

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

+ + + + +

ATOMIC SAFETY AND LICENSING BOARD
(ASLB)

+ + + + +

CLOSED HEARING

DOCKETED
USNRC

December 21, 2005 (3:30pm)

OFFICE OF SECRETARY
RULEMAKINGS AND
ADJUDICATIONS STAFF

In the Matter of:

LOUISIANA ENERGY SERVICES, L.P.

(National Enrichment Facility)

Docket Nos.
70-3103-ML
ASLBP No.
04-826-01-ML

Thursday, October 27th, 2005

Room T-B345
NRC Building 2
11454 Rockville Pike
Rockville, Maryland

The above-entitled matter came on for hearing, pursuant to notice, at 8:00 a.m.

BEFORE:

G. PAUL BOLLWERK, III Chair
PAUL B. ABRAMSON Administrative Judge
CHARLES N. KELBER Administrative Judge

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

(202) 234-4433

www.nealgross.com

APPEARANCES:

On Behalf of Louisiana Energy Services:

JAMES R. CURTISS, ESQ.
MARTIN J. O'NEILL, ESQ.
DAVID A. REPKA, ESQ.
AMY ROMA, ESQ.

TYSON SMITH, ESQ.

Of: Winston & Strawn, LLP
1400 L Street, NW
Washington, D.C. 20005-23502
(202) 371-5726

Of: JOHN W. LAWRENCE, ESQ.
Louisiana Energy Services, L.P.
2600 Virginia Avenue, NW. Suite 610
Washington, D.C. 20037

On Behalf of Nuclear Information & Resource
Service and Public Citizen:

LINDSAY A. LOVEJOY, JR., ESQ.
618 Paseo del Peralta, Unit B
Santa Fe, NM 87501

On Behalf of the Nuclear Regulatory
Commission:

Of: LISA CLARK, ESQ.
MARGARET BUPP, ESQ.
Office of the General Counsel
Mail Stop O-15 D21
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001
(301) 415-8339 AF

Also Present:

ATOMIC SAFETY LICENSING BOARD:

BETHANY ENGLE
CHERVERNE CLOYD

JONATHAN RUND
KAREN VALLOCH
JACK WHETSTINE
ANDREW WELKIE

ALSO PRESENT: (Cont.)

LOUISIANA ENERGY SERVICES
PAUL HARDING
ROD KRICH
PAUL SCHNEIDER
LESLIE COMPTON

NUCLEAR INFORMATION & RESOURCE SERVICES AND
PUBLIC CITIZEN
MELISSA KEMP
ARJUN MAKHIJANI
BRICE SMITH

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

I-N-D-E-X

EXAMINATION

PREFILED DIRECT TESTIMONY OF
DONALD PALMROSE
JENNIFER MAYER
TIMOTHY JOHNSON
JAMES PARK
CRAIG DEAN 2831

PREFILED REBUTTAL TESTIMONY OF
DONALD PALMROSE
JENNIFER MAYER
TIMOTHY JOHNSON
JAMES PARK
CRAIG DEAN 2831

EXAMINATION BY MS. CLARK OF
DONALD PALMROSE
JENNIFER MAYER
TIMOTHY JOHNSON
JAMES PARK
CRAIG DEAN 2834

EXAMINATION BY MR. LOVEJOY OF
DONALD PALMROSE
JENNIFER MAYER
TIMOTHY JOHNSON
JAMES PARK
CRAIG DEAN 2881

EXAMINATION BY MS. CLARK OF
DONALD PALMROSE
JENNIFER MAYER
TIMOTHY JOHNSON
JAMES PARK
CRAIG DEAN 2950

EXAMINATION BY MR. CURTISS OF
DONALD PALMROSE
JENNIFER MAYER
TIMOTHY JOHNSON
JAMES PARK
CRAIG DEAN 2955

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

I-N-D-E-X (Cont.)

EXAMINATION

EXAMINATION BY MR. LOVEJOY OF: DONALD PALMROSE JENNIFER MAYER TIMOTHY JOHNSON JAMES PARK CRAIG DEAN	2961
PREFILED DIRECT TESTIMONY OF ARJUN MAKHIJANI	2968
PREFILED REBUTTAL TESTIMONY OF ARJUN MAKHIJANI	2969
EXAMINATION BY MR. LOVEJOY OF ARJUN MAKHIJANI	2974
EXAMINATION BY MR. CURTISS OF ARJUN MAKHIJANI	3011
EXAMINATION BY MS. CLARK OF ARJUN MAKHIJANI	3050
EXAMINATION BY MR. LOVEJOY OF ARJUN MAKHIJANI	3058
EXAMINATION BY MR. CURTISS OF ROD KRICH THOMAS POTTER	3066
EXAMINATION BY MR. LOVEJOY OF ROD KRICH THOMAS POTTER	

EXHIBIT INDEXKEY

I-Identified
 A-Admitted into evidence
 R-Rejected
 W-Withdrawn
 TUA-Taken under advisement

