the general population are considered in
21 the Staff's testimony.

22 There is one line of the testimony which happened
23 to include a total of the dose to the population which would
24 include an item from the field cycle, but by no means should
25 that line dictate the way the Board ruled back in April 1976

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1 when it admitted the contention.

2 I'll admit to some amount of unclarity myself as
3 to just how the numbers should have been in. If it's the Board's
4 determination that in fact the genetic effects should be
5 segregated out for the facility itself, which as I understand,
6 there is one number or something that could easily be deleted
7 from the Staff's testimony on genetics only; not from somatics.
8 Somatic does deal just with the plant.

9 (Bench conference.)

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1 MS. FINAMORE: Which sentence are you referring
2 to?

3 MR. SWANSON; The Staff's testimony was
4 desgined to address the contention dealing primarily with
5 the effects of worker exposure as well as effects on the
6 population from the plant.

7 At one point we happened to include a number
8 which we'll concede in a pre-filed written testimony,
9 which included a dose -- it's in Answer 12, on the fourth
10 line, which happens to be a cumulative dose from one table of
11 the FES which happened to be all effects.

12 As I mentioned, though, it seems a little
13 backwards to determine what the Board's basis was for
14 admitting the contention in the first place, but what we
15 -- by a number that we happened to have in our pre-filed
16 testimony.

17 If it's the Board's ruling that, in fact, the
18 basic contention is limited to plant effects, we can very
19 easily eliminate that one number.

20 We haven't offered it yet.

21 JUDGE MILLER: We don't really believe that the
22 Staff, by virtue of whatever it does in the FES, can alter
23 the nature of the Board's inquiry, the issue before it nor
24 the contentions admitted.

25 Now, in part, of course, the Staff is performing a

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1 somewhat different function and, as we say, even if there
2 were no admitted contentions, the Staff would still, on
3 behalf of NRC, necessarily would have to come up with a
4 drafted environmental impact statement and with an FES.
5 And that's complying with the NEPA duty and the NEPA statute
6 but that, in and of itself, does not impair nor modify nor
7 limit the jurisdiction of the Board, which is to allow
8 a contested application for a construction permit and for
9 a limited work authorization.

10 Those matters which are projected under
11 pleadings, which in our practice, we denominate as
12 contentions....

13 MR. SWANSON: Well, so there's no confusion,
14 I'm not suggesting that we want to in any way limit our
15 FES. We readily admit. We address the whole picture in
16 the FES. What we are addressing in pre-filed testimony
17 is within the scope of the contentions and --

18 JUDGE MILLER: Well, that's, I think, what
19 matter comes to our attention here. Your pre-filed
20 testimony has not yet been offered and certainly has not
21 been accepted. So, if there is some conflict between the
22 scope of the issues as admitted by the Board and contentions,
23 both in 1977 and as updated or modified last year, certainly
24 the Board is going to stick to its issues as set forth
25 in the Contentions.

1 Yes.

2 MS. FINAMORE: I believe Mr. Edgar referred to
3 the Board's order of April 6, 1976.

4 JUDGE MILLER: That was the one that set up
5 the contentions?

6 MS. FINAMORE: That is the one that originally
7 admitted the contentions. It was originally numbered
8 Contention 7.

9 Mr. Edgar stated that that contention provided
10 evidence that it only applied to CRBR plant operations,
11 rather than fuel cycle operations.

12 However, a reading of the Board's order does
13 not seem to me to apply to that point at all. It merely
14 states that -- the middle paragraph under Title Contention
15 7 :

16 "At the request of the Board, the
17 Intervenor, NRDC, has reworded
18 Contention 7A to eliminate a
19 challenge to the regulations and
20 to state a residual risk claim for
21 a NEPA analysis, even if the
22 regulations are complied with.
23 This reworded contention does not
24 waive the right NRDC to assert the
25 original contention which was

1 denied above."

2 and it has transcript citations.

3 "As reworded, we hold Contention 7A
4 as admissable."

5 I don't think that provides much light one way or the
6 other as to the meaning of the Contention.

7 It's also my recollection that when the
8 Contention was readmitted in April of this year, it was
9 stipulated to by the parties, except for another sub part
10 of 11, which is not at issue here.

11 MR. EDGAR: That is exactly correct.

12 I agree with Ms. Finamore that her citation to
13 the order which she related does not shed a bit of light
14 on the subject.

15 That, in fact, the Contention was not contested.
16 The Contention is what it is. Plain English.

17 The Health and Safety consequences which must
18 -- which may occur if the CRBR merely complies with current
19 NRC standards for radiation protection. That's the
20 Contention.

21 We are entitled to fair notice of what the
22 issues are. We have proceeded to address them and we are
23 not obligated to go beyond the bounds of the Contention.

24 JUDGE MILLER: The Contentions were the subject
25 of considerable discussion at two pre-hearing conferences,

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1 I believe, and we finally stated very clearly we were going
2 to set them forth once and for all, no matter what has
3 previously been said, numbered and so forth.

4 We made a very definite attempt to have them in
5 one place and we do have Appendix 1 admitted and renumbered
6 contention and published in the 15 NRC 355, April of 1982.
7 It's in our published reports.

8 We intend for that to be dispositive as to fram-
9 ing of the contentions, regardless of whatever -- what might
10 have been said previously by Counsel, the Board or anyone
11 else.

12 MS. FINAMORE: Well, Mr. Chairman, this
13 particular Contention, since it was stipulated, was not
14 the subject of --

15 JUDGE MILLER: No.

16 MS. FINAMORE: -- much discussion at all.

17 JUDGE MILLER: We made it perfectly clear that
18 the Board wasn't going to be bound by the stipulation of
19 the parties. I went through it. I told you where we
20 wanted to change and, frankly, that jurisdiction was not
21 going to be the subject of stipulation.

22 It could be the subject of agreement among the
23 parties and you could urge it on the Board but the Board
24 reserved at all times the right and duty -- so, that was
25 made clear, I believe, twice. Two different days.

1 MS. FINAMORE: I believe I can explain to you
2 the reason for the wording of the Contention as it is.

3 If, in the Board order that I just read to you,
4 which, although you're not bound by it, might shed some
5 light on this situation in another manner.

6 It says that the Intervenor's reworded
7 Contention 7A , to state a residual risk claim.

8 Now, in other contentions --

9 JUDGE MILLER: You were directed to reword it
10 to do that.

11 MS. FINAMORE: That's correct.

12 JUDGE MILLER: And then the order which
13 followed, this long colloquy in our transcript, was pursuant
14 to the Board's direction.

15 MS. FINAMORE: That's correct.

16 JUDGE MILLER: It's not something which was
17 volunteered by you. It was something that was directed
18 by the Board.

19 MS. FINAMORE: Well, that's absolutely correct.

20 All I'm saying now is, that it was reworded to
21 include the phrase, "If the CRBR merely complies with
22 current NRC standards for radiation protection of the
23 public health and safety."

24 That was the residual risk claim that was
25 added.

1 The original Contention, as I recollect it,
2 referred to all portions of the CRBR operation.

3 JUDGE MILLER: I think you all did and I think
4 that's why it was cut down. The health and safety
5 consequences to the public and plant employees. We didn't
6 mean plant employees down the road or somewhere else.
7 We meant CRBR plant employees, which is one-half, at least,
8 of your radiation exposure problem, the public and plant
9 employees and we meant those. It wasn't something that
10 was a subject of inadvertence by the Board.

11 I can't speak for the parties but we felt
12 that we were pretty clear about it.

13 MR. EDGAR: And from our vantage point and
14 looking at it in terms of notice pleading, I think we're
15 entitled to rely on the plain English. I can't read
16 someone's hidden intention and we can't expect the expert
17 witnesses to do that, either.

18 JUDGE MILLER: Well, the Board is going to rule
19 that the Contention is as it was rephrased at the request
20 and direction of the Board, that the Board was very careful
21 in going through the Contentions and the various objections
22 to them and changes made to some of them.

23 We wanted to get them in one place at one
24 time all of the pleading matters which would frame the
25 issues and we weren't going to be arguing who struck John,

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1 as we've had in other cases.

2 We've been through this kind of thing. We get
3 to a hearing and, boom, everybody says, "My God, I didn't
4 mean that."

5 Well, it's as it is. It's as stated and the
6 plant employees, in our concept, is the same as the public
7 in terms of the health and safety consequences of the
8 Clinch River Plant.

9 So, we're going to adhere that ruling.

10 What was the subject of your motion, Mr. Edgar?

11 MR. EDGAR: It was an objection to a question
12 which went beyond the CRBRP.

13 JUDGE MILLER: The objection will be sustained,
14 then, and the record will show your disagreement but,
15 nonetheless, you may proceed with your cross-examination and
16 stay within the bounds of the Board's ruling.

17 MS. FINAMORE: I don't believe it's necessary
18 to take exception to that ruling.

19 JUDGE MILLER: No, it's not necessary. You
20 have the benefit

21 BY MS. FINAMORE:

22 Q Dr. Preston, are you aware that the Staff
23 uses a dose estimate for occupational exposure of 1000
24 man-rem, rather than a 400 man-rem assumed in your
25 analysis?

1 WITNESS PRESTON:

2 A Yes, I am aware of that,

3 Q Dr. Preston, have you calculated genetic
4 effects for any dose estimates other than the ones given on
5 Page 4 of your testimony?

6 WITNESS PRESTON:

7 A With the addition that we have just done a
8 rapid calculation over .1 man-rems in place of 2 man-rems,
9 no, I have not.

10 Q Mr. Healy, am I correct that you performed your
11 somatic cancer analysis based solely on the dose
12 estimates given on Page 4 of your testimony, as corrected?

13 WITNESS HEALY:

14 A That is correct.

15 Q Is it correct that you have no independent
16 basis for judging whether those dose estimates are correct?

17 WITNESS HEALY:

18 A That is correct.

19 Q Have you performed somatic risk estimates
20 for any dose estimate, other than the ones given on Page 4
21 of your testimony?

22 WITNESS HEALY:

23 A Those are the doses that we used for the CRBR
24 plant.

25 Q So, is it correct that you have not calculated

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2 somatic risks for any dosage other than those given on
3 Page 4 of your testimony?

4 WITNESS HEALY:

5 A. We have not.

6 Q. Dr. McClellan, I'll ask you this question. If
7 anyone else is more prepared to answer, please let me know.

8 On Page 26 of your testimony, Answer 22,
9 approximately two-thirds of the way down the page, you state:

10 "Because of current uncertainties
11 in the data employed by the BIER-III
12 Committee in the derivation of their
13 linear-quadratic estimates, we have
14 chosen to apply the more conservative
15 linear no-threshold hypothesis in
16 the estimates that follow."

17 Would you explain to me what you meant by
18 "current uncertainties in the data employed by the BIER-III
19 Committee"?

20 WITNESS McCLELLAN:

21 A. The point that is being made there is that
22 the BIER-III Committee provided two basic approaches of
23 the linear-quadratic and the linear no-threshold and as
24 there is evidence within the document, in terms of the
25 BIER-III report, some question over the linear-quadratic
estimates, we simply chose to use the more conservative

19-11

1 linear model that was also presented in the report.

2 Q I'd like to focus on what you called "some
3 question" as to the use of the linear-quadratic model.

4 What is the basis for your feeling there is
5 some question of that type?

6 WITNESS McCLELLAN:

7 A My basis is derived primarily from the BIER-III
8 report and its contents, which make note of a differing
9 opinion among the members of the Committee with regard to
10 the model.

11 Q The BIER-III report was published in 1980; was
12 it not?

13 WITNESS McCLELLAN:

14 A That's correct.

15 Q And your testimony refers to current
16 uncertainties; does it not?

17 WITNESS McCLELLAN:

18 A Well, the BIER-III Committee was a committee.
19 The report was prepared and was published and there is no
20 further resolution of what is in that report.

21 The report stands on its own today, thus it is
22 a current report. I mean, it's still current. The
23 information that is there, we used it.

24 Q Dr. McClellan, haven't there been other reports
25 published since 1980 that call into question the use of

19-12

1 the linear-quadratic model used in the BIER-III report?

2 WITNESS McCLELLAN:

3 A I don't recall specific published reports
4 related to that issue, with regard to the BIER-III
5 Committee report. It stands as reported.

6 Q But are you aware of any reports that might
7 shed some uncertainty on the use of the linear-quadratic
8 model, that have been published since 1980?

9 WITNESS McCLELLAN:

10 A Yes.

11 Q Which reports are you referring to?

12 WITNESS McCLELLAN:

13 A I am referring to a general continuation of
14 a dialogue that was evident in terms of the BIER-III
15 Committee and a continuation of that dialogue in the
16 scientific community with regard to the use of the linear-
17 quadratic estimates.

18 Q Would you define what is meant by the term
19 "continuing dialogue"? Or is there any report that you
20 can think of that is involved in that continuing dialogue?

21 WITNESS McCLELLAN:

22 A What I mean by continuing dialogue, is that
23 the scientific community continues to exchange information
24 on a broad range of matters and that through that exchange
25 of information, that there is a communication, a body of

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1 knowledge that changes with time.

2 That's what I meant to imply by the words
3 "continuing dialogue".

4 That is continuing,

5 Q And you are aware of no specific report or
6 other published matter that might shed uncertainty on the
7 use of the linear-quadratic model?

8 WITNESS McCLELLAN:

9 A I said that I'm not aware of any report that
10 changes substantively the situation as it existed with
11 regard to BIER-III.

12 Q Are you aware of any reports that might
13 relate in another way to the use of the linear-quadratic
14 model, rather than the one you just described?

15 WITNESS McCLELLAN:

16 A None that comes to mind.

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1 BY MS. FINAMORE:

2 Q But it is a fair statement, is it not, that
3 there is recent opinion by experts in the field that
4 indicates the use of the linear quadratic model may not
5 be appropriate?

6 BY WITNESS McCLELLAN:

7 A Yes. I'm aware that some individuals would
8 strongly advocate the use of the linear model over the
9 linear quadratic model.

10 Q Which individuals do you have in mind?

11 BY WITNESS McCLELLAN:

12 A Personally, myself, in this case I felt that
13 the use of the linear model was the appropriate model to
14 use. Thus, I advocated it over the use of the linear
15 quadratic model.

16 Q Are there any other individuals that you know
17 of?

18 BY WITNESS McCLELLAN:

19 A For purposes of this proceeding, my colleagues
20 who participated in preparation of the testimony agreed
21 with that viewpoint.

22 Q Are you aware of any other individuals?

23 BY WITNESS McCLELLAN:

24 A Yes. I'm aware of a number of individuals
25 who would subscribe to the use of that -- the linear

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1 approach -- model, as being a more conservative one and
2 use it in favor of the linear quadratic model for pur-
3 poses such as this, keeping in mind certain reservations
4 that it may tend to overestimate the risks that might be
5 realized.