Official Hearing Document Exhibit #/letter Title	Disposition/ Page
Staff 43 NRC process to identify decommissioning sites with inadequate funding for remediation	I-2832
Staff 44 Finerfrock letter, 9-19-05	I-2832
Staff 43	A-2833
Staff 44	A-2833
Staff 46 CEC FEIS excerpts	A-2861
Staff 46	A-2862
NIRS/PC 179 Envirocare amendment 22	I-2879
NIRS/PC 179	A-2880
NIRS/PC 256 Hickey letter, 9-22-92	I-2931
NIRS/PC 256	A-2931
NIRS/PC 277 Bagart letter, 1-12-93	I-2933
NIRS/PC 277	A-2934
NIRS/PC 247 Bernero letter, 1-3-95	I-2936
NIRS/PC 247	A-2936
NIRS/PC 248 Leeds letter, 10-18-00	I-2942
NIRS/PC 248	A-2942
NIRS/PC 222 SAR, Rev 2, 7-04	I-2971
NIRS/PC 259 Rule R313-15	I-2971
NIRS/PC 260 Title 246 Washington	I-2972
NIRS/PC 263 ASLB Decision, 3-2-95	I-2972
NIRS/PC 222, 259, 260, 263	A-2973
NIRS/PC 278 Daily Herald Article, 10-26-05	I-3063
NIRS/PC 278	A-3064

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
 1323 RHODE ISLAND AVE., N.W.
 WASHINGTON, D.C. 20005-3701

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25

P-R-O-C-E-E-D-I-N-G-S

8:00 a.m.

CHAIR BOLLWERK: Why don't we go ahead and go on the record?

Good morning, everyone, we appreciate you all coming in early this morning so we can proceed on with the testimony on disposal of depleted uranium. Any procedural matters we need to talk about before we get going this morning, that anyone has?

I know we had one thing, a question about the exhibit yesterday, that has portions of a deposition in it. And I think between, we've worked it out so that all the pages, at least the ones that were referred to, up to this point, are now part of the exhibit.

And can you give me the number of that one? Exhibit 243. Do you anticipate using more of that deposition, at any point, do we want to hold off admitting it until we get all the pieces in?

MR. LOVEJOY: Perhaps we should do that, although I don't actually think it is likely to be used for very much more.

CHAIR BOLLWERK: All right. Well, let's go ahead, I hate to admit it and then have to add more pieces to it, so it is better to admit it when we have

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 all the pieces together.

2 We will put that on our list, 243, we need
3 to deal with that. All right, at this point, then, do
4 any of the Board members have anything?

5 (No response.)

6 CHAIR BOLLWERK: If not then we are ready
7 to begin with the Staff's panel on disposal. So if
8 you want to bring your witnesses up, this would be the
9 time to do it.

10 One thing we will mention, we will sort of
11 be pulsing you all, throughout the day, in terms of
12 time. Because, again, with the public session
13 potentially, we are getting some feedback from public
14 affairs, there are some people that are interested in
15 coming, and there is questions, as we get late in the
16 day, about the ability to get those folks in, and
17 things with security, and things like that.

18 So we need to keep that in mind, and we
19 will be talking with you about it.

20 JUDGE ABRAMSON: So let's have a mutual
21 goal of finishing disposal by lunch. And that may
22 mean a late lunch, but let's not make it too late.

23

24

25

1 Whereupon,

2 DONALD PALMROSE

3 JAMES PARK

4 JENNIFER MAYER

5 CRAIG DEAN

6 TIMOTHY C. JOHNSON

7 MS. CLARK: Good morning. Since you are
8 still under oath I will ask you, if you have before
9 you, a document entitled NRC Staff testimony regarding
10 disposal?

11 CHAIR BOLLWERK: Let's have each of the
12 members identify themselves one more time, so that
13 they --

14 JUDGE ABRAMSON: They can identify them
15 when they say yes, and we will get it all at once.

16 MS. CLARK: Could you each, individually
17 identify yourself and state whether you have this
18 testimony before you?

19 WITNESS PALMROSE: Dr. Donald Palmrose.
20 Yes, I do.

21 WITNESS PARK: James Park of the Staff.
22 And, yes, I do.

23 WITNESS JOHNSON: Tim Johnson of the
24 Staff, and yes, I do.

25 WITNESS MAYER: Jennifer Mayer, ICF

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 Consulting. Yes, I do.