6 Q And which individuals are you referring to?

7 BY WITNESS McCLELLAN:

8 A In using that -- In using the linear model
9 over the linear quadratic model?

10 Q That's correct. You said you were aware
11 of several other individuals.

12 BY WITNESS McCLELLAN:

13 A Several other individuals. Would you like
14 for me to give them by name?

15 Q Yes, please.

16 BY WITNESS McCLELLAN:

17 A Dr. Richard Cutahey, Dr. Bruce Becker. I
18 can -- you know -- continue with other individuals, if
19 the hearing panel so desires.

20 Q Do you consider those two individuals to be
21 experts in their field?

22 BY WITNESS McCLELLAN:

23 A Yes, I do.

24 Q Do you think it prudent to consider the
25 opinions of other experts in the field that may differ

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1 with the opinions presented in the BEIR-III Report?

2 BY WITNESS McCLELLAN:

3 A I've always considered it prudent to consider
4 the opinions of other individuals in the scientific
5 field and weigh their opinions accordingly.

6 Q Do you think the opinion of other experts in
7 the field on matters related to the BEIR-III Report would
8 give you some indication of the uncertainty in the esti-
9 mates used in the BEIR-III Report?

10 JUDGE MILLER: Pardon me. Aren't the uncer-
11 tainties those in the data employed by the BEIR-III
12 Committee? Isn't that what you're addressing, in line
13 with the testimony on Page 26?

14 MS. FINAMORE: Yes. The testimony refers
15 to data employed by the BEIR-III Committee and the
16 derivation of their estimates.

17 JUDGE MILLER: Well, when you talk about un-
18 certainties, are you changing the ground rules; or are
19 you using them in the same context in which the testimony
20 has been prepared?

21 MS. FINAMORE: The same context as the testi-
22 mony.

23 JUDGE MILLER: Okay.

24 WITNESS McCLELLAN: Since we've had a little
25 lapse, perhaps you could repeat the question so I ...

1 BY MS. FINAMORE:

2 Q In determing -- I'll rephrase the question.

3 In determining whether there is uncertainty
4 in any of the data used by the BEIR-III Committee, do you
5 think it appropriate to consider the views of other ex-
6 perts in the field as an indication that there is some
7 uncertainty?

8 BY WITNESS McCLELLAN:

9 A Yes. I think that the extent to which in-
10 dividuals may look at data -- the same set of data and
11 see it in different light may give you an indication of
12 a degree of uncertainty with which the scientific com-
13 munity looks at the data.

14 Q And it might also indicate a degree of
15 uncertainty in the data used by the BEIR-III Committee;
16 is that not true?

17 BY WITNESS McCLELLAN:

18 A I think it could give an indication of the
19 uncertainty, yes.

20 Q Concerning the models used by the BEIR-III
21 Committee as opposed to the data employed in those
22 models, would you also consider the views of other ex-
23 perts in the field regarding the adequacy of those
24 models in your analysis?
25 /

1 BY WITNESS McCLELLAN:

2 A Yes, I would -- as a scientist I feel it's
3 appropriate to listen and hear all opinions as relate
4 to the subject matter at hand and then to use my best
5 professional judgment in proceeding on a particular
6 matter.

7 Q If a particular expert, hypothetically, dis-
8 agrees with the use of a model in the BEIR-III Report,
9 would that indicate to you some uncertainty in the
10 reliability of that model?

11 MR. EDGAR: I'll object to the question on
12 the grounds that that hypothetical is so speculative.
13 Unless we have a specification of which expert, under
14 which conditions and which model --

15 JUDGE MILLER: Sustained.

16 BY MS. FINAMORE:

17 Q Dr. McClellan, are you aware of a paper
18 prepared by Lowe and Mendelsohn -- that's L-o-w-e and
19 M-e-n-d-e-l-s-o-h-n -- in February of 1971 entitled
20 "Revised" -- excuse me -- '81, entitled "Revised Dose
21 Estimates at Hiroshima/Nagasaki"?

22 BY WITNESS McCLELLAN:

23 A I am not certain as to the specific paper
24 you may be referring to. I'm aware of several papers
25 that they have presented -- information they have presented

1 in that subject area.

2 Q Didn't those papers suggest that the calculated
3 doses to victims of the Nagasaki bombing may have been
4 underestimated?

5 BY WITNESS McCLELLAN:

6 A The heart of those papers went to the question
7 of the extent of the neutron dose contribution.

8 Q To the victims at Nagasaki; is that not
9 correct?

10 BY WITNESS McCLELLAN:

11 A Yes.

12 Q Didn't it say -- Didn't that paper suggest
13 that that particular dose contribution may have been under-
14 estimated?

15 BY WITNESS THOMPSON:

16 A If I can respond to that --

17 Q Please do.

18 BY WITNESS THOMPSON:

19 A I believe it said that some of the doses might
20 have been underestimated and some of them might have
21 been overestimated. It essentially called for a complete
22 re-evaluation of the relative contribution of neutron and
23 gamma dose to the victims of that explosion.

24 MR. EDGAR: Dr. Thompson, could you move a
25 little closer to the mike. We couldn't hear you on this

20-7

1 side.

2 BY MS. FINAMORE:

3 Q Isn't it correct that that substantial re-
4 evaluation of the dose to the victims at Nagasaki is pre-
5 sently undergoing?

6 BY WITNESS THOMPSON:

7 A Yes, that's my understanding.

8 Q And isn't it a fair statement, Mr. Thompson --
9 Dr. Thompson, that that present re-evaluation would in-
10 dicate that there is substantial uncertainty as to the
11 doses to those particular victims?

12 BY WITNESS THOMPSON:

13 A There has always been uncertainty. I don't
14 know that the uncertainty is any more substantial now than
15 it was previously. In fact, they're attempting to reduce
16 the uncertainty and get at a better estimate of the
17 dose.

18 Q But you'd admit that there is substantial
19 uncertainty at this time, would you not, whether or not
20 it was substantial --

21 BY WITNESS THOMPSON:

22 A There is and has been uncertainty.

23 Q Would you consider it to be substantially
24 uncertain?

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BY WITNESS THOMPSON:

A I don't know what you mean by "substantial."

Q Well, you said that the doses were being completely re-evaluated.

BY WITNESS THOMPSON:

A That's correct.

Q So isn't it substantially uncertain how that re-evaluation will turn out and what the doses will be, once that re-evaluation is completed?

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1 MR. EDGAR: Objection. The witness has indi-
2 cated that he cannot answer the question about "sub-
3 stantial uncertainty."

4 MS. FINAMORE: Well, he asked me what I meant
5 by "substantial uncertainty."

6 JUDGE MILLER: So far the witness has inquired
7 what counsel meant. Now, he may or may not find the
8 explanation meaningful so that he can make an answer.
9 We'll have to leave that to the expert.

10 WITNESS THOMPSON: In my opinion, the changes
11 that are apt to result from this re-evaluation will not
12 be substantial.

13 BY MS. FINAMORE:

14 Q Do you believe that as a result of this re-
15 evaluation the numbers used to calculate doses in the
16 BEIR-III Report could go up by a factor of two?

17 BY WITNESS THOMPSON:

18 A I would be surprised if the difference was
19 that great.

20 Q Is it possible that they could go up by as
21 much as a factor of two?

22 BY WITNESS THOMPSON:

23 A I suppose it's possible.

24 Q Is it fair to say, Dr. Thompson, that the
25 re-evaluation of the doses to the Nagasaki victims has been

1 interpreted by some experts in the field as indicating
2 that the linear quadratic model may not be appropriate?

3 BY WITNESS THOMPSON:

4 A I believe that's part of the reason why we
5 chose not to use the linear quadratic model.

6 Q So your answer is yes; am I correct?

7 JUDGE MILLER: I didn't hear that.

8 WITNESS THOMPSON: Could you repeat the
9 question?

10 BY MS. FINAMORE:

11 Q Is it a fair statement that some experts
12 have suggested that the re-evaluation of the doses to
13 the victims at Nagasaki indicates that the use of
14 the linear quadratic model is not appropriate?

15 BY WITNESS THOMPSON:

16 A I wouldn't say that there is an indication
17 that it's not appropriate. I would say that the re-
18 evaluation may shed additional light on what is appropriate.

19 Q Is one possible outcome of the re-evaluation,
20 in your mind, an indication that the linear quadratic
21 model may not be appropriate?

22 BY WITNESS THOMPSON:

23 A I would not want to speculate on that.
24 The re-evaluation is in progress. I don't know how it
25 might turn out.

20-11

1 Q Is that one possible outcome that might
2 occur?

3 BY WITNESS THOMPSON:

4 A It obviously is a possible outcome.

5 Q Turning to Page 27 of your testimony, Dr.
6 McClellan, you've included a Table 1 entitled "Total
7 Cancer Mortality Per Million Person-Rems."

8 In that table you use two methods in deter-
9 mining total cancer mortality entitled "absolute risk"
10 and "relative risk"; is that correct?

11 BY WITNESS McCLELLAN:

12 A Yes, that is correct.

13 Q And is it not also correct that in your
14 estimates of somatic risk on the final page of your testi-
15 mony -- Page 28 -- is a range of estimated somatic
16 effects which correspond at the lower end to the use
17 of the absolute risk model and at the higher end to the
18 use of the relative risk model?

19 BY WITNESS McCLELLAN:

20 A Yes.

21 Q Am I not correct that you have made no at-
22 tempt to determine which one of those two models is more
23 appropriate in your testimony?

24 BY WITNESS McCLELLAN:

25 A Yes.

1 Q And isn't it true that the absolute risk model
2 is not as conservative as the relative risk model?

3 BY WITNESS McCLELLAN:

4 A That is correct.

5 Q Do you believe it appropriate in determining
6 somatic effects to use a range of estimates, such as
7 you've done in your testimony, rather than a single
8 estimate?

9 BY WITNESS McCLELLAN:

10 A Yes.

11 Q Is the reason for that because it is --
12 there is substantial uncertainty in the actual effects
13 and, therefore, range of effects would be more appropriate?

14 BY WITNESS McCLELLAN:

15 A That, I think, is substantially correct.

16 Q How accurate do you believe a single estimate
17 of somatic effects would be in calculations of the
18 Clinch River plant risk?

19 MR. EDGAR: Objection. Again, we're asking
20 the witness to speculate. We haven't specified what are
21 the circumstances or conditions of this phantom single
22 estimate.

23 JUDGE MILLER: That's something that the wit-
24 ness, being an expert, can indicate, if it be signi-
25 ficant.

1 Overruled.

2 WITNESS McCLELLAN: If I'm understanding the
3 question, the question being in terms of the usefulness
4 of a range of values rather than a single value, I think
5 that our testimony addresses that in providing the range
6 of values, one calculated with the absolute risk method,
7 the other with the relative risk method.

8 And I think perhaps unspoken in the testimony
9 is the extent to which the real value could be zero. So
10 there is a range of values that could, in fact, be from
11 zero to zero point two cancers, appreciating that these
12 are estimates.

13 BY MS. FINAMORE:

14 Q Isn't it possible that the upper range could
15 be much higher than the one you just stated, 0.2 cancers?

16 BY WITNESS McCLELLAN:

17 A I believe it's unlikely that the actual
18 value would be in excess of the upper bound of the esti-
19 mate that we have provided.

20 Q But isn't it possible that the upper bound
21 could be higher than 0.2 cancers?

22 BY WITNESS McCLELLAN:

23 A It's possible, but I think it very unlikely.

24 Q Dr. Preston, on Page 24 of your testimony,
25 you estimate the total genetic disorders induced by

20-14

1 population exposure from the CRBRP. Those values are
2 given as per million liveborn.

3 Can you tell me how that would translate
4 into the actual estimated population of the Clinch River
5 area?

6 BY WITNESS PRESTON:

7 A With an estimated population of about 900,000
8 people, one assumes that in a 30-year period that
9 population approximately doubles itself. So one would
10 have approximately one million liveborn in that popula-
11 tion.

12 Q So these are the numbers that you estimate
13 for the actual estimated CRBR population?

14 BY WITNESS PRESTON:

15 A No, these are estimates per million live-
16 born.

17 Q And you estimate that there will be one
18 million liveborn in the Clinch River area by --

19 BY WITNESS PRESTON:

20 A No, I did not estimate that as such. I have
21 estimated the values here on the basis of per million
22 liveborn for the purpose of the calculation.

23 Q Well, I'm just asking you if you can give me
24 a number of genetic effects that you would estimate for
25 the actual Clinch River population?

1 BY WITNESS PRESTON:

2 A Only on that assumption that I made, that
3 the population of one million persons would approximately
4 double itself in a 30-year period.

5 Q Is that a reasonable assumption for the
6 Clinch River site?

7 BY WITNESS PRESTON:

8 A Not being familiar with all the information
9 that goes into that population, I cannot tell you. But
10 the estimates stand as per million liveborn.

11 Q So you don't really know what the actual
12 genetic effect would be for the Clinch River popula-
13 tion?

14 BY WITNESS PRESTON:

15 A Yes, I do. The frequencies would be as stated
16 there on the basis of per million liveborn.

17 Q But you can't give me a number at this
18 point, can you?

19 BY WITNESS PRESTON:

20 A I believe you have the number in the table
21 there -- as -- the frequency based on a per million live-
22 born. You can simply correct that for any other number
23 of liveborn by a simple division or multiplication.

24 Q But you're not familiar with the actual
25 population estimates for the Clinch River site; is that

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correct?

BY WITNESS PRESTON:

A. I'm familiar with the size of the population,
but not at what rate it would repopulate itself.

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21-1 1 Q Dr. McClellan, on Page 28, you estimated somatic
ge 2 effects among the public and the workers for each year of
3 operation of the plant.

4 For the record, can you tell me what those total
5 estimated cancer effects would be for the public and for exposed
6 workers?

7 BY WITNESS McCLELLAN:

8 A The total cancers would be what is shown here,
9 .00015 to 0.00005 cancers among the public, and 0.07 to 0.2
10 cancers among the workers for each year of operation.

11 Q What would that translate to over the lifetime
12 of the plant, the total cancers expected over the lifetime of
13 the plant, rather than each year of operation?

14 BY WITNESS McCLELLAN:

15 A It's my understanding that the plant is -- the
16 license application is for a 30-year period of operation; thus,
17 the values in terms of an aggregate value would be 30 times the
18 values that are shown here.

19 Q Am I correct that would translate into
20 approximately a total of six cancers for the exposed worker
21 population?

22 BY WITNESS McCLELLAN:

23 A That would translate into two to six cancers.

24 Q In your opinion, Dr. McClellan, do you consider
25 that total to constitute a negligible impact upon the health

21-2

1 of the workers?

2 BY WITNESS McCLELLAN:

3 A I haven't personally addressed the question of
4 whether it is a negligible impact or not. I have used my best
5 professional judgment in arriving at these values so they may be
6 used for decision-making purposes.

7 As I indicated earlier, the value might be -- real
8 value could be zero and up to, as we have just gone through, six
9 cancers.

10 Q I'm just asking your expert opinion at the
11 moment.

12 Do you consider that number to constitute a
13 negligible impact on the public health of the workers?

14 BY WITNESS McCLELLAN:

15 A I don't think it would be appropriate for me in
16 terms of using my professional judgment to just use that value
17 along in reaching that kind of a decision.

18 That kind of a decision is one that must have a
19 number of other elements brought to bear beyond the set of
20 values that we are looking at here.

21 Q I'm just asking you about this one particular
22 value.

23 MR. EDGAR: Objection. He has answered the
24 question.

25 JUDGE MILLER: Sustained.

21-3 1 BY MS. FINAMORE:

2 Q On the final sentence on Page 28 you state that,
3 "By way of comparison, one in six of these people would be
4 expected to die of cancer from other causes."

5 Are you referring to -- What do you mean by
6 "other causes"? What does that include?

7 BY WITNESS McCLELLAN:

8 A That includes all other factors that contribute
9 to the causation of cancer in the human population.

10 Q And how did you derive that figure?

11 BY WITNESS McCLELLAN:

12 A That is a figure that is based on national
13 health type statistics.

14 Q Is it your understanding that the causes that
15 you are referring to could include man-made causes as well as
16 natural incidents of cancer?

17 BY WITNESS McCLELLAN:

18 A Yes.

19 JUDGE LINENBERGER: Does your "yes," sir, permit
20 the inclusion of causes such as, let's say, medical X-rays?

21 WITNESS McCLELLAN: Yes, certainly, I would
22 include in terms of the causative factors there such elements
23 as spontaneously originating, use of medical X-rays, the use
24 of various environmental work and social factors.

25 JUDGE LINENBERGER: Thank you.

21-4

1 BY MS. FINAMORE:

2 Q Could it include radiation from other commercial
3 power plants, to your understanding?

4 BY WITNESS McCLELLAN:

5 A To the extent that those past and current nuclear
6 power plant operations are contributing factors, they would be
7 included within past statistics.

8 Q You feel it's probable that that is the case?

9 BY WITNESS McCLELLAN:

10 A If there are cancers that have been caused by
11 those operations, they would be included in any aggregate
12 national statistics that exist today that report all cancers.

13 Q And is it your understanding that cancers would be
14 caused by radiation from commercial lightwater reactors, just
15 as you've estimated it for the Clinch River breeder reactor.

16 MR. EDGAR: Objection on the grounds of relevance.

17 MS. FINAMORE: I'm just trying to find out the
18 basis for his statement in the testimony, how he derived the
19 one-sixth comparison. What are the probable components of that
20 figure.

21 JUDGE MILLER: I think he's told you that twice,
22 hasn't he?

23 MS. FINAMORE: Well, he said if you assume, blank,
24 but I'd like to know whether or not --

25 JUDGE MILLER: He has told you it's national

21-5

1 figures that cover all causes, so you could name, I suppose, a
2 thousand causes and they would all be within the answer, that the
3 statistics on a national basis and time in question, that the
4 universe is such that all means all.

5 So you can continue to go through parts, but I don't
6 see how you are changing the testimony already given. I don't
7 know what you have in mind. You have already got the answer
8 that all includes all, and every example you gave him, including
9 lightwater reactors, was testified to be included within that
10 statistical universe.

11 MS. FINAMORE: I have no further questions of this
12 panel.

13 JUDGE MILLER: Thank you.

14 Staff?

15 MR. SWANSON: Just one short line.

16 CROSS-EXAMINATION

17 BY MR. SWANSON:

18 Q Who on the panel was responsible for Answer 22 on
19 Page 26?

20 BY WITNESS McCLELLAN:

21 A We noted it was a collegial effort. I,
22 Dr. Thompson, Mr. Healy all participated heavily in that, as
23 well as a review by Dr. Preston.

24 I would be happy to address any questions you may
25 have on it.

21-6

1 Q I just want to get a clarification. I have,
2 unfortunately, passed on my copy of the precorrected testimony,
3 but the question now deals with a question of the data base; is
4 that correct? How was that specifically worded?

5 JUDGE MILLER: Question 22?

6 MR. SWANSON: Yes.

7 JUDGE MILLER: "What data are available to
8 calculate the incidence of cancer associated with particular
9 levels of radiation exposures?"

10 MR. SWANSON: I was just handed a corrected copy.
11 Thank you.

12 BY MR. SWANSON:

13 Q Did this data base include the warm particle
14 hypothesis by Martelle; are you aware?

15 BY WITNESS McCLELLAN:

16 A I am aware of the warm particle hypothesis by
17 Dr. Martelle, and it is a hypothesis that certainly was
18 considered in terms of developing our responses here.

19 That is a -- It is a hypothesis which Dr. Martelle
20 has put forth. I would view it at this stage as being an
21 interesting, perhaps speculative, working hypothesis that
22 purports to attribute a significant portion of the lung cancer
23 in cigarette smokers to the inhaled naturally occurring
24 Polonium-210 that occurs in cigarette smoke and the deposition
25 of that material in the conducting airways.

21-7 1 Q You considered it, but do I understand correctly
2 that in your professional judgment you rejected that as having a
3 weight in the analysis of data?

4 BY WITNESS McCLELLAN:

5 A I think we viewed it in terms of our professional
6 judgment, as I said, as an interesting and speculative and a
7 working hypothesis that is not really with a proven foundation
8 today.

9 There are two elements of it which are of particular
10 concern to me as one looks at the hypothesis.

11 The first is that in attributing all or a
12 significant portion of the excess lung cancer attributable to
13 cigarette smoking to the Polonium-210, it fails to recognize
14 the potential role of other known mutagens and carcinogens that
15 are present in cigarette smoke and irritant materials there.

16 It just seems very unlikely that a single factor,
17 the Polonium-210, could account for the total excess lung cancer
18 risk from cigarette smoking.

19 The second point, I think, that one has to keep in
20 mind is that a large number of studies have been done with
21 laboratory animals using a broad range of particles of varying
22 activity, including particles that span across the area of
23 concern when one talks about warm particles.

24 To the best of my knowledge, none of those studies
25 have identified a particular particle size or particle activity

21-8

1 as having unique properties for lung cancer induction, as one
2 would have to have if you were to put a solid foundation under
3 the Martelle hypothesis.

4 MR. SWANSON: Thank you. No further questions.

5 JUDGE MILLER: Is there anything further before
6 the Board has its questions?

7 MS. FINAMORE: Yes.

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FURTHER CROSS-EXAMINATION

BY MS. FINAMORE:

Q Dr. McClellan, isn't it true that when you were referring to the data base employed by the BEIR-III Committee, that Committee was estimating the somatic risk from whole body exposure, for your purposes?

BY WITNESS McCLELLAN:

A The various BEIR Committees have reviewed and considered a broad base of knowledge.

What we used in our specific dose estimates here are the values for whole body dose.

Q And in your testimony you did not consider the lung dose, did you?

BY WITNESS McCLELLAN:

A We did not take specific consideration of the lung dose.

Q Isn't it true that the warm particle hypothesis refers solely to lung dose?

BY WITNESS McCLELLAN:

A Yes.

Q And, therefore, the warm particle hypothesis is not included within the data employed by the BEIR Committee that you referred to in your testimony?

BY WITNESS McCLELLAN:

A In developing the values that are shown on Page 27

21-10

1 of our testimony, as related to total cancers from whole body
2 radiation, I do not believe that the BEIR Committee took special
3 account in developing those values of the warm particle
4 hypothesis.

5 MS. FINAMORE: Judge Miller, it appears to me that
6 the previous line of questioning had nothing to do with the
7 testimony and should be struck, since as the witness just
8 admitted, it's not part of the data base that he referred to in
9 his testimony.

10 MR. SWANSON: The witness just described what the
11 BEIR Committee considered. I asked him what he considered.

12 This question, as reworded, is, "What data are
13 available to calculate the incidence of cancer associated
14 with particular levels of radiation exposures?"

15 I wanted to know what went into his consideration,
16 what did he accept, what did he reject.

17 JUDGE MILLER: In any event, cross-examination may
18 be rather broad, inasmuch as you are testing the expertise,
19 reasoning, everything else.

20 So in that respect, without trying to get into the
21 precise aspects of relevancy, which we believe are with respect
22 to the proposed findings when you get to them, the testimony
23 would not be subject to being stricken.

24 Anything further?

25 MR. EDGAR: We have no redirect.

21-11

BOARD EXAMINATION

1
2 BY JUDGE LINENBERGER:

3 Q Gentlemen, on Page 4 of your prefiled testimony,
4 Applicants' exhibit marked for identification No. 42, that table
5 on Page 4 contains no explicit reference to time.

6 Should it have or not?

7 BY WITNESS THOMPSON:

8 A It is an annual rate. Yes, it should have.

9 Q Annual. Is this, then, per reactor year of
10 operation?

11 BY WITNESS THOMPSON:

12 A Yes.

13 Q Tell me, if you will, to what extent any of the
14 effects reported in the prefiled testimony are sensitive in any
15 substantive way to the source of plutonium used for the Clinch
16 River Breeder Reactor fuel, and by "source of plutonium," I am
17 restricting this to a comparison of plutonium derived from a
18 reprocessing of lightwater reactor utility plant fuel versus
19 weapons grade plutonium?

20 To what extent might any of the results be
21 sensitive to which of those two brands of plutonium, if you
22 will, that might be used?

23 BY WITNESS HEALY:

24 A The radiation doses we used that were given to us
25 by the Staff are whole body doses, and as such do not reflect

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21-12 1 the quality of the plutonium, excepting as it would involve the
2 neutron dose -- well, it wouldn't even do that in the CRBR. I'm
3 sorry.

4 This could happen in the fuel fabrication
5 facility.

6 Q Are there any other places in the testimony where
7 a time dimension or unit needs to be attached to the numbers?

8 BY WITNESS THOMPSON:

9 A I believe it is attached in all the other required
10 places. The risk estimates are made in terms of reactor year,
11 but that is stated, I think.

12 Q Generally speaking, or I guess rather explicitly
13 speaking, I think you gentlemen define genetic disorders in
14 terms of effects on subsequent generations to the person having
15 been exposed; is that correct?

16 BY WITNESS PRESTON:

17 A Yes, that is correct.

18 Q I should like to understand why that is
19 appropriate in the following sense, that radiation, I believe, is
20 acceptably understood to be capable of causing cell damage in
21 the individual receiving the radiation, and cell damage itself,
22 I have the impression, involves gene damage; and, therefore, why
23 is it appropriate to look only to successive generations when
24 you talk about genetic effects, or is this a convention that is
25 just convenient to use?

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BY WITNESS PRESTON:

A. Genetic effects are, as we have defined them here and as they are usually defined, effects that are induced in a parent that are recovered or seen in the offspring.

The type of damage that you refer to is in fact a somatic effect, because it affects somatic cells, and in a dividing cell that might be an effect which is passed on to subsequent daughter cells, but somatic effect in that sort of event might be considered to be a cancer or some other somatic effect.

Q. So in other words, in that sense, since gene damage is not associated with reproductive organs, it is strictly related to somatic effects, I gather?

BY WITNESS PRESTON:

A. That is correct.

- - -

1 BY JUDGE LINENBERGER:

2 Q Does that definition or distinction in any
3 way alter how one evaluates subsequent impacts, such as
4 you've evaluted here? Does it really make any difference
5 how this is defined, somatic versus genetic?

6 BY WITNESS PRESTON:

7 A No. I think for these types of calculations
8 one considers the cells in a person's body of two types:
9 the somatic cell where the effects would be in the
10 individual themselves, and genetic effects which will be
11 induced in germ cells specifically passed on to the
12 offspring.

13 But I don't think it really -- It will not
14 make a difference in the types of calculations made.

15 Q Explicitly is fetal exposure to radiation
16 considered in what you've done here capable of generating
17 genetic effects to the offspring of that fetus?

18 BY WITNESS PRESTON:

19 A In that situation where there are germ cells
20 present that would receive irradiation, yes, it would;
21 and, yes, I did take it into account. The absolute
22 sensitivity of the fetus is approximately the same.

23 Q Finally, although you've done it once or
24 twice already, would you please explain once again the
25 origin of the factor of 20 production on Page 4, that

1 sort of made its way through the rest of the prefiled
2 testimony.

3 BY WITNESS McCLELLAN:

4 A Yes. We were originally provided for the
5 general population a dose or exposure value of two man-
6 rem per year.

7 Q By whom?

8 BY WITNESS McCLELLAN:

9 A That was provided to us. Its origin, I
10 believe, was the Staff in terms of the draft FES material
11 that we received.

12 Subsequently -- and subsequent to preparation
13 of this testimony, we were advised that the final value
14 that would appear and that we have verified does appear
15 in the document, is 0.1 man-rem.

16 So it's simply a matter that at one point in
17 time the estimate that was provided to us was two man-
18 rem, and subsequently a revised value was provided. That
19 revised value was 0.1 man-rem.

20 Q Did any of you attempt to assess the reason-
21 ableness of that reduction? Did you put it to any test of
22 reasonableness within your own context of expertise?

23 BY WITNESS McCLELLAN:

24 A No, we did not. We were not asked to address
25 that question. We took as a given the values provided to

1 us, in terms of the estimates of exposure for the popula-
2 tions and then using that as starting input, made our
3 estimates of the health risks.

4 Q Well, at the risk of being a little ridiculous
5 here, suppose you had been told, "No, it's a thousand
6 times smaller," would you also have accepted that and
7 marched that factor of a thousand through the testimony
8 without a test of reasonableness; or is there some point
9 where you would indeed raise your eyebrows and say,
10 "Whoa, there, let's understand how that happened"?

11 BY WITNESS McCLELLAN:

12 A That's a difficult question. From the stand-
13 point of scientific curiosity, if I had sufficient time
14 and the resources available, I would like very much to do
15 exactly what you've said.

16 I did not have that, nor did my colleagues,
17 in terms of this particular activity -- have the op-
18 portunity, in terms of time, to go back and do those kinds
19 of assessments.

20 So we did not. Now, I can't really address
21 the question of whether -- you know -- if the value were
22 substantially lower or substantially higher, would we have
23 done that.

24 There is no basis, in terms of our activity,
25 to really assess the adequacy of that exposure value. We

22-4

1 had to take that as a given, in terms of our activity.

2 JUDGE LINENBERGER: All right. Thank you very
3 much, gentlemen. That's all I have.

4 JUDGE MILLER: Dr. Hand.

5 BOARD EXAMINATION

6 BY JUDGE HAND:

7 Q On Page 19 of the testimony, Question 17 was a
8 question asked, "What are irregularly inherited diseases?"
9 It's followed by several pages of information, including
10 a definition -- two definitions perhaps.

11 And in the definition at the top of Page 20 it
12 includes things that are called constitutional and de-
13 generative diseases.

14 This clearly is falling into the area that is
15 called inherited diseases. Is it clear, in fact, that
16 the data that goes into that is based on heritable ma ... al?

17 And I would add, too, that if I turn to Page
18 24 and look at the current incidence of the irregularly
19 inherited diseases in that table at the top of the page,
20 that the number is very large. It's a huge number,
21 90,000 per million.

22 It just sort of startled me that we've got
23 something that appears so messy in identifying the basic
24 genetics. And yet we come up with a very large number
25 for this factor.