2 WITNESS DEAN: Craig Dean, ICF Consulting.

3 Yes, I do.

4 CHAIR BOLLWERK: And as Staff counsel
5 pointed out you all are under oath, so bear that in
6 mind.

7 MS. CLARK: Do you also have before you a
8 document entitled NRC Staff Rebuttal Testimony
9 Regarding Disposal?

10 WITNESS PALMROSE: Yes.

11 WITNESS PARK: Yes.

12 WITNESS MAYER: Yes.

13 WITNESS DEAN: Yes.

14 WITNESS JOHNSON: Yes, I do.

15 MS. CLARK: Did you prepare these
16 documents for submission in this proceeding?

17 WITNESS PALMROSE: Yes.

18 WITNESS PARK: Yes.

19 WITNESS MAYER: Yes.

20 WITNESS DEAN: Yes.

21 WITNESS JOHNSON: Yes.

22 MS. CLARK: Do you have any corrections,
23 or revisions, to that testimony, to make at this time?

24 WITNESS MAYER: No.

25 WITNESS PARK: No.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 WITNESS DEAN: No.

2 WITNESS PALMROSE: No.

3 WITNESS JOHNSON: No.

4 MS. CLARK: Do you adopt this written
5 testimony as your sworn testimony in this proceeding?

6 WITNESS PALMROSE: Yes.

7 WITNESS PARK: Yes.

8 WITNESS MAYER: Yes.

9 WITNESS DEAN: Yes.

10 WITNESS JOHNSON: Yes.

11 MS. CLARK: I therefore move to have this
12 testimony admitted into the record of this proceeding.

13 CHAIR BOLLWERK: All right, so we are
14 talking about both the direct and the rebuttal,
15 correct?

16 MS. CLARK: Yes.

17 CHAIR BOLLWERK: All right. Then the
18 motion has been made that the NRC Staff testimony
19 regarding disposal, as well as the NRC Staff rebuttal
20 testimony regarding disposal be admitted into the
21 record.

22 Any objections?

23 (No response.)

24 CHAIR BOLLWERK: All right, hearing none,
25 then the record should reflect that the NRC Staff's

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 disposal and rebuttal testimony regarding disposal
2 should be entered into the record as if read.

3 (Whereupon, the prefiled direct and rebuttal
4 testimony of Mr. Johnson, Ms. Mayer, Mr. Dean, Mr.
5 Palmrose and Mr. Park were bound into the record as if
6 having been read.)**

7

8

9

10

11

12

13

14

15

16

17

18

19

20

21

22

23

24

25

September 15, 2005

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of)	
)	
LOUISIANA ENERGY SERVICES, L.P.)	Docket No. 70-3103
)	
(National Enrichment Facility))	ASLBP No. 04-826-01-ML
)	

NRC STAFF TESTIMONY REGARDING DISPOSAL

Q.1. Please state your name, occupation and by whom you are employed.

A.1. (TJ) Timothy C. Johnson. I am the U.S. Nuclear Regulatory Commission (NRC) Project Manager overseeing the licensing of the proposed Louisiana Energy Services, L.P. (LES) uranium enrichment facility near Eunice, New Mexico. I have been the PM for the project since its inception in January of 2002, when LES initiated discussions with NRC for the project. A statement of my professional qualifications is attached hereto.

A.1. (JP) James Park. I am the NRC Project Manager for the environmental review of the application for construction and operation of the proposed uranium enrichment facility submitted by LES. A statement of my professional qualifications is attached hereto.

A.1. (JM) Jennifer Mayer. I am employed as a consultant by ICF Consulting. I am providing this testimony under a technical assistance contract with the NRC.

A statement of my professional qualifications is attached hereto.

~~PROPRIETARY INFORMATION~~

A.1. (CD) Craig Dean. I am employed by ICF Consulting. I am providing this testimony under a technical assistance contract with the NRC. A statement of my professional qualifications is attached hereto.

A.1. (DP) Donald E Palmrose, Ph.D. I am employed by Advanced Systems Technology and Management, Incorporated. I am providing this testimony under a technical assistance contract with the NRC. A statement of my professional qualifications is attached hereto.

Q.2. Please describe your current job responsibilities in connection with the NRC Staff's review of the application by LES to construct and operate a uranium enrichment facility in Lea County, New Mexico, to be known as the National Enrichment Facility (NEF).

A.2. (TJ) As Project Manager, my current job responsibilities include coordinating the review of the application for construction and operation of the proposed uranium enrichment facility submitted by LES and the preparation of NUREG-1827, "Safety Evaluation Report, for the National Enrichment Facility in Lea County, New Mexico", June 2005, (SER) that documents the safety review prepared by NRC Staff including the portion relevant to this proceeding, Chapter 10 ("Decommissioning"), attached as Staff Exhibit 37. In the review of the application, I focused particularly on the decommissioning funding and waste management aspects of the proposed facility.

A.2. (JP) I was responsible for overseeing the preparation of NUREG-1790, the "Final Environmental impact Statement for the Proposed National Enrichment Facility in Lea County, New Mexico," June 2005, (FEIS), including the portions relevant to the current proceeding, Chapters 2 and 4 ("Alternatives" and "Environmental Impacts"),

attached as Staff Exhibit 36.

A.2. (JM) I have assisted the NRC Staff in evaluating the proposed decommissioning funding plan for the NEF and was the principal author of the decommissioning cost sections of Chapter 10 of the SER.

A.2. (CD) I am the manager responsible for the technical support provided by ICF Consulting to NRC in evaluating the financial assurance provisions in LES's decommissioning funding plan. In that capacity, I was the principal evaluator of the financial assurance instruments and the assessment of the adequacy of the contingency factor.

A.2. (DP) I developed or contributed to the sections and appendices of the Draft Environmental Impact Statement, NUREG-1790, September 2004, (DEIS) and FEIS. As relevant to this testimony, I was the principal author of Sections 2.1.9, DUF₆ Disposition Options; 2.2.2.4, Alternatives for DUF₆ Disposition; 2.2.2.5, Anhydrous Hydrofluoric Acid Option; and 4.2.14.4, Impacts from Disposal of the Converted Waste.

I. Plausibility of Disposal

Q.3. What is the purpose of this portion of your testimony?

A.3. (TJ, JP, DP) The purpose of our testimony is to provide the NRC Staff's views concerning the admitted contention regarding the plausibility of LES's proposal to dispose of the triuranium oxide (U₃O₈) produced by the deconversion process. The specific contention we will address is EC-6/TC-3 as supported by Basis (I).

Q.4. Are you familiar with that Contention and supporting Basis?

A.4. (TJ, JP, DP) Yes, EC-6/TC-3, as supported by Basis (I) states:

Petitioners contend that the Louisiana Energy Services, L.P., ("LES") application seriously underestimates the costs and the feasibility of

managing and disposing of the Depleted Uranium Hexafluoride ("DUF₆") produced in the planned enrichment facility in that:

- (l) The "engineered trench" method of waste disposal proposed by LES is not likely to be acceptable (ER 4.13-11.-19) if DUF₆ is not considered low-level waste.

Q.5. Please explain your understanding of the reference to the "engineered trench" method of disposal.

A.5. (TJ, DP, JP) In the context of this contention, the term refers to a specific method of disposal of low level waste. In its application, LES listed various disposal options for the depleted uranium following deconversion. One of the disposal options discussed is disposal in shallow earthen structures, commonly referred to as engineered trenches. LES described these as shallow earthen structures (excavated to a depth of about 8 meters) consisting of a stable structural pad and barrier walls constructed of compacted clay. Waste containers would be stacked on the bottom of the structure and surrounded by earth, sand, gravel or other similar material. After filling, a cap composed of dirt and clay would be placed on top and compacted. LES exhibit 109, at 4.13-10 to 4.14-11.

Q.6. Will the radioactive waste generated by the NEF necessarily be disposed of in this manner?

A.6. (TJ, JP, DP) No, there is no requirement that a particular type of disposal method be used. However, this type of disposal method is used by one of the disposal facilities identified in the FEIS as a potential disposal site - Envirocare, which is located in Clive, Utah. Staff Exhibit 36 at 2-31 to 2-33.

Q.7. Is Envirocare authorized to accept the type of radioactive waste that will be generated by the NEF?

A.7. (TJ, JP, DP) Yes. Envirocare, which is regulated by the State of Utah Department of Environmental Quality Division of Radiation Control, is licensed to accept Class A low-level radioactive waste. Staff Exhibit 36 at 2-32. The Commission, in its decision *Louisiana Energy Services, L.P.*, CLI-05-5, 61 NRC 22 (2005), determined that depleted uranium is low-level waste. As explained in our FEIS, for regulatory purposes low level radioactive waste is categorized in three classifications: Class A, B or C based on the concentration of certain long-lived radionuclides which are set forth in Tables 1 and 2 of 10 C.F.R. § 61.55. The regulation further provides, in § 61.55(a)(6), that if radioactive waste does not contain any of the nuclides listed in those Tables, it is Class A. Depleted uranium consists mostly of long-lived isotopes of uranium, with small quantities of thorium-234 and protactinium-234. None of those isotopes is listed in Table 1 or 2. Accordingly, pursuant to 10 C.F.R. § 61.55(a)(6), depleted uranium is considered Class A low level radioactive waste. Staff Exhibit 36 at 2-27 to 2-28.

Q.8. Have you confirmed that Envirocare can accept the waste to be generated by the NEF?

A.8. (TJ) Yes. On February 3, 2005, Envirocare confirmed in a letter to LES that it could accept U_3O_8 for disposal. LES Exhibit 103. As documented in a telephone summary of April 6, 2005, the Staff contacted the State of Utah Division of Radiation Control which verified that Envirocare can accept depleted uranium for disposal under its license with no quantity limits. LES Exhibit 104

Q.9. Is Envirocare the only option available to LES for disposing of depleted uranium?

A.9. (TJ, JP, DP) No. The Staff considered other options for disposal as set forth in

the Staff Exhibit 36 at 2-31 to 2-33. These included disposal at the Barnwell site in Barnwell, South Carolina, the Hanford commercial site in Hanford, Washington, the Nevada Test Site, located in Nye County, Nevada, and the Waste Control Specialists site (WCS) in Andrews County, Texas.

Q.10. What were your conclusions with regard to those options?

A.10. (TJ, JP, DP) LES would be able to dispose of waste from the NEF at: (1) the Hanford site, which accepts waste from the States in the Rocky Mountain compact (which includes New Mexico) provided the waste meets the Waste Acceptance Criteria for the facility; (2) the Nevada Test Site if ownership of the waste was first transferred to the DOE; or (3) the WCS site provided that WCS obtains a license to accept this material (currently, WCS is licensed to accept RCRA hazardous waste for disposal) and certain procedures and processes are successfully addressed. The Barnwell site currently accepts waste from most United States generators; however, beginning in 2008, Barnwell will only accept from the Atlantic Compact States (Connecticut, New Jersey, and South Carolina). Staff Exhibit 36 at 2-31 to 2-33.

Q.11. What is your opinion of the claim in Contention EC-6/TC-3 that the "engineered trench" method of disposal is not likely to be acceptable if DUF_6 is not considered low-level waste?