22-5

1 Now, we want to look at it. You, indeed, have
2 made calculations for CRBR's comparative contribution
3 to the natural role.

4 I just find it a little difficult to think
5 about.

6 BY WITNESS PRESTON:

7 A. The value of 90,000 comes -- in the table on
8 Page 24 -- comes from the percentage presented at the top
9 of Page 20, nine percent of one million is 90,000.

10 90,000 comes from the nine percent. The nine
11 percent value used by BEIR-III comes from a British
12 Columbia population study.

13 There are several other population studies
14 that come out with similar percentages. It is a fuzzy
15 category. The most likely thing that would happen on
16 larger population studies is the percentage would, in
17 fact, go up.

18 The current incidence would, thus, go up.
19 And so the values used in the table would not change.

20 It is an area that is difficult to study be-
21 cause they are irregularly inherited diseases, so you
22 need the information over several generations in order
23 to determine the inherited nature for something that
24 doesn't show up in every generation.

25 So it is a muddy category in that respect, but

1 I would say at this point that it's underidentified
2 rather than overidentified.

3 Q Can you help me a little bit in trying to
4 understand what kind of information allows it to be called
5 "inheritive," and yet the irregularly -- put that in
6 front of it -- I'd like to just get at the inherited part
7 of it. Don't worry about the irregularity.

8 BY WITNESS PRESTON:

9 A The fact that in familial pedigree
10 studies there is the return in -- either in subsequent
11 generations or by missing generations, there is a return
12 of the specific disorder. It does show up with more
13 regularity than random when doing pedigree studies.

14 Q And this might be anything from senility
15 to appendicitis?

16 BY WITNESS PRESTON:

17 A Various are eye defects, senility, yes. A
18 whole range of different diseases.

19 Q And has the scientific community, when they
20 discover that this fits this pattern of an irregularly
21 inherited disease -- then when they find a cataract,
22 does that become a datum in the statistic that leads to
23 a number, like 90,000, quite regardless of the inheritance
24 of that particular datum?

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22-7

1 BY WITNESS PRESTON:

2 A In general, in this case that is what is
3 done. They have established a whole range of diseases
4 that are called irregularly inherited.

5 If that then shows up in a subsequent
6 population study, that would be considered in that cate-
7 gory.

8 Q Is there any evidence that radiation can in-
9 duce this kind of disease?

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22-8

1 BY WITNESS PRESTON:

2 A The answer is no, in humans. In animal
3 studies there is a suggestion that a very small proportion
4 of the mutations induced in -- studies where radiation was
5 given over multiple generations, there is a small in-
6 crease in quantitative characters, not single-gene
7 effects. There is an indication.

8 Q For multiple low ciphers, I guess --

9 BY WITNESS PRESTON:

10 A Yes.

11 Q All of those numbers for current incidence
12 are very round looking numbers: 10,000, 6,000, 90,000.
13 How did that 1100 slip in there for recessive disorders?
14 Why isn't that 1000?

15 BY WITNESS PRESTON:

16 A That's the frequency reported by the BEIR-
17 III Committee from the British Columbia study. It could
18 equally well be 1000. I usually quote it as about 1000.

19 JUDGE HAND: I think that's all. Thank
20 you.

21 JUDGE MILLER: Anything further?

22 (No response.)

23 JUDGE MILLER: Is there any reason why the
24 panel cannot be excused?

25 (No response.)

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JUDGE MILLER: Thank you very much. You may
be excused.

(Witnesses excused.)

MS. FINAMORE: I'd like to renew my request
that the changes to the testimony that have not yet been
reported be reported before the testimony is introduced --
be admitted into evidence.

MR. EDGAR: With permission of the Board and
the parties, I'd like to have a copy marked up overnight
to reflect -- It's a question of dividing by 20, and
get that done accurately, mark it up, provide it to all
parties and then make the offer of the testimony.

JUDGE MILLER: What is it you wish to do?

MR. EDGAR: I'm sorry.

I'd like to have the testimony marked up
overnight, to make sure that several of the preceding
calculations to Page 24 all reflect the division by 20 --
the correct number, and then offer it into evidence
tomorrow.

JUDGE MILLER: Does that mean that there's
some uncertainty in your mind as to whether all of the
corrections of the factor of 20 have been made?

MR. EDGAR: Yes, sir. I explained --

JUDGE MILLER: Is it possible it could be
a large number of such --

22-10

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1 MR. EDGAR: I don't think so.

2 JUDGE MILLER: I was just testing you. All
3 right.

4 MR. EDGAR: Oh, you were cross-examining me.
5 (Laughter.)

6 JUDGE MILLER: You may do as you propose, get
7 this thing cleaned up. By agreement with fellow counsel,
8 we will consider that first thing in the morning.

9 MR. EDGAR: All right.

10 JUDGE MILLER: Now what witness is next?

11 MR. SWANSON: Staff witnesses would be next.

12 JUDGE MILLER: All right.

13 MR. SWANSON: At this time I would ask --

14 JUDGE MILLER: Let's take a short recess
15 while you get them all geared up.

16 (A short recess was taken.)

17 JUDGE MILLER: All right. Have you gentle-
18 men been sworn?

19 MR. SWANSON: One has, and one hasn't. Dr.
20 Edward F. Branagan, Jr., was sworn in August. Dr. Michael A.
21 Bender is new at these proceedings.

22 JUDGE MILLER: Okay. The oath will remain.

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1 Whereupon,

2 EDWARD F. BRANAGAN, JR.

3 was recalled as a witness by and on behalf of the Staff,
4 and, having been previously duly sworn, was examined and
5 testified as follows:

6 JUDGE MILLER: Would you stand, please.

7 Whereupon,

8 MICHAEL A. BENDER

9 was called as a witness by and on behalf of the Staff
10 and, having been first duly sworn, was examined and testi-
11 fied as follows:

12 DIRECT EXAMINATION

13 BY MR. SWANSON:

14 Q Would you first identify yourselves for the
15 record, please, and your affiliation.

16 BY WITNESS BENDER:

17 A I'm Michael A. Bender. My address is the
18 Medical Department of the Brookhaven National Laboratory,
19 Upton, New York.

20 BY WITNESS BRANAGAN:

21 A I'm Edward F. Branagan, Jr. I'm with the
22 Nuclear Regulatory Commission.

23 Q Gentlemen, I'm going to refer to two documents;
24 the first is entitled "NRC Staff Testimony of Michael A.
25 Bender, Ph.D., Regarding Contention 11(b)," and ask if

22-12

1 that was prepared by you, Dr. Bender?

2 BY WITNESS BENDER:

3 A It was.

4 Q Is that -- Do you have any additions or
5 corrections to make to that document?

6 BY WITNESS BENDER:

7 A No, I do not.

8 Q Do you wish to make any changes as a result
9 of the clarification of the Board regarding the scope of
10 the contention in its ruling made earlier today?

11 BY WITNESS BENDER:

12 A With respect to the clarification earlier
13 today, I think it would be appropriate to correct or
14 amend certain numbers that appear in my testimony, which
15 have to do with fuel cycle -- fuel reprocessing exposure.

16 Those changes, if I may read them, would
17 appear on Page 10 of my testimony in the last four lines.
18 In the line starting "2010 is about," the number 1170
19 should be changed to 1000.1. That is one zero zero zero
20 point one.

21 In the next line, the number 0.035 should be
22 corrected to 0.03.

23 In the next line, the number 0.18 should
24 become 0.15, and the number 2.6 should become 2.25.

25 In the last line on the page, the number 2.1

22-13

1 should become 1.8. The number 39 should become 33.

2 In addition --

3 JUDGE LINENBERGER: Excuse me, sir. May we
4 back up to the very first correction you gave us in which
5 you deleted the 1170 and replaced it by what?

6 WITNESS BENDER: 1000.1.

7 JUDGE LINENBERGER: Thank you.

8 WITNESS BENDER: In addition, on the last
9 page of my testimony, Page 13, in Answer 15, about halfway
10 down the page, in parenthesis there is an "i.e., 2.1 to
11 39 genetic effects)."

12 Those two numbers should become, respectively,
13 1.8 and 33.

14 That completes the corrections.

15 BY MR. SWANSON:

16 Q And as modified, do you adopt this as a
17 true and accurate statement of your proposed testimony in
18 this proceeding?

19 BY WITNESS BENDER:

20 A I do.

21 MR. SWANSON: Mr. Chairman, I would ask that
22 this document identified as NRC Staff Testimony of
23 Michael A. Bender, Ph.D., Regarding Contention 11(b)
24 with attached copy of Dr. Bender's professional quali-
25 fications, be marked as Staff Exhibit 12.

1 JUDGE MILLER: 12, okay.

2 (Staff Exhibit No. 12 was
3 marked for identification.)

4 MR. SWANSON: I'll now turn to a document
5 entitled "NRC Staff Testimony of Edward F. Branagan, Jr.,
6 Regarding Contention 11(c)," and ask you, Dr. Branagan,
7 if that document was prepared by you.

8 WITNESS BRANAGAN: Yes, it was.

9 BY MR. SWANSON:

10 Q Do you have any additions or corrections to
11 make?

12 BY WITNESS BRANAGAN:

13 A No.

14 Q Do you adopt this as a true and accurate
15 statement of your testimony in this proceeding?

16 BY WITNESS BRANAGAN:

17 A Yes, I do.

18 MR. SWANSON: Mr. Chairman, I would ask that
19 the document just referred to, the testimony of Edward F.
20 Branagan, Jr., regarding Contention 11(c) be marked as
21 Staff Exhibit 13.

22 JUDGE MILLER: So marked.

23 (Staff Exhibit No. 13 was
24 marked for identification.)

25 MR. SWANSON: We had indicated before the

1 time limitation that does exist for Dr. Bender's parti-
2 cipation today. He has to catch a plane.

3 The parties indicated, I think, on the record
4 yesterday that they were able to separate the cross-
5 examination between the two pieces of testimony.

6 I would ask then, if we could -- either that --
7 one of two things -- that the testimony be -- the cross-
8 examination be completed by 5:30, or if that's not
9 likely --

10 JUDGE MILLER: What we will do, we'll go first
11 with Dr. Bender.

12 And then I must caution you, Mr. Swanson,
13 that I've been instructed by Mary, that when you start
14 talking more than 50 miles an hour, I'm going to slow you
15 down and cut you off.

16 I caution you because you're just starting to
17 warm up.

18 (Laughter.)

19 MR. SWANSON: Very good. I will try to slow
20 down.

21 I would ask then that the examination commence
22 first with Dr. Bender, and if at all possible, that we
23 try to conclude the testimony --

24 JUDGE MILLER: We'll start with Dr. Bender at
25 any rate and proceed with Dr. Branagan as soon as we

22-16 1 can.

2 But, at any rate, I take it there's no ob-
3 jection to that; is that, Ms. Finamore?

4 MS. FINAMORE: No, there isn't.

5 JUDGE MILLER: Are you ready for cross-
6 examination?

7 MR. SWANSON: Yes, we are. Thank you.

8 JUDGE MILLER: Very well. Starting with Dr.
9 Bender.

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1 BY MS. FINAMORE:

2 Q Dr. Bender, your testimony states that you are
3 employed by Brookhaven National Laboratory.

4 WITNESS BENDER:

5 A That is correct.

6 Q Is it true that that facility is owned by DOE?

7 WITNESS BENDER:

8 A That is true.

9 Q And could you explain to me what, if any, work
10 you have or are performing for the Department of Energy at
11 this time?

12 WITNESS BENDER:

13 A Yes, surely.

14 My research program at the laboratory is a
15 research program into very largely the molecular basis
16 for genetic effects and it is presently funded at a level
17 of something under one-half of the total support by DOE.

18 The rest comes from other agencies, including
19 the National Cancer Institute and the Centers for Disease
20 Control.

21 Q Would you explain to me whether or not you
22 were involved in preparing any portion of the final
23 environmental impact statement supplement or the draft
24 environmental impact statement supplement?
25

23-2

1 WITNESS BENDER:

2 A I was not directly involved in preparing any
3 portion of either document. However, I did have on one
4 or two occasions, some consultant role, in telephone
5 conversations with those who were preparing those documents.

6 Q And what was the nature of your consultant role?

7 WITNESS BENDER:

8 A To essentially review the genetic effects
9 estimate which appears in originally the FES and then
10 subsequently the FES supplement.

11 Q Were there any changes made to the Staff
12 calculations as a result of your consultation?

13 WITNESS BENDER:

14 A I'm not aware of any that resulted from that
15 consultation.

16 Q Did you review the draft environmental statement
17 supplement, as well as the final?

18 WITNESS BENDER:

19 A I reviewed those portions of it which were
20 pertinent to genetic hazard estimation; yes.

21 Q And you consulted with the Staff on both the
22 draft supplement and the final supplement; is that correct?

23 WITNESS BENDER:

24 A I cannot recall any consultation on the final
25 supplement. However, it's my belief that there were no

3-3
1 changes in the estimates, other than those dictated by
2 the changes in the dose estimates, for which, of course,
3 I was not responsible.

4 Q Have you read the final supplement to the
5 final environmental statement?

6 WITNESS BENDER:

7 A Only those portions which I felt had bearing
8 on my own testimony.

9 Q Dr. Bender, on Page 2 of your testimony,
10 Answer 4, you state -- you state that you used as a
11 basis of your analysis, the genetic effects estimates made
12 by the BIER -- made in the BIER-III report.

13 Are you aware of other genetic effects estimates
14 that you might have used?

15 WITNESS BENDER:

16 A Yes.

17 Q Could you explain those to me, please?

18 WITNESS BENDER:

19 A There are a number.

20 One of them, for example, would be the 1977,
21 I believe it is, UNSCEAR report.

22 Of course, there was the option of using the
23 BIER-I numbers. The choice of those or other bases would,
24 however, have made very little numerical difference in my
25 estimates, in my opinion.

23-4

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1 Q On Page 6 of your testimony, you state in
2 Answer 8, that the estimates given in the BIER-III report
3 were not made specifically for the purpose of evaluating
4 the consequences of the operation of nuclear facilities,

5 Is it possible, in your judgment, that if
6 estimates had been derived specifically for the purpose of
7 evaluating the consequences of the operation of nuclear
8 facilities, those estimates might be different than the
9 ones that you have used?

10 WITNESS BENDER:

11 A No, I cannot agree with that statement.

12 The BIER Committee's report does, in fact, in
13 one of the notes to the genetic effects section, discuss
14 the ways in which one should apply the numbers upon which
15 I have relied, to the question of occupational exposure
16 and at least tacitly, the operation of nuclear facilities.

17 Q You state in your testimony, I believe on Page
18 7, -- well, let me ask you.

19 Is it your judgment that the BIER-III genetic
20 effects estimates that you have used, represent an upper
21 limit?

22 WITNESS BENDER:

23 A Yes. That is my position.

24 Q Are you aware of any statements in the BIER-III
25 report to the effect that those genetic effects estimators

23-5

1 are upper limits?