A.11 (TJ, JP, DP) The Commission has determined that the type of waste generated by the NEF- depleted uranium - is low level waste. Therefore, the premise for the contention - that DUF_6 is not considered low-level waste - is not valid. Furthermore, Envirocare - which uses this type of disposal - and the responsible State regulatory authority consider the disposal of depleted uranium at Envirocare under its current

license to be acceptable. This is consistent with the Staff's determination that depleted uranium is Class A low level waste. Therefore, disposal at Envirocare, or at the other waste disposal sites discussed above under certain specified conditions, is a credible disposal option for the depleted uranium generated by the NEF.

II. Cost of Disposal

Q.12. What is the purpose of this portion of your testimony?

A.12. (TJ, JM, CD) The purpose of this portion of our direct testimony is to provide the NRC Staff's views concerning the admitted contention regarding the cost of LES's proposal to dispose of the U₃O₈ produced by the deconversion process. The specific contention we address here is EC-5/TC-2.

Q.13. Are you familiar with Contention EC-5/TC-2?

A.13. (TJ, JM, CD) Yes. EC-5/TC-2, as it relates to disposal, states:

Louisiana Energy Services, L.P., (LES) has presented estimates of the costs of decommissioning and funding plan as required by 42 U.S.C. 2243 and 10 C.F.R. 30.35, 40.36, and 70.25 to be included in a license application. See Safety Analysis Report 10.0 through 10.3; ER 4.13.1. Petitioners specifically contest the sufficiency of such presentations as based on . . .(4) the lack of any relevant estimate of the cost of . . .disposing of depleted uranium, given it does not rely upon the three examples - the 1993 CEC estimate, the LLNL report, and the UDS contract - cited in its application.

LES has presented additional estimates for the costs of deconversion, transportation, and disposal of depleted uranium for purposes of the decommissioning and funding plan required by 42 USC 2242 and 10 CFR 30.35, 40.36, and 70.25. See LES Response to RAI dated January 7, 2005. Such presentations are insufficient because they contain no factual bases or documented support for the amounts of the following particular current LES estimates, i.e., . . .\$1.14/kgU for disposal, . . .and cannot be the basis for financial assurance.

Q.14. Has LES provided a basis for its estimate for disposal of the DU following

conversion (\$1.14/kgU)?

A.14. (TJ, JM, CD) Yes. LES provided a Memorandum of Agreement between LES and WCS that contained a unit cost of \$ [REDACTED]/ft³ to \$ [REDACTED]/ft³ for disposal of depleted U₃O₈. LES Exhibit 105. Based on a representation from Envirocare that the cost range presented in the LES application is a conservative estimate of what disposal costs would be at Envirocare, LES used the lower estimate, \$ [REDACTED]/ft³. LES Exhibit 103 LES then converted the estimate in dollars per cubic foot to dollars per kilogram uranium using a density range of [REDACTED] to [REDACTED] g/cm³ and a ratio of 1 kg U₃O₈ to 0.85 kgU to arrive at the cost estimate for disposal.

Q.15. In your opinion, does the information described provide a sufficiently documented and reasonable basis for estimating the cost of disposal?

A.15. (TJ, JM, CD) Yes. There are a limited number of facilities that can accept LLW so getting a price quotation from a facility provides a solid basis for the estimate. The quotation provided (\$ [REDACTED]/ft³ to \$ [REDACTED]/ft³) is considerably higher than I have seen quoted by these facilities in the past for bulk material. For example, a recent NRC report relating to decommissioning funding Staff Exhibit 43, indicates that \$11/ft³ is an average disposal rate at Envirocare for disposal of bulk contaminated soil. It is likely that disposal of loose soil generally would have lower disposal costs, and soil which is delivered in containers would have somewhat higher disposal costs because of increased handling requirements. Because the U₃O₈ produced by deconversion of the depleted uranium generated by LES will be placed in containers for shipments, the cost would be expected to be somewhat higher than the average. Nevertheless, the fact that the cost used by LES, \$ [REDACTED]/ft³, is over [REDACTED] times the average disposal rate further

supports the use of the lower end of the cost range provided by WCS. On the basis of our review, we concluded that the use of this estimate was adequately conservative.

Q.16. Does this conclude your testimony?

A.16. (TJ, JP, JM, CD, DP) Yes.

TIMOTHY C. JOHNSON

Professional Qualifications

I am currently the Licensing Project Manager of the Louisiana Energy Services (LES) uranium enrichment plant project in the Gas Centrifuge Facility Licensing Section, Special Projects Branch, Division of Fuel Cycle Safety and Safeguards, Office of Nuclear Material Safety and Safeguards, U.S. Nuclear Regulatory Commission.

I received a Bachelor of Science degree in Mechanical Engineering from Worcester Polytechnic Institute in Worcester, Massachusetts, in 1971 and a Master of Science degree in Nuclear Engineering from Ohio State University, in Columbus, Ohio, in 1973.

Courses I have taken that are pertinent to my present discipline are in the areas of advanced mathematics, engineering design, mass and heat transport, thermodynamics, reactor theory, nuclear physics, nuclear power plant engineering, and health physics. I was elected to membership in Pi Mu Epsilon, the mathematics honorary society.

From January 1973 to August 1977, I was employed by Stone & Webster Engineering Corporation in Boston, Massachusetts. As the offgas and ventilation filter system specialist, I was responsible for the technical adequacy of offgas and ventilation filter systems for pressurized water reactor, boiling water reactor, high temperature gas cooled reactor, and liquid metal fast breeder reactor projects. My responsibilities included ensuring that equipment met both applicable regulatory and equipment code requirements. I prepared master specifications for offgas and ventilation filter systems for use by project staff. I reviewed project specifications and performed technical reviews of vendor proposals. I also reviewed vendor procedures for qualification and testing of offgas and ventilation system components.

Since September 1977, I have been employed by the U.S. Nuclear Regulatory Commission in the areas of radioactive waste management, decommissioning, and fuel cycle facility licensing.

From September 1977 to April 1984, I had lead responsibility for the waste form performance aspects of low-level radioactive wastes to include radwaste processing, solidification, high integrity containers, and volume reduction systems. In this capacity, I developed programs for analyzing, evaluating, coordinating, and recommending licensing actions related to the waste form and waste classification areas of 10 CFR Part 61. These responsibilities have specifically included coordinating the development of the waste form and waste classification requirements and preparing the appropriate sections for: (1) the low-level waste management regulation, 10 CFR Part 61; (2) the draft and final environmental impact statements that support 10 CFR Part 61; and (3) the technical positions on waste form and waste classification that provide guidance to waste generators for complying with the 10 CFR Part 61 requirements. I also acted as lead for an intra-agency task group for implementation for the 10 CFR Part 61 requirements at nuclear power plants.

TIMOTHY C. JOHNSON

-2-

During this time, I also participated on a Task Force responsible for Three Mile Island Unit 2 (TMI-2) waste disposal issue resolution to include the evaluation of EPICOR-II, Submerged Demineralizer System, and decontamination solution wastes. I also prepared and coordinated waste disposal section for the TMI-2 Programmatic Environmental Impact Statement. For other nuclear power facilities, I prepared and coordinated waste disposal sections for the Dresden Unit 1 Decontamination and the Turkey Point Steam Generator Replacement Environmental Impact Statements.

As Project Officer, I coordinated with contractors and managed the following technical assistance studies:

1. Alternative Methods for the Disposal of Low-Level Waste;
2. Chemical Toxicity of Low-Level Waste;
3. Volume Reduction Techniques for Low-Level Wastes;
4. TMI Resin Solidification Test Program; and
5. Assay of Long-Lived Radionuclides in Low-Level Waste from Power Reactors.

From April 1984 to April 1987, I was Section Leader of the Materials Engineering Section in the Division of Waste Management. In this capacity, I supervised a section that performed technical and engineering evaluations of low-level and high-level radioactive waste packages. This included planning and executing section programs, providing technical direction and integration of materials concerns into NRC low-level and high-level waste licensing activities, and supervising the management of technical assistance programs.

In the low-level waste area, my responsibilities included planning and supervising: (1) the reviews of topical reports on solidification agents, high integrity containers, and waste classification computer codes; and (2) the reviews of licensee specific requests for packaging unique waste materials.

In the high-level waste area, my responsibilities included planning and supervising: (1) the reviews of DOE waste package programs; (2) the reviews of draft and final Repository Site Environmental Assessments in the materials and waste package areas; (3) the direct interactions with DOE in formal waste package and waste glass program meetings; (4) the development of five-year plans for waste package activities; (5) the development of a capability to review the DOE Site Characterization Plans; and (6) the development of technical positions in the areas of waste package reliability and extrapolation of test data to long time frames.

From April 1987 to May 1992, I was Section Leader of the Special Projects Section in the Division of Waste Management. In this capacity, I supervised a section responsible for mixed wastes, decommissioning of materials licensee facilities and power reactors, financial assurance for decommissioning materials licensees and low-level waste disposal facilities, greater than Class C wastes, low-level waste disposal site quality assurance, and the low-level waste data base.

TIMOTHY C. JOHNSON

-3-

In these areas, the Special Projects Section issued three joint NRC/U.S. Environmental Protection Agency guidance documents on mixed wastes, a Standard Review Plan and a Standard Format and Content Guide on financial assurance mechanisms for materials licensee decommissioning, and a guidance document on quality assurance for low-level waste disposal facilities. The section was also responsible for coordinating the storage and disposal of greater than Class C wastes with DOE, reviewing decommissioning plans for the Pathfinder, Shoreham, Rancho Seco, and Fort St. Vrain nuclear power facilities, and developing a financial assurance program for materials licensees.

From May 1992 to November 1999, I was Section Chief of decommissioning sections in the Division of Waste Management responsible for developing and executing the Site Decommissioning Management Plan (SDMP), an agency effort to ensure that 17 decommissioning policy issues were resolved and over 40 non-routine decommissioning sites would be properly decommissioned. During this time, I acted as Project Manager for the decommissioning of the Chemetron site in Cleveland, Ohio, a controversial contaminated site located in a residential neighborhood. The site was remediated and the license terminated in 1998.