2 WITNESS BENDER:

3 A I'm sorry. My recollection is not that good.
4 I believe that there are such statements but I would need
5 to check to be absolutely sure.

6 Q So that was not the basis for your conclusion
7 that the BIER-III estimates are an upper limit?

8 WITNESS BENDER:

9 A In order to answer, I have to say that I was
10 in part responsible for the BIER-III estimates. There were
11 some differences of opinion. The BIER-III estimates
12 represent a consensus view.

13 I personally, although I agree with the
14 consensus view in that context, feel, indeed, that they
15 do constitute upper bound estimates. That's my personal
16 view.

17 Q But other than your personal view, you don't
18 recall any specific language in the BIER report to that
19 effect; is that not true?

20 WITNESS BENDER:

21 A That is true but I believe that I need to
22 qualify that, if I may.

23 The BIER-III genetic effects estimates are, in
24 fact, ranges and I think it is true that everyone on the
25 Committee, myself included, view the upper bound estimate

23-6

1 as the highest plausible or credible estimate and the use
2 of that would, in my opinion, constitute an upper bound
3 maximum effect estimate.

4 Q Am I correct that you derived your estimates
5 of genetic effects in your testimony based on information
6 regarding dose that was given to you?

7 WITNESS BENDER:

8 A That is quite true.

9 Q And am I correct that you have no independent
10 basis for judging whether or not those doses are correct or
11 reasonable?

12 WITNESS BENDER:

13 A That's true.

14 Q And am I correct that you have done no
15 calculations of what the genetic effects would be if the
16 doeses were, in fact, higher than provided to you?

17 WITNESS BENDER:

18 A No specific calculations.

19 I would point out, however, that since the
20 assumption underlying the estimates is one of linearity
21 or linear relationship between dose and effect, one has to
22 recognize the fact that any change in the dose estimates
23 would simply be reflected by or in a proportionate increase
24 or decrease in the genetic effects estimates.

25 Q Turn now to Page 3 of your testimony, first

23-7

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1 full paragraph.

2 You state that it is generally agreed that the
3 majority of mutations, whether spontaneously arising or
4 induced, are to a greater or lesser extent deleterious.

5 What do you mean by "majority of mutations"?
6 Do you have a specific percentage in mind?

7 WITNESS BENDER:

8 A. I have no specific percentage in mind but to
9 clarify what I mean by majority, is a very large
10 percentage. My own guess would be probably as much as
11 ninety-nine percent (99%).

12 Q And when you state in the middle of that
13 paragraph;

14 " -- that a few human mutations are
15 known to have both deleterious and
16 beneficial effects, depending on the
17 circumstances -- "

18 am I correct in inferring that these mutations, if the
19 circumstances are such, they would have -- it's possible
20 that under certain circumstances, those mutations would be
21 completely deleterious?

22 WITNESS BENDER:

23 A Yes. That's quite so. What the statement says
24 is, that depending on the circumstances, they could be
25 either deleterious or beneficial.

1 Q I see,

2 And am I correct that you don't know how many
3 mutations fall in that category?

4 WITNESS BENDER:

5 A I know of only a very few human mutations
6 falling in that category. It is, we think, prudent to
7 summarize that there are undoubtedly ones that we have not
8 yet identified.

9 Q In the middle of that paragraph, you state;
10 "that most mutations, however, have relatively minor
11 effects and many produce no detectable effect at all upon
12 the individuals health or well-being.".

13 Is it possible that in that case, mutations
14 might appear in the offspring of those individuals? Or
15 effects might appear in the offspring of those individuals?

16 WITNESS BENDER:

17 A That was not the intent of that sentence,
18 although that also is possible.

19 The intent of the sentence was to point out
20 that certain mutations, although they produce a detectable
21 effect, have no detectable effect upon the health and
22 well-being of the individual.

23 As an example, a mutation from a gene calling
24 for brown eyes to a gene calling for blue eyes. This is
25 what the sentence meant.

23-9 1

Q Isn't it possible that a particular mutation, although it has no detectable effect in an individual, would have a deleterious effect in the offspring of such individual.

WITNESS BENDER:

A That is quite true.

Q And isn't it possible that such a deleterious effect could be seriously deleterious or even lethal?

WITNESS BENDER:

A That is also true.

Q Turning now to Page 7 of your testimony, if you would, you quote a paper by Shull, Otake and Neel as the basis for your judgment that the BEIR report estimates may be overestimated.

Now, this Shull report is a recent one; am I correct? 1981.

WITNESS BENDER:

A That is true.

Q Has there been many comments or a critical analysis of this report, to your knowledge?

WITNESS BENDER:

A A paper such as this one, which appeared in the Journal of Science, is, in effect, peer review. So, to that extent, the material contained in it was reviewed and considered by others.

1 On the other hand, I cannot say that I have
2 seen any published discussions of this work myself.

3 Q Is it possible that such critical analysis may
4 be published at some time in the future; in your judgment?

5 WITNESS BENDER:

6 A It is possible.

7 Q And despite that fact, am I correct that you
8 still rely upon it as the basis for your statements in the
9 testimony?

10 WITNESS BENDER:

11 A I do.

12 Q Do you think it's prudent to consider effects
13 of experts such as these in determining whether the results
14 of the BEIR-III Committee still retain their validity?

15 WITNESS BENDER:

16 A Yes, I do.

17 Q Do you believe papers such as those prepared
18 by Shull, Otake and Neel are evidence of the uncertainty
19 attending the estimates in the BEIR-III report?

20 WITNESS BENDER:

21 A Yes, I do.

22 Q Do you feel that the information in the Shull,
23 Otake and Neel report is weighty enough to overturn the
24 conclusions of the BEIR-III Committee?

25

23-11

1 WITNESS BENDER;

2 A. No, I do not.

3 You have used the word "overturn". I believe
4 that had the sub-committee had the paper in its hands at
5 the time we were writing the report, that the effect of it
6 would very likely have been to increase the upper bound of
7 what is called "doubling dose". That is, to make the
8 range of effects given in the report upon which I relied,
9 broader and broader in the direction of considering the
10 possibility that the effects would be less; even then, the
11 minimum bound which we adopted in the absence of the Shull,
12 et al papers.

13 Q So, in your judgment, the findings of the
14 BEIR-III Committee are still subject to evolution, based
15 on new information and analysis?

16 WITNESS BENDER:

17 A. Yes.

18 Q Turning now to Page 8 of your testimony,
19 fourth line from the bottom, you refer to the current
20 spontaneous incidence and that's referring to genetic
21 effects.

22 Could you define what you mean by "spontaneous
23 incidence"?

24 WITNESS BENDER:

25 A. I'm sorry. Perhaps I have the wrong page.

23-12

1 Could you be more --

2 Q Page 8.

3 WITNESS BENDER:

4 A Page 8.

5 Q Fourth line from the bottom, last word in the
6 line.

7 WITNESS BENDER:

8 A Yes. And you wish my definition of
9 spontaneous incidence?

10 Q Yes.

11 WITNESS BENDER:

12 A The spontaneous incidence is simply the current
13 incidence insofar as we can determine, of genetically
14 related ill health, given, stated in the BEIR report and
15 I have used that number to be about 10.6 percent of 106,00
16 per million live births.

17 Q Is it a fair statement, then, that what you
18 call spontaneous genetic effects could also include effects
19 from man-made causes as well as from natural causes?

20 WITNESS BENDER:

21 A Yes. The current spontaneous incidence would,
22 as I understand the term, include the incidence from all
23 causes, whether man-made, not man-made, whether radiation
24 induced or induced by other factors.

25 Q On Page 9 of your testimony, final paragraph

23-13

1 on the page, you state that;

2 " -- the annual whole body non-
3 occupational dose which will be
4 received by the CRBR fifty-mile
5 population is less than 0.09
6 man-rems per year."

7 Do you have any idea what the CRBR fifty-mile
8 population is?

9 / / /

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24-1

1 BY WITNESS BENDER:

2 A I have taken that population to be, in the first
3 place, the population residing within the radius of 50 miles of
4 the proposed plant site; and the second place, to be numerically
5 the value of roughly 910,000 people in the year 2010.

6 Q And that's a population estimate made by the
7 Staff?

8 BY WITNESS BENDER:

9 A Yes, it is.

10 Q Are you aware that that population estimate is
11 different from the one in the 1977 Final Environmental Statement?

12 BY WITNESS BENDER:

13 A I believe that that is correct. It is my
14 impression that the difference is rather small, however.

15 Q Are you aware that the population estimate is now
16 higher than it was in the 1977 FES?

17 BY WITNESS BENDER:

18 A I really cannot recollect in which direction that
19 estimate changed.

20 Q Can you tell me why you used the 50-mile
21 population?

22 BY WITNESS BENDER:

23 A I suppose because that was the -- I'm sure that
24 it was because one of the populations cited in the FES and in
25 the FESS.

24-2

1 Q Were you requested to calculate the effects based
2 on the 50-mile population?

3 BY WITNESS BENDER:

4 A I cannot recall, since I started making some of
5 these calculations in about 1976, whether it was my notion or
6 whether I was requested to do so.

7 Q So you don't know why you chose a 50-mile radius?

8 BY WITNESS BENDER:

9 A That's a fair statement, yes.

10 Q Turning to Page 7 of your testimony, in the middle
11 of the page, you state that, "Because, as already mentioned,
12 our attempts to detect genetic effects in irradiated human
13 populations, notably among the offspring of survivors of the
14 atomic bombings of Hiroshima and Nagasaki, have all failed to
15 demonstrate statistically significant increases, genetic
16 effects estimates such as those in the BEIR III Report rely
17 largely upon data from extensive experiments with mice."

18 Focusing upon the reference to the survivors of
19 the atomic bombings, that refers to epidemiological studies,
20 does it not?

21 BY WITNESS BENDER:

22 A It does.

23 Q What was the sample size of that population
24 studied?

25

24-3

1 BY WITNESS BENDER:

2 A I'm afraid I don't remember what the population
3 size was.

4 Q Do you have any estimate in mind, range of
5 possible population that was studied?

6 BY WITNESS BENDER:

7 A There were several populations studied, in fact,
8 in several separate studies, and the number of individuals in the
9 samples is different for each of those.

10 They are, however, if I remember correctly, of the
11 order of tens of thousands of individuals, with one exception.

12 Q Okay. What was the exception?

13 BY WITNESS BENDER:

14 A The exception was a chromosome aberration study,
15 which was limited, if I remember correctly, to of the order of
16 4,000 subjects.

17 Q In your judgment, is it fair to say that the
18 population is not large enough at this point to enable you to
19 make any unequivocal conclusions regarding the genetic effects
20 in those survivors?

21 BY WITNESS BENDER:

22 A No, I do not believe that that's a fair statement.
23 The populations are what they are, and they -- that is, the
24 number of persons available.

25 They allow us to make upper bound estimates of what

24-4

1 the effects might have been.

2 They don't allow us to demonstrate statistically
3 that there were indeed any effects.

4 Q But you did detect genetic effects?

5 BY WITNESS BENDER:

6 A We are not sure whether those studies detected
7 any induced genetic effects at all. Of course, because the
8 spontaneous incidence is high in many of the categories
9 under consideration, there were effects, that is, cases of
10 genetically related ill health and so forth detected.

11 The question is whether there was any excess in
12 the populations that had irradiated parents.

13 Q But you state in your testimony that there were
14 small numerical excesses noted; is that correct?

15 BY WITNESS BENDER:

16 A That is correct.

17 Q Is it possible, in your judgment, that given a
18 larger population sampling, you might have detected a
19 significant increase in genetic effects?

20 BY WITNESS BENDER:

21 A That is quite possible.

22 Q Turning to Page 11 of your testimony, in the final
23 sentence in that carryover paragraph, it's unclear to me whether
24 you are using a single risk estimate or a range of risk
25 estimates.

24-5

1 BY WITNESS BENDER:

2 A In this particular case, I chose to use as an
3 upper bound the upper bound single estimate.

4 Q Do you feel in general it is prudent to use a
5 range of estimates in determining genetic effects estimates?

6 BY WITNESS BENDER:

7 A Yes, I do.

8 Q In your testimony on Page 13, Answer 15, you
9 again use single estimates of genetic effects among the
10 non-occupationally exposed and the occupationally exposed.

11 Can you tell me where you derived those single
12 estimates from?

13 BY WITNESS BENDER:

14 A As the first sentence of my Answer 15 states,
15 they are upper limits and they were derived from the upper
16 bound estimates in the BEIR Report.

17 Q But in this case, also, do you feel it's prudent
18 to indicate a range of estimates?

19 BY WITNESS BENDER:

20 A As a generality, I believe it is prudent to include
21 a range, which I have done elsewhere in the testimony.

22 This statement was intended as a summary, and the
23 intent was to give some feeling in summary for what the upper
24 bound estimate was, the maximum and credible.

25 Q Am I correct, then, in your judgment, unless you

24-6

1 use an upper bound, it's more prudent to use a range of
2 estimates?

3 BY WITNESS BENDER:

4 A That is --

5 JUDGE MILLER: Unless you use one, you use
6 another, or are you questioning the prudence?

7 MS. FINAMORE: I'll strike the question.

8 Let me rephrase it.

9 BY MS. FINAMORE:

10 Q In your judgment, is it prudent to use either
11 an upper bound limit or a range of estimates?

12 BY WITNESS BENDER:

13 A I certainly feel that it is the extreme of
14 prudence to use the upper bound estimate, the single value.

15 I prefer personally to give a range. I would
16 not, however, object strenuously if someone wished to take some
17 point in the middle and use that as the single estimate.

18 The objection I would have is it does not give
19 the reader or hearer any real feeling for the plausible
20 variance about that estimate, how good an estimate it is, in
21 other words.

22 Q Again on Page 13, you note that, "The Staff
23 central estimate...results in 9 genetic effects."

24 Is it possible that all of those nine genetic
25 effects could be lethal?

24-7

1 BY WITNESS BENDER:

2 A I suppose that it has to be said to be
3 possible. I consider it very, very highly unlikely.

4 Q But it's likely, is it not, that all of those
5 genetic effects would be deleterious?

6 BY WITNESS BENDER:

7 A To one extent or another, yes.

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24-8

1 Q Is it possible that a large number of those
2 effects would be seriously deleterious?

3 BY WITNESS BENDER:

4 A Again, I would have to say that it is certainly
5 within the realm of possibility, but my personal judgment is
6 that it is highly unlikely.

7 Q In your judgment, do those nine genetic effects
8 constitute a serious impact upon human health and safety?

9 JUDGE MILLER: To the individuals, or are you
10 comparing it with something larger?

11 MS. FINAMORE: I'm referring to the individuals.

12 JUDGE MILLER: I guess every one.

13 All right, go ahead.

14 MR. SWANSON: I just want to make sure I
15 understand the question.

16 Is it of serious public health and safety; was
17 that the question?

18 MS. FINAMORE: Well, as Judge Miller pointed
19 out, I'm referring to the individual, the health and safety
20 of those individuals.