From November 1999 to the present, I was a Senior Mechanical Systems Engineer in the Division of Fuel Cycle Safety and Safeguards. In this position, I acted as deputy project manager for the Mixed Oxide Fuel Fabrication Facility licensing and project manager for the licensing of gas centrifuge uranium enrichment facilities. I am currently Project Manager for the Louisiana Energy Services gas centrifuge enrichment plant.

At the NRC, I have participated as the NRC and Division of Waste Management representative on the following industry, government, and international committees:

1. American Nuclear Society Subcommittee 16.1, Leach Testing Standard;
2. American Nuclear Society Subcommittee 40.35, Volume Reduction Systems Standard;
3. American National Standards Institute Subcommittee N14.9.2, Packaging for Transportation Standard;
4. American Society of Mechanical Engineers Radwaste Committee;
5. American Society for Testing and Materials Subcommittee C26.07, Waste Management Committee;
6. International Atomic Energy Agency Committee to prepare a Code of Practice for Low-Level Waste Management at Nuclear Power Plants;
7. International Atomic Energy Agency Committee to prepare a document "National Policies and Regulations for Decommissioning Nuclear Facilities;"
8. Interagency Review Board for the Chemical Waste Incinerator Ship Program;
9. Interagency Review Group for Disposal of Low-Level Wastes at Sea;
10. American Society of Mechanical Engineers Mixed Waste Committee.

I also served as a member of the Nuclear Engineering Program Advisory Board at Worcester Polytechnic Institute.

TIMOTHY C. JOHNSON

-4-

am a member of the following professional societies:

American Nuclear Society
American Society of Mechanical Engineers
American Society for Testing and Materials

Publications and Presentations

T.C. Johnson, M.J. Bell, "Volume Reduction of Low-Level Wastes," Ninth Biennial Conference of Reactor Operating Experience, Arlington, Texas, August 1979.

T.C. Johnson, P.H. Lohaus, R.D. Smith, "10 CFR 61 Waste Form Requirements," Atomic Industrial Forum Conference on NEPA and Nuclear Regulation, Washington, DC, October 1981.

T.C. Johnson, P.H. Lohaus, R.D. Smith, "10 CFR Part 61 Waste Classification Requirements," Electric Power Research Institute Radwaste Workshop, Charlotte, NC, October 1981.

T.C. Johnson, P.H. Lohaus, R.D. Smith, "10 CFR Part 61 Requirements," American Society of Mechanical Engineers/Electric Power Research Institute Radwaste Workshop, Augusta, GA, February 1982.

T.C. Johnson, H. Lowenberg, "Classification of TMI Wastes," Waste Management '82, Tucson, AZ, March 1982.

T.C. Johnson, P.H. Lohaus, R.D. Smith, "10 CFR 61 Waste Form Requirements," American Nuclear Society Topical Meeting on Radioactive Waste Management, Richland, WA, April 1982.

T.C. Johnson, P.H. Lohaus, G.W. Roles, "Implementation of 10 CFR 61 Part Waste Classification and Waste Form Requirements," Waste Management '83, Tucson, AZ, March 1983.

R.E. Browning, Et al., "Status Report on NRC Regulation for Land Disposal of Low-Level Radioactive Wastes and Geologic Disposal of High-Level Wastes," International Atomic Energy Agency Radioactive Waste Management Conference, Seattle, WA, May 1983.

P.H. Lohaus, T.C. Johnson, "NRC Approach to Dealing with Hazardous Substances in Low-Level Radioactive Wastes," American Nuclear Society Summer Meeting, Detroit, MI, June 1983.

T.C. Johnson, P.H. Lohaus, G.W. Roles, "Implementation of 10 CFR 61 Part Waste Classification and Waste Form Requirements," ERM-Midwest Workshop, Columbus, OH, June 1983.

TIMOTHY C. JOHNSON

-5-

T.C. Johnson, P.H. Lohaus, G.W. Roles, "Implementation of 10 CFR 61 Part Waste Classification and Waste Form Requirements," Electric Power Research Institute Radwaste Workshop, Washington, DC, July 1983.

T.C. Johnson, P.H. Lohaus, G.W. Roles, "Implementation of 10 CFR 61 Part Waste Classification and Waste Form Requirements," Test, Research, and Training Reactor Conference, Boston, MA, October 1983.

T.C. Johnson, P.H. Lohaus, G.W. Roles, "Implementation of 10 CFR 61 Part Waste Classification and Waste Form Requirements," Pennsylvania Low-Level Radioactive Waste Symposium, Harrisburg, PA, October 1983.

T.C. Johnson, et al., "Economics of 10 CFR Part 61," Waste Management '84, Tucson, AZ, March 1984.

M. Tokar, et al., "NRC Licensing Requirements for High-Level Radioactive Waste Packages," Waste Management '85, Tucson, AZ, March 1985.

T.C. Johnson, et al., "Current Regulatory Issues," American Society of Mechanical Engineers/Electric Power Research Institute Radwaste Workshop, Savannah, GA, February 1986.

T.C. Johnson, et al., "High-Level Waste Package Licensing Considerations for Extrapolating Test Data," Materials Research Society Symposium, Boston, MA, December 1986.

T.C. Johnson, et al., "Update on LLW Regulatory Guides and Topical Reports," Waste Management '87, Tucson, AZ, March 1987.