21 WITNESS BENDER: Well, one cannot say that any
22 health impact on anyone is trivial from the point of view of
23 that individual.

24 On the other hand, I think that for the present
25 purposes, one has to put a number, such as nine, in perspective,

24-9 1 and I attempted to do that in my Answer 15, making the
2 comparison that those nine would appear against the background
3 of over a hundred thousand that would occur, even in the
4 absence of the building of this particular plant.

5 So percentagewise, one has to conclude, I think,
6 that it's a rather minor, and indeed, it would be an undetectable
7 increase in human ill health.

8 BY MS. FINAMORE:

9 Q Let's assume as a hypothetical that all those
10 nine genetic effects were lethal. Would you still consider
11 those effects to be -- or would you consider those effects to
12 be negligible upon the public health and safety?

13 BY WITNESS BENDER:

14 A I believe the answer to that has to depend in part
15 on the period in life at which these hypothetical effects were
16 lethal.

17 However, were they all to be lethal at some time
18 in life, instead of, as we defined in the BEIR Report, the
19 nature of a genetic effect simply causing the individual
20 possessing the mutation to have to seek medical care at some
21 point in life, I would have to state the fact they were all
22 lethal would make them less acceptable with the population and
23 constitute a larger public health burden.

24 Q In your estimation, the genetic effects could be
25 up to 33 people; is that correct?

24-10

1 BY WITNESS BENDER:

2 A Yes, that is correct.

3 Q Let's assume as a hypothetical that all those
4 effects were lethal. Would you consider that to be a serious
5 impact upon public health and safety?

6 BY WITNESS BENDER:

7 A Within the context of what I have said earlier in
8 previous questions, from the point of view of the individual,
9 of course, they can't be considered negligible.

10 I would point out, however, that this maximum of
11 33 is over all future human generations.

12 We have no way of knowing how many future
13 generations there may be or how many live births, but it is
14 surely some huge number, and if 10 or 11 percent of them are
15 affected any way, the additional 33 will surely be a very tiny
16 percentage increase.

17 Q Am I correct, then, that under our assumption that
18 all 33 effects would be lethal, you do not consider that to be
19 a serious impact upon public health and safety?

20 MR. SWANSON: Objection. The question is
21 already asked and answered. The witness put it in perspective
22 and answered it.

23 JUDGE MILLER: Sustained.

24 BY MS. FINAMORE:

25 Q Dr. Bender, am I correct that you served on the

24-11

1 BEIR-III Committee?

2 BY WITNESS BENDER:

3 A Yes.

4 Q Are you familiar with the BEIR-III Report? I
5 assume you are since you stated it in your testimony.

6 BY WITNESS BENDER:

7 A Yes, I am.

8 Q I'd like to read you a statement from the BEIR-III
9 Report and I can show it to you.

10 BY WITNESS BENDER:

11 A I have a copy in front of me, if you'll give me
12 the page.

13 Q Wonderful. I'd like to refer you to Page 71 of
14 the BEIR-III Report.

15 The final sentence on that page, or rather, the
16 final paragraph of that page, says, "Since the publication of
17 BEIR-I, new data have been obtained and perspectives have been
18 modified to an extent that makes a new review desirable. The
19 methods of BEIR-I remain valid; however, new numbers have caused
20 some changes in the estimates and some new methods of
21 estimation have been added."

22 Do you agree with that statement?

23 BY WITNESS BENDER:

24 A Yes, I do.

25 Q Would you explain what the BEIR-I Report is,

24-12

1 please?

2 BY WITNESS BENDER:

3 A. BEIR-I Report is a report of a committee on the
4 biological effects of ionizing radiation, which was dated
5 1972.

6 Q. Is it a fair statement, then, that other than
7 the effects of new numbers, the methods of BEIR-I remain valid?

8 BY WITNESS BENDER:

9 A. That is a fair but incomplete statement. One of
10 the things which was developed between the deliberations of
11 the BEIR-I and the BEIR-III Committees was a new method for
12 making one particular kind of estimate based upon the
13 acquisition of new data; but otherwise, yes.

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1 BY MS. FINAMORE:

2 Q Well, I have the BEIR-I Report in front of
3 me. I'd like to read to you a statement from that Report.
4 Do you have a copy of that Report also?

5 BY WITNESS BENDER:

6 A Yes, I do.

7 Q Let me read you the title of that. "The
8 Effects on Populations of Exposure to Low Levels of
9 Ionizing Radiation," Report of the Advisory Committee on
10 the Biological Effects of Ionizing Radiation, National
11 Academy of Sciences, November 1972.

12 I'd like to turn your attention to Page 58 of
13 that BEIR-I Report, the second column, the second full
14 paragraph.

15 I quote: "We remind all who may use our
16 estimates as a basis for policy decisions that these esti-
17 mates are an attempt to take into account only known
18 tangible effects of radiation, and that there may well be
19 intangible effects, in addition, whose cumulative impact
20 may be appreciable, although not novel."

21 Do you agree with that statement?

22 BY WITNESS BENDER:

23 A No, I do not.

24 Q And why is that?

25 /

25-2

1 BY WITNESS BENDER:

2 A I'm not sure exactly what this Committee, of
3 which I was not a member, meant by the statement. I
4 personally consider it highly unlikely that there are
5 significant or intangible effects about which we do not
6 already know.

7 Q Is it possible that there could be such ef-
8 fects?

9 BY WITNESS BENDER:

10 A It is conceivable.

11 Q I'd like to turn you now to Page 59, the
12 second column, third full paragraph, which refers to the
13 risk in terms of overall ill health, and I quote: "It is
14 clear that these estimates are subject to great uncer-
15 tainty. The ranges of plausible values are broad, and
16 there is no assurance that the true values are within
17 these ranges. We are well aware that future information
18 will necessitate revisions."

19 Do you agree with that statement?

20 BY WITNESS BENDER:

21 A Yes, I do.

22 Q In your judgment, would that same statement
23 apply to the BEIR-III Report?

24 BY WITNESS BENDER:

25 A Yes.

Q. And I'd like to turn you to Page 56, if you would.

MR. SWANSON: I think I'm going to object if we start going into -- much further into BEIR-I. It's not referenced as a document by Dr. Bender. It's certainly a reasonable exploration of his bases and the confidence he has in the report.

He did rely on it, and it's allowable. I wonder how far we're going to go on this tangent.

JUDGE MILLER: Cross-examination --

MS. FINAMORE: I have one more question.

JUDGE MILLER: -- is not required to track either what you or the witness have said. One of the functions of cross is to test. I assume you won't take a lot of unnecessary time to test, but, certainly counsel is entitled.

Proceed.

MS. FINAMORE: I have one further quote from that Report, on Page 56.

The first paragraph under Subsection (d) states: "There is danger that the previous sections," which you can check for yourself, "by concentrating only on fairly well-defined genetically associated diseases, have dealt with only the exposed part of the iceberg. What about the rest of human illness? It, too,

1 has some degree of genetic determination."

2 Do you agree with that statement, Dr. Bender?

3 WITNESS BENDER: I agree with it in general.

4 I find the phrase, "exposed part of the iceberg," a bit
5 strong for my personal taste. But, in general, I agree
6 with the philosophy, yes.

7 BY MS. FINAMORE:

8 Q Dr. Bender, are you aware of the book entitled
9 "Radiation and Human Health" by John W. Goffman?

10 BY WITNESS BENDER:

11 A Yes, I am.

12 Q Do you have a copy of that book in front of
13 you?

14 BY WITNESS BENDER:

15 A No, I do not.

16 Q Okay. I'd like to read you a statement from
17 this book, and then I'll show it to you. Maybe I'll carry
18 it over to you --

19 JUDGE MILLER: Have you established that the
20 book is that by an acknowledged expert and so forth, so
21 that we're accomplishing something?

22 MS. FINAMORE: Okay.

23 BY MS. FINAMORE:

24 Q Is it your judgment that Dr. Goffman is an
25 expert in the area of radiation and human health?

1 BY WITNESS BENDER:

2 A I am unable to adequately judge Dr. Goffman's
3 qualifications in all areas of radiation and human
4 health. I do not personally consider that he is expert
5 in the area of genetic effects of radiation.

6 Q Can you explain the basis for your statement?

7 BY WITNESS BENDER:

8 A I am unaware of Dr. Goffman's having received
9 any training in the area of genetics. I have read Dr.
10 Goffman's chapter on genetic effects, and it is my personal
11 judgment that he misunderstands some issues and that his
12 conclusions are not correct.

13 Q I have one final quote from the BIER-I
14 Report, on Page 57, the first full paragraph on the page.
15 It says, "Using this value, and again taking 20 rem as
16 a lower limit of the mutation rate" --

17 BY WITNESS BENDER:

18 A Excuse me for interrupting.

19 Q Yes.

20 BY WITNESS BENDER:

21 A Are you speaking of the BEIR-I? I see it
22 now.

23 Q Okay. I'll begin again.

24 "Using this value, and again taking 20 rem
25 as the lower limit of the mutation rate doubling dose,

1 an exposure of 5 rem per generation would increase the
2 equilibrium ill health incidence by 5/20 times 1/5 or
3 5 percent of the present value. With 200 rem as the
4 doubling dose, this would be .5 percent."

5 Do you agree with that statement?

6 BY WITNESS BENDER:

7 A. Neither I nor the BEIR-III Committee would
8 use precisely the same numbers, but the concept I certainly
9 can agree with. At the risk of going further than I
10 should, perhaps I should note, however, that that is for
11 the special case of equilibrium, which is the case where
12 the exposure continues to occur in each generation for
13 enough generations for what the geneticist calls
14 equilibrium to be established.

15 MS. FINAMORE: I have no further questions
16 of this witness.

17 JUDGE MILLER: Thank you.

18 Applicant?

19 MR. EDGAR: We have no questions.

20 JUDGE MILLER: Nothing, I take it, from
21 Staff?

22 MR. SWANSON: If we could take just a moment
23 to talk to the witness, I may have a couple of questions.

24 JUDGE MILLER: Is this the witness you want
25 to put on an airplane?

1 MR. SWANSON: Correct.

2 If I could take just a moment to discuss with
3 him the need for redirect.

4 WITNESS BENDER: I think probably I have
5 missed the opportunity to catch that airplane in any
6 case, so don't feel too pressed.

7 MR. SWANSON: If I could have just a moment's
8 recess.

9 (Pause.)

10 MR. SWANSON: We do have just a few questions
11 on redirect.

12 REDIRECT EXAMINATION

13 BY MR. SWANSON:

14 Q Dr. Bender, you were asked with reference to
15 Page 3 of your testimony about the possibility of
16 mutations going undetected, and then showing up
17 genetically in offspring.

18 I was wondering if that possibility is, in
19 fact, accounted for in your testimony already?

20 BY WITNESS BENDER:

21 A Yes, it is. There are two phenomena at
22 least which would cause such things. One is the recessive
23 nature of some mutations, and the other is the phenomenon
24 known as penetrants to the geneticist, which sometimes
25 causes a dominant trait not to be expressed in one

1 generation, but to be expressed in another.

2 Both of those factors are, in fact, allowed
3 for in the BEIR-III estimates.

4 Q And incorporated into your testimony?

5 BY WITNESS BENDER:

6 A Yes.

7 Q Do you also take account of reports, such as
8 that referenced by Intervenor -- Shull, Otake and Neel --
9 and also mentioned at Page 7 of your testimony?

10 BY WITNESS BENDER:

11 A Yes.

12 Q Those reports are specifically accounted
13 for and a part of the consideration that you made in ar-
14 riving at your conclusions regarding genetic effects?

15 BY WITNESS BENDER:

16 A That is true.

17 Q The size of the population considered in the
18 Japanese study was also raised on cross-examination. I
19 was wondering if you could address to what extent, if
20 any, the size of that population studied affects the
21 competency you have in your genetic analysis?

22 BY WITNESS BENDER:

23 A The populations studied were either the largest
24 ones available or, in the judgment of the persons studying
25 the population, the largest that it's feasible to study.

25-9

1 If the populations had been larger, it is pos-
2 sible that some of the increases, numerical increases, ~~that~~
3 that were seen would have turned out to be statistically
4 significant, and that would have increased my certainty
5 about the human effect estimates that we can make.

6 I would note, however, that they would simply
7 constitute a firmer upper bound in any case.

8 Q Thank you.

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26-1 1 Q Thank you.

ge 2 You were also asked about the size of the
3 population that you assumed in the 50-mile radius of Clinch
4 River in the year 2010, and I was wondering what effect
5 qualitatively it would make in your analysis of dose estimates
6 if the population increased from 910,000 to, let's say,
7 987,000, as was referenced in the 1977 FES?

8 BY WITNESS BENDER:

9 A It would not make any difference at all. In
10 fact, the estimates I have made assumed that the population,
11 whatever its exact size, would be responsible for one million
12 live births in the next 30 years, which is essentially the
13 assumption that it will replace itself, so that the number of
14 potential parents in the population is immaterial to the
15 calculation.

16 Q Finally, you were asked about your current
17 employer, Brookhaven National Laboratory, the funding that it
18 receives from DOE.

19 At the time you were contracted by the Staff to
20 do work on this contention and the time you developed the
21 methodology as to how to perform the analysis to respond to this
22 contention, were you in fact employed at Brookhaven?

23 BY WITNESS BENDER:

24 A No, I was not.

25 Q Who were you employed by at that time?

26-2 1 BY WITNESS BENDER:

2 A At that time I was on the staff of the Johns
3 Hopkins University in Baltimore.

4 Q Addressing that same point, Dr. Bender, you are
5 a member of a number of National Academy of Sciences
6 Committees concerned with radiation effects on human health,
7 including the BEIR-III Committee, the current panel on
8 reassessment of A-bomb dosimetry, and also subcommittees of the
9 National Committee on Radiation Protection, including evaluation
10 of genetic hazards of radioactive isotopes.

11 Your work is also subject to peer review, both
12 this work and work on those committees.

13 I just wanted you to express your opinion as to
14 whether or not you can afford to allow your conclusions to be
15 influenced by the source of your funding when it may be in
16 conflict with your analysis or available data.

17 MS. FINAMORE: Objection to that question.

18 MR. SWANSON: The Intervenors --

19 MS. FINAMORE: He's leading the witness.

20 JUDGE MILLER: How is he leading him? I'm not
21 quite following that.

22 MS. FINAMORE: Well, the conclusion is embodied
23 within the question.

24 JUDGE MILLER: What is that conclusion so embodied?

25 MR. SWANSON: If the Intervenors are willing to

26-3 1 stipulate --

2 JUDGE MILLER: She's getting close to it. Maybe
3 we can --

4 MR. SWANSON: -- that there's an obvious
5 conclusion to that, then we can strike the prior cross-
6 examination and we can go home.

7 JUDGE MILLER: Maybe we can.

8 MS. FINAMORE: I'm sorry. I didn't hear.

9 JUDGE MILLER: The question I'm asking you.
10 When you say it's leading, in the first place, a certain amount
11 of leading is permitted on redirect in order to get to the
12 point that is to be covered as a result of cross-examination.

13 So I don't think it's within the scope.

14 But I was curious as to what you thought was
15 leading and suggestive about the question.

16 MS. FINAMORE: He was asking the witness if he
17 believed that his employment would have any effect on his
18 professional qualifications, but that was not the way the
19 question came out. Is it possible that it would cause you to
20 have any impact on the work that you do.

21 JUDGE MILLER: Had you gone into that inferentially
22 by going into the question of who he was employed by and
23 when, or is this virgin territory, as you see it?

24 MS. FINAMORE: Yes, I did go into that subject.

25 JUDGE MILLER: All right, then, you may answer.

26-4

1 WITNESS BENDER: I think perhaps I had better
2 ask for a restatement of the question.

3 (Laughter.)

4 JUDGE MILLER: We will sell you a copy of this
5 portion of the transcript at a slight charge.

6 I agree that it's a handsome encomium.

7 BY MR. SWANSON:

8 Q Given your status and your --

9 JUDGE MILLER: No. You don't want to have that
10 re-read, do you?

11 WITNESS BENDER: I think I understand what
12 the question is --

13 JUDGE MILLER: I think the question is, whatever
14 the source of employment, as consultant or otherwise, does
15 that in any way cause your testimony here to be other than it
16 otherwise would have been?

17 WITNESS BENDER: No, sir, it did not.

18 MR. SWANSON: That's all the redirect we have.

19 JUDGE MILLER: Any other questions?

20 MS. FINAMORE: Yes.

21 RECROSS-EXAMINATION

22 BY MS. FINAMORE:

23 Q I would just like to know when you became
24 employed at Brookhaven National Laboratories?

25

26-5
1 BY WITNESS BENDER:

2 A I believe it was July 1976. It could have been
3 1977. I'm sorry, my recollection is not perfect on that point.

4 Q And you've been employed at Brookhaven National
5 Laboratories since that time?

6 BY WITNESS BENDER:

7 A That is correct.

8 MS. FINAMORE: No further questions.

9 JUDGE MILLER: Anything further?

10 MR. SWANSON: No.

11 JUDGE MILLER: Mr. Linenberger? Dr. Hand?

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27-1 1 JUDGE LINENBERGER: Mr. Swanson, I need to know
ge 2 how much of a critical path the witness is on here to be
3 guided by how far --

4 MR. SWANSON: You had better let him state that.
5 It's important to develop an adequate record, so I had better
6 let him.

7 WITNESS BENDER: I agree that it's important to
8 develop the record, and I believe that it is not practical for
9 me to attempt to catch that plane in any case. So I'm at your
10 disposal.

11 JUDGE LINENBERGER: All right, sir.

12 BOARD EXAMINATION

13 BY JUDGE LINENBERGER:

14 Q Have you participated in other licensing
15 hearings in which subjects such as the one you are testifying
16 on today have come up?

17 BY WITNESS BENDER:

18 A Yes, sir, I have.

19 Q I have noticed, and you may have, also, that
20 in attempting to assess in some manner the seriousness of the
21 impacts of radiation on people that there has frequently been
22 a practice of looking at some plant activity or operation,
23 attempting to assess doses to the population at large that
24 might derive from that operation, comparing those doses with
25 the man-rem dose attributable to natural background, finding

27-2 1 the former small compared to the latter, and then deriving
2 some comfort, sometimes quite a bit of comfort, from the
3 conclusion, well, it's de minimus, the effect of background is
4 large compared with the effect of the plant, and so one should
5 take comfort in this de minimum effect and go ahead and
6 build the plant and don't worry about it.

7 I really don't feel that I'm qualified to judge
8 the merit or the wisdom of that kind of thought.

9 I would very much appreciate hearing your
10 professional opinion about this, and I encourage you to be
11 as absolutely candid as you feel capable of being.

12 BY WITNESS BENDER:

13 A Well, you are quite correct, of course, that
14 there is a tendency, and I tend to do it myself, to compare
15 the population exposures anticipated as a result of some
16 activity like the Clinch River Breeder Reactor to the exposure
17 which people receive in any case from natural background.

18 In fact, in my testimony, I have done a similar
19 thing, which is to compare my estimates of what the genetic
20 effects might be to the spontaneous background.

21 I think that that is something that one has to
22 do, not as an expert, but as a member of society. I think
23 these things have to be considered on the basis of relative
24 risks and relative benefits.

25 I would point out, however, that there is another

27-3 1 element when one moves from dose to health effects, possible
2 health effects, and that is the extent to which the scientific
3 community believes that it is possible that the natural
4 background radiation exposure is responsible for the observed
5 spontaneous ill health in the population.

6 I think it is a fair statement, and certainly
7 my opinion, that the consensus view is that only a very small
8 fraction of current human ill health, whether it be somatic
9 effects or genetic effects, can possibly be attributable to
10 natural background exposure.

11 So I personally feel that comforting as some
12 may find the comparison of doses or exposures, one must also
13 find the comparison with respect to the health effects even
14 more comforting.

15 Q All right. Thank you very much.

16 I think, as a matter of fact, you do make a
17 point about spontaneous occurrences at the bottom of Page 2
18 and top of Page 3 of your testimony, "It is clear that the
19 vast majority arise from other causes, the nature of which is
20 not as yet known," "other causes" meaning causes other than
21 attributable to natural background.

22 What makes that clear that the vast majority
23 arises from other causes?

24 BY WITNESS BENDER:

25 A There is a variety of experimental evidence

27-4 1 showing this to be the case, I believe.

2 For example, attempts were made very early in
3 the study of radiation-induced genetic effects by
4 Herman Mueller to see to what extent spontaneous mutation could
5 be attributed to background, and he did this very simply by
6 limiting the background exposure to which the fruit fly
7 chrysophial was exposed and looking for changes in the mutation
8 rate, and none were demonstrable.

9 There have also been attempts to demonstrate
10 effects in populations exposed to higher or lower -- human
11 populations exposed to higher or lower natural background
12 rates.

13 These have been inconclusive, but certainly not
14 supportive of the notion that there was a higher incidence
15 where there was higher natural background.

16 Finally, there are a number of measurements of
17 what I referred to earlier, that is, the doubling dose for
18 mutation in experimental organisms, and indeed, the range that
19 we use in the BEIR-III case, between 50 and 250 rads. You
20 could take that to be rem, I think.

21 The natural background to which humans are
22 exposed, on the average, might approximate three rem during a
23 30-year average pre or reproductive period, which means that
24 the absolute minimum value for genetic effects that the
25 doubling dose could have would be three rem; and this, again,

27-5 1 leads me to conclude that the vast majority are due to other
2 causes.

3 Q Okay. At the bottom of Page 3, the second
4 sentence in the Answer No. 6 indicates that one is concerned
5 only with doses accumulated by cells prior to conception, and
6 I'm curious why it is that fetal doses are not seemingly within
7 this ambit of concern that you're talking about there.

8 BY WITNESS BENDER:

9 A What you said is not quite correct, sir. The
10 doses received by the reproductive cells or their precursors --
11 and I'm quoting Answer 6 -- would include the reproductive cells
12 and their precursors in every stage of existence from the
13 moment of fertilization of the ovum through to the point at
14 which the individual, then prenatal, reproduced himself.

15 Q Then I misinterpreted what you said. Thank you.
16 Page 4, third full sentence, begins with the
17 word, "Fortunately," and I guess I don't quite understand why
18 what follows deserves to be preceded by "fortunately."

19 BY WITNESS BENDER:

20 A What I intended by that possibly poorly chosen
21 word was that it was a fortunate circumstance that in the
22 absence of detailed information, which, of course, we cannot
23 have until somebody gets the information following the building
24 and operation of the plant, fortunately, we have an alternate
25 means of making estimates.

27-6
1 Does that answer your question?

2 Q Again, I apologize for misinterpreting it.

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1 JUDGE LINENBERGER: Thank you very much, Dr.
2 Bender. That's all I have, Judge Miller.

3 JUDGE MILLER: Thank you.

4 Is there any reason why Dr. Bender may not be
5 excused at this time?

6 MR. SWANSON: While he's here, I would like
7 to offer into evidence Dr. Bender's testimony, Staff
8 Exhibit 12.

9 JUDGE MILLER: Any objection to the admission
10 into evidence of --

11 MS. FINAMORE: No objection.

12 JUDGE MILLER: -- Staff Exhibit 12?

13 MR. EDGAR: No objection.

14 JUDGE MILLER: It will be admitted.

15 (Staff Exhibit No. 12 was
16 marked for identification
17 and follows.)
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Nov. 1, 1982

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UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

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

NRC STAFF TESTIMONY OF MICHAEL A BENDER, Ph.D.
REGARDING CONTENTION 11(b)

Question 1: By whom are you employed, what is your position, and what is the nature of your work?

Answer 1: I am employed by the Brookhaven National Laboratory where I am Senior Scientist in the Medical Department. I am also employed by the United States Nuclear Regulatory Commission as a consultant through a contract between the Clinch River Breeder Reactor Program Office and the Brookhaven National Laboratory. At Brookhaven I conduct research on the genetic effects of radiation and other environmental agents, and on the molecular mechanisms involved. A statement of my professional qualifications is attached.

Question 2: What is the subject of your testimony?

Answer 2: My testimony addresses Intervenor's Contention number 11b:

"Neither Applicants nor Staff have adequately assessed the genetic effects from radiation exposure including genetic effects to the general population from plant employee exposure."

Question 3: Have you read and are you familiar with the Final Environmental Statement (FES) and the Supplement to the Final Environmental Statement (FESS) for the Clinch River Breeder Reactor?

Answer 3: Yes.

Question 4: Do you agree with the genetic effects estimates of the Staff that are presented in the FESS?

Answer 4: I am in agreement with the Staff's genetic effects estimates.

There are, however, several ways to make such estimates, and I have independently estimated the genetic effects using as a basis the dose estimates supplied in the FESS (Sect. 5.7) and the genetic effects estimates made by the National Academy of Sciences Committee on the Biological Effects of Ionizing Radiation as given in its Report "The Effects on Populations of Exposure to Low Levels of Ionizing Radiation: 1980" (the BEIR III Report).

Question 5: What are the genetic effects of radiation?

Answer 5: Such genetic effects include both gene mutations and chromosomal aberrations, and by definition will be expressed only in the offspring and the more remote descendants of the exposed population. Though the production of genetic effects by radiation has not been demonstrated in humans, it is extensively documented in experimental organisms, and must surely occur in humans as well. Since radiation-induced genetic effects have not been demonstrated directly in humans, however, the estimation of the number to be expected as a consequence of a particular exposure presents some uncertainties.

In all organisms studied experimentally, mutations arise spontaneously, without any deliberate exposure to radiation or other mutagenic agents. While some of these spontaneous occurrences may be due to the

natural background radiation to which we are all exposed, it is clear that the vast majority arise from other causes, the nature of which is not as yet known. A striking feature of radiation-induced mutations, both genetic and chromosomal, is that the types observed are exactly the same as the types which occur spontaneously. None are novel or unique. Thus radiation simply increases the frequency of events which are occurring already in the population.

It is generally agreed that the majority of mutations, whether spontaneously arising or induced, are to a greater or lesser extent deleterious. Some produce dramatic effects on the health of the individual, shorten lifespan or interfere with normal embryonic development to produce congenital defects. Most mutations, however, have relatively minor effects, and many produce no detectable effect at all upon the individual's health or well being. A few human mutations are known to have both deleterious and beneficial effects, depending on the circumstances, and it is possible that many mutations fall in this category. Thus while an increase in human mutation rate must be considered undesirable, it must also be noted that much of the effect on affected individuals will be relatively minor and frequently undetectable.

Question 6: What aspects of radiation dose are important for your estimates?

Answer 6: For the purpose of genetic hazard estimation, only doses received by the reproductive cells or their precursors need be considered. Furthermore, only the doses accumulated by these cells prior to conceiving a child are of concern. Obviously, exposures accumulated in other cells or tissues cannot produce effects which may be passed on to the

next generation, nor can those accumulated by persons who will not reproduce again result in inherited effects. The concept of "genetically significant dose" (GSD) is a convenient means of dealing with genetic hazards. Where detailed information on population structure and dose distribution is available, the GSD may be calculated by taking the sum of the gonadal doses weighted by the probability of future reproduction for each age group. Fortunately, since such detailed information is not available for future populations such as that of concern in connection with the Clinch River Breeder Reactor (CRBR), and acceptable "GSD" may be derived by estimating the whole body dose accumulations in man-rem for the population of interest and assuming that the population is a stable one, for which the average age at reproduction (i.e., at the birth of the middle child) is thirty years.

For the purpose of radiation protection and hazard estimation, doses are expressed in units of rem, or "roentgen equivalents, man." Radiations of different physical quality produce different levels of biological effect per physical dose unit (rad). The effectiveness of a particular radiation type in relation of a standard reference, usually either X or gamma rays, is termed its relative biological effectiveness, or RBE. Thus alpha particles, for example, have a higher RBE than less highly ionizing radiation. The RBE of a given radiation is allowed for in calculation of rem doses, so that doses from radiations of all types can be pooled, and no further allowance need be made for radiation quality for the purpose of hazard estimation.

Another property of some radiation types with high RBE values, such as alpha particles, is that they have a limited penetrating power, or range. Where the range in tissue is only a few micrometers, as for

example in the case of plutonium alpha particles, only the radiation actually arising in the gonad can produce any exposure of germ cells or their precursors. This is taken into account in the calculation of GSD from actual gonadal doses, but is not where the whole body dose is used as an estimate of gonadal dose. Because few radionuclides concentrate in the gonads (i.e., the gonad is rarely the critical organ), the use of whole body dose in genetic hazard estimation is most likely to lead to an overestimation of gonadal dose, and thus, of genetic effect. It should be noted that this is the case for the actinide elements, and especially so for the transuranic radionuclides such as ^{239}Pu which will be present in the CRBR fuel.

Question 7: What is the relationship between radiation dose and genetic effects?

Answer 7: Radiation genetic hazard estimates are made on the basis of an assumption called the "linear hypothesis"; i.e., that there is a linear relation between dose and effect, and that it makes no difference, at least within the range of dose of interest, how the dose is distributed among the population. It is this assumption which makes it possible to estimate effects from population man-rem doses. Under the linear hypothesis the same genetic effect would result if a population of one million persons each received one millirem per year or if one thousand people in the population each received one rem per year while the rest received no dose; in either case the population dose is 1000 man-rem per year, and the effect is simply proportional to the population dose (obviously there are limits to the applicability of this idea, for a 1,000 rem whole body dose to one person in our population would kill him, and no genetic effect could possibly result).

The applicability of the linear hypothesis to genetic effects estimation for populations exposed to low-level chronic radiation is supported by both experimental evidence and radiobiological theory. The linear hypothesis is thus a conservative basis for hazard estimation. The data available on radiation-induced genetic effects is all for much higher doses and dose rates, and for these circumstances both radiobiological theory and experimental evidence strongly suggest that the dose-effect relationship for acute doses is greater than linear, that is, that there is an increasing increment in effect per increment of dose as the dose increases. Downward linear extrapolation from the lowest dose for which data are available to the spontaneous background level will inevitably in such a case lead to an overestimate of effect for all dose levels in between.

Question 8: Why have you chosen to use the BEIR III Report as a basis for your calculations?

Answer 8: Over the years a number of national and international groups of experts have attempted to estimate the genetic effects likely to result from increases in human population radiation exposure, of which the most recent is the National Academy of Sciences Committee on the Biological Effects of Ionizing Radiation. I have adopted their 1980 Report and the so-called BEIR III estimates because I served on the Committee and am thus more familiar with it than with other reports. The estimates given in the BEIR III Report, though not made specifically for the purpose of evaluating the consequences of the operation of nuclear facilities, constitute a suitable, and in my opinion, the most appropriate basis for estimating the genetic effects likely to result from operation of the CRBRP. It must be emphasized, however, that any numerical estimates of

genetic hazards of radiation exposure at the very low dose rates anticipated are simply conservative estimates of the upper credible limits of risk. Such estimates cannot be considered reliable point estimates.

Question 9: If your estimates are upper limits, are they then conservative ones?

Answer 9: It is my opinion that the BEIR Report estimates of genetic effects are conservative ones, and likely to overestimate the actual effects. This opinion has several bases. First, as I have already stated, the linear hypothesis is likely to overestimate effects. Second, a paper has appeared since the BEIR III Report (Shull, Otake and Neel, Science 213 (1981) 1220-1227) that suggests that the sensitivity of humans of the induction of genetic effects by radiation may well be less than the BEIR III estimates. Because, as already mentioned, our attempts to detect genetic effects in irradiated human populations, notably among the offspring of survivors of the atomic bombings of Hiroshima and Nagasaki, have all failed to demonstrate statistically significant increases, genetic effects estimates such as those in the BEIR III Report rely largely upon data from extensive experiments with mice. From these data are derived a "doubling dose"; that dose which will produce as many extra mutations as occur naturally in the absence of any added radiation exposure. This doubling dose, or actually its reciprocal, the relative mutation risk per unit dose, is then used to estimate the genetically-related ill health to be expected in each generation. Shull, Otake and Neel have noted that though the results of a number of individual investigations to detect genetic effects at Hiroshima and Nagasaki have failed to reveal statistically significant increases, there are small numerical

excesses. Making the assumption that they are indeed real, the result of parental radiation exposure, these authors have calculated a doubling dose. This doubling dose is substantially higher than the lower end of the range of from 50 to 250 rem adopted by the BEIR III Report on the basis of the mouse data, suggesting that the BEIR III estimates are if anything on the high side. Nevertheless, I have adopted the BEIR III estimates as a basis for my calculations of the genetic effects, as an upper credible limit, to be anticipated in connection with operation of the CRBR.

Question 10: What are the BEIR III genetic effect estimates?

Answer 10: The BEIR III Report (page 85) estimates that exposure of a population to 1 rem per 30-year generation would result in an increase in total genetic effects in the first generation of between 5 and 75 cases of genetic effects of all kinds affecting health per million live births. As stated by the BEIR III Committee this represents an increase of between 0.005 and 0.07 percent over the 106,000 children with such effects expected among the one million children born to the same population if there were no added radiation exposure. Many of the genetic effects produced will not, however, be expressed in the first generation but will appear in later generations. The Report estimates that if the population continued to receive 1 rem per generation over enough generations for genetic equilibrium to be established, the number of additional genetic effects would ultimately level off at between 60 and 1,100 per generation, or between 0.06 and 1.0 percent of the current spontaneous incidence. Though the BEIR III Committee did not consider the case of a radiation exposure of a population for one single generation, the equilibrium estimate is actually numerically equal to the genetic effects

arising in all future generations over all times as a result of a 1 rem exposure for a single generation.

Question 11: How have you converted these estimates to specific estimates for CRBR?

Answer 11: The BEIR III estimates are for a population of unspecified size and makeup. All that is specified is that all members who reproduce receive an average accumulated dose of 1 rem during the assumed 30 year interval between their own conception and that of their own children. Obviously, the number of man rem to the whole population is undefined, since some of any population will already have had their children, and others though of reproductive age will not for one reason or another have children. Thus in order to make my estimates I have assumed that the hypothetical BEIR III population and the population living within a 50 mile radius of the CRBR have the same age, sex and reproductive characteristics. I have further assumed that the 50 mile population estimated to number 910,000 persons in the year 2010 (FESS, Sect. 5.7.2.8) approximately reproduces itself, and that there will be one million live births in each generation.

The BEIR III estimates are for a population exposed to 1 rem per 30 year generation, or 0.033 rem per year. Under the above assumptions this is 33,333 man rem per year to the population. The annual whole body non-occupational dose which will be received by the CRBR 50 mile population is less than 0.09 man rem per year; the occupational dose is estimated to be 1,000 man rem per year (FESS, Table A 5.5). Because most of those occupationally exposed may be expected to be part of the 50-mile population, the total dose is thus about 1000.1 man rem per year. The ratio of the estimated 50-mile population dose to the BEIR III dose is

1000.1/33,333, or 0.03. Since the BEIR population is the same, the genetic effects to be expected are simply that fraction of the BEIR estimates, or between 0.15 and 2.25 cases in the first generation and between 1.8 and 33 over all time (from the BEIR III equilibrium estimates), assuming that the CRBR is operated for the entire 30 year generation time. Since 106,000 cases occur in each generation spontaneously, the first generation increase in risk caused by operation of the CRBR amounts at most to about 0.00002 percent. The percentage increase in risk per generation in subsequent generations would, of course, be even less.

Although the occupationally exposed are expected to be part of the 50-mile population, and their dose is properly included in the above estimates, it is also true that the risk on the part of occupationally exposed parents is voluntary, so for the first generation, at least, it is of interest to know the genetic risk from non-occupational exposure. Here the ratio of doses is $0.09/33,333 = 0.000003$, and the maximum credible first generation estimate is 0.0002 cases, or an increase over the current incidence of about 0.0000002 %.

Question 12: What about effects in the population residing further than 50 miles from CRBR?

Answer 12: Genetic effects to be anticipated in the entire United States population as a result of operation of the CRBR may be estimated. The estimated total dose to the 280 million population projected for the year 2010 is about ~~170~~ ^{1000.1} man-rem (FESS, Table A 5.5). The ratio to the BEIR population dose is ~~0.035~~ ^{0.03} and the first generation estimates based on the BEIR estimates are between ~~0.10~~ ^{0.15} and ~~2.6~~ ^{2.25} additional genetic effects, or between ~~2.1~~ ^{1.8} and ~~30~~ ³³ over all time. Assuming for simplicity that the 2010

U.S. population just reproduces itself (i.e., 280×10^6 live births per 30 years), some 29 million spontaneous genetic effects would occur in the population during the same period, so operation of the CRBR would result, in the worst case, in an increased rate of affected births of about $8.8 \times 10^{-6}\%$. To put it another way, the number of affected births would rise from 986,666.7 to not more than 986,666.8 affected births per year.

Question 13: Is it possible to estimate individual, rather than population risk?

Answer 13: Yes, the risk of genetic effects to be expected as a result of operation of the CRBR can indeed be considered from the point of view of the individual, rather than the population. Since the current incidence of genetic effects is 106,000 per million live births, the individual risk for each child a couple might have is about 11%. As a worst possible case we may consider a couple who are conceived at the time the reactor begins to operate, are born and live continuously at the fence line, who obtain their food and water from the area, and who have a child at the end of the reactor's lifetime of 30 years. The maximum annual whole body dose to such a person is estimated to be less than 0.44 millirem per year (from Tables A 5.2 and A 5.3 of the FESS, assuming very conservatively that the infant doses from milk continue through life). In thirty years this would add up to 0.013 rem. The BEIR III Committee estimate of a maximum of 75 affected births in the first generation for a population receiving 1 rem per generation and having one million live births amounts to an added risk of 0.008% per birth per rem. For a dose of 0.013 rem, the risk becomes approximately 0.0001%. The risk for our hypothetical couple's child would, then, rise from the current incidence figure of 10.6% to 10.6001% as a result of CRBR operation.

Question 14: Have you considered the possible genetic effects of possible exposure to radiation from plutonium and other transuranic elements?

Answer 14: Yes. The estimates I have given actually include the effects attributable to radiation from plutonium and other transuranic elements simply because the whole body rem dose estimates used include the dose contribution from them. As I have already noted, the use of the rem unit includes an allowance for the high biological effectiveness of alpha particles such as those from plutonium. However, my use of whole body dose estimates (in lieu of gonadal dose estimates) must surely result in an overestimation of the genetic effects to be anticipated from plutonium, and possibly from the other transuranics as well. The plutonium in the CRBR fuel elements will be in an insoluble form. Most would enter the bodies of those exposed through the gut, and only a very small fraction would be absorbed. Very little of the plutonium entering the circulatory system would become located in the gonads. According to Richmond and Thomas (Health Phys. 29 (1975) 241-250), about 5×10^{-4} of the systemic burden will be taken up by the testis in males, and only about 1×10^{-4} by the ovaries in females. Furthermore, though studies of the genetic effects of plutonium in mice have only been undertaken recently, what results are available so far tend to confirm that the effects are no greater than would be predicted on the basis of the RBE for the plutonium alpha particle and the radionuclide's distribution and retention in the gonad (Grahm, et al., Radiation Res. 67 (1976) 587-588; Lunning, Frolen and Nielson, Mutation Res. 34 (1976) 539-542; Searle, et al., Mutation Res. 41 (1976) 297-301). Thus all of the available evidence indicates that the genetic effects of plutonium and other transuranics are adequately, and indeed quite conservatively, accounted for in the estimates I have presented.

Question 15: What is your final conclusion regarding the genetic effects likely to result from operation of the CRBR?

Answer 15: I have estimated that the genetic effects resulting from operation of the CRBR will, as an upper limit, be about 0.004 case among the one million births to the 50 mile population in the first generation from non-occupational exposure for 30 years and about 2.25 cases from occupational exposure for the 30 year plant lifetime. The Staff central estimate of about 0.3 case over all future generations from occupational and non-occupational exposure for one year when adjusted to a common basis (i.e., 30 years' exposure) results in 9 genetic effects, which is within the range of values I have calculated (i.e., ~~2.1~~^{1.8} to ~~32~~³³ genetic effects over all time, as stated in my response to Question 12). Among the one million births over the same period 106,000 "spontaneous" cases are expected without the CRBR. Such an increase is not only very small, but would certainly not be detectable. Furthermore, the actual increase is, in my opinion, very likely to be smaller, possibly much smaller, than the upper limit estimates. I therefore conclude that the genetic effects from operation of the CRBR will be so small as to constitute a negligible impact upon human health and welfare.

MICHAEL A BENDER

PROFESSIONAL QUALIFICATIONS

I am presently Senior Scientist in the Medical Department of the Brookhaven National Laboratory, where I devote most of my time to research on the genetic effects of radiation and other mutagenic and carcinogenic agents, on the molecular mechanisms involved in the production of chromosomal aberrations in human and other vertebrate cells, and to the study of the molecular lesions involved in certain inherited human diseases which are characterized by sensitivity to radiation and a predisposition to develop cancer.

I hold a Bachelor of Science Degree in Zoology from the University of Washington, and the Ph.D. in Genetics from the Johns Hopkins University. I am a member of the American Society for Photobiology, The Radiation Research Society, the American Society for Cell Biology and the American Association for the Advancement of Science, and am a Counselor of the Environmental Mutagen Society. I was on the Editorial Board of CYTOGENETICS from 1962 to 1967 and Associate Editor of RADIATION RESEARCH from 1974 to 1977. I am presently on the Editorial Boards of MUTATION RESEARCH and RADIATION PROTECTION DOSIMETRY.

My professional experience totals approximately 25 years of research in radiation genetics and cytogenetics. I was a Senior Biologist and Group Leader in the Biology Division of the Oak Ridge National Laboratory for almost 12 years, carrying out research on the radiation sensitivity of human chromosomes and cells. In 1969 I joined the Faculty of the Vanderbilt University School of Medicine, where I continued my research and also did some teaching in Radiation Biology. In 1971 I accepted a two-year Professional Term Appointment as Geneticist with the U.S. Atomic Energy Commission, where I was responsible for evaluation of research programs in genetics. Following two years as Visiting Professor of Radiology at the Johns Hopkins University I moved to my present position at Brookhaven in 1975.

My experience includes work with the National Committee on Radiation Protection on the evaluation of the genetic hazards of radioactive isotopes, as well as membership on a number of National Academy of Sciences Committees concerned with radiation effects on human health, the most recent being the Committee on the Biological Effects of Ionizing Radiation (the BEIR III Committee) and the Panel on Reassessment of A-bomb dosimetry. I have published over 100 scientific papers, many dealing directly with the effects of radiation on humans and the evaluation of human radiation hazards.

28-2

1 JUDGE MILLER: Dr. Bender, we will excuse you
2 at this time. I'm sorry you missed your airplane, every-
3 body having tried their very best, but we can't control --

4 WITNESS BENDER: I quite understand, and no
5 apology is necessary. Is it your intention to recess
6 at this point, sir?

7 JUDGE MILLER: Yes, it is.

8 I'm discharging you.

9 WITNESS BENDER: I understand. I would like
10 to consult with Staff counsel, however, about whether
11 they would like me to remain on the panel since I have
12 indeed missed the airplane.

13 JUDGE MILLER: Yes. It is our intention to
14 recess at this time. We've covered a good deal of terri-
15 tory today, to resume at 8:00 tomorrow morning with the
16 cross-examination of Dr. Branagan.

17 MR. SWANSON: I wonder if we could get an
18 estimate on how long the cross is expected to be of
19 Dr. Branagan. He is the last remaining witness on this
20 issue.

21 JUDGE MILLER: It gets a little hard, it gets
22 into the realms of uncertainty and extrapolation, and
23 all of those nasty things you've been telling me about.

24 (Laughter.)

25 JUDGE MILLER: So I don't believe counsel

1 should be pressed. I think she has cooperated very well
2 in handling the matters today, including Dr. Bender. So
3 I don't think it would be fair to press.

4 We're on schedule, so I think that's sufficient.

5 Now let me just inquire very briefly --
6 We'll go off the record.

7 Thank you.

8 (Witness Bender excused.)

9 (Whereupon, at 6:00 p.m. the hearing was re-
10 cessed, to reconvene on Thursday, November 18, 1982, at
11 8:00 a.m. in the same place.)
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NUCLEAR REGULATORY COMMISSION

This is to certify that the attached proceedings before the

in the matter of: CLINCH RIVER BREEDER REACTOR

Date of Proceeding: November 17, 1982

Docket Number: 50-537

Place of Proceeding: OAK RIDGE, TENNESSEE

were held as herein appears, and that this is the original transcript thereof for the file of the Commission.

Mary L. Bagby

Official Reporter (Typed)

Mary L. Bagby

Official Reporter (Signature)