E.A. Wick, et al., "NRC Staff Perspective on Performance of Vitrified HLW and How It Relates to Other Components," Waste Management '87, Tucson, AZ, March 1987.

T.C. Johnson, G.W. Roles, "Data Requirements for Waste Classification and Manifesting," Department of Energy Low-Level Waste Management Conference, Denver, CO, August 1988.

T.C. Johnson, D.E. Martin, "Decommissioning Rule Overview," NRC Region III State Liaison Meeting, Glen Ellyn, IL, September, 1988.

T.C. Johnson, D.E. Martin, "Decommissioning Rule Overview," NRC All Agreement States Meeting, Potomac, MD, October 1988.

T.C. Johnson, D.E. Martin, "NRC Perspective on Mixed Wastes," California Mixed Waste Workshop, Davis, CA, October 1988.

T.C. Johnson, "NRC Regulatory Initiatives," DOE Low-Level Waste Management Conference, Pittsburgh, PA, August 1989.

TIMOTHY C. JOHNSON

-6-

T.C. Johnson, "NRC Residual Contamination Criteria," Environmental Protection Agency/Japanese Atomic Energy Research Institute Residual Contamination Workshop, St. Michaels, MD, September 1989.

T.C. Johnson, G.W. Roles, "Decommissioning Waste Characteristics," Environmental Protection Agency/Japanese Atomic Energy Research Institute Residual Contamination Workshop, St. Michaels, MD, September 1989.

T.C. Johnson, "Air Treatment Issues Associated with a Mixed Oxide Fuel Fabrication Facility," 27th Nuclear Air Cleaning and Treatment Conference, Nashville, TN, September 2002.

Instructor: American Society of Mechanical Engineers Radwaste Course, 1982, 1984-1989;
NRC Transportation and Low-Level Waste Course, NRC Technical Training Center, Chattanooga, TN, 1988, 1989.
Harvard School of Public Health Waste Disposal Course, Boston, MA, 1990.

James R. Park
6007 Jennings Lane, Springfield, VA 22150 / (703) 971-6007

RELEVANT PROFESSIONAL EXPERIENCE

U.S. NUCLEAR REGULATORY COMMISSION (NRC)

ROCKVILLE, MD

Environmental Project Manager

March 2004 - present

- Prepare and review environmental assessments and environmental impact statements on various aspects of the nuclear fuel cycle.

Project Manager

August 1994 - December 1998

- Interacted with federal and state governmental agencies, private companies, and members of the public on NRC actions related to the 10 Code of Federal Regulations (CFR) Part 40 licensing of active and inactive uranium mining sites
- Coordinated detailed interdisciplinary technical reviews of licensing actions proposed by 10 CFR Part 40 licensees and reporting of review findings in accordance with NRC policies
- Coordinated periodic meetings between the NRC, other federal and state governmental agencies, private companies, and members of the public on issues related to uranium recovery and site decommissioning
- Received extensive experience in word processing, graphics, and database software, and in Internet search and retrieval during the preparation of technical evaluation reports, environmental assessments, and environmental impact statements
- Received "Outstanding" rating in annual performance appraisals for the period of Fiscal Years 1996, 1997, and 1998

Systems Performance Analyst

June 1989 - August 1994

- Participated in the development of high-speed computer simulations of the long-term performance of the proposed 10 CFR Part 60 high-level waste repository at Yucca Mountain, Nevada
- Monitored several tasks related to scenario analysis on multi-million dollar contracts with the Center for Nuclear Waste Regulatory Analyses (CNWRA) and ensured final CNWRA products met specified technical requirements and schedule constraints
- Presented one paper at and was co-author on two other papers for the annual International High-Level Radioactive Waste Management (IHLRWM) Conference in 1994. Supported NRC preparations for 1990 - 1993 IHLRWM Conferences

James R. Park
6007 Jennings Lane, Springfield, VA 22150 / (703) 971-6007

-2-

OTHER EMPLOYMENT

FAIRFAX COUNTY, VA PUBLIC SCHOOLS

General Education Classroom Teacher 6th Grade

Lorton Station Elementary School (Lorton, VA) August 2003 - February 2004
Newington Forest Elementary School (Springfield, VA) August 1999 - June 2001

- Plan and implement lessons and activities in all major areas of the curriculum
- Instruct in both individual and team teaching situations

EDUCATION

ST. CHARLES BORROMEO SEMINARY PHILADELPHIA, PA
Emphasis in Philosophy August 2001 - May 2003

MARYMOUNT UNIVERSITY ARLINGTON, VA
M.Ed., emphasis in Elementary Education, NK-8 May 1999

IMPERIAL COLLEGE / UNIVERSITY OF LONDON LONDON, ENGLAND
MSc. in Structural Geology and Rock Mechanics October 1988

VIRGINIA POLYTECHNIC & STATE UNIVERSITY BLACKSBURG, VA
B.S. in Geology (cum laude) June 1986

VOLUNTEER EXPERIENCE

- Assisted in and developed activities for and visited with seniors at an assisted-living facility and in a day-care setting (September 2002 - April 2003)
- Assisted in and developed activities for Community Outreach Program for adults with developmental disabilities (September 2001 - April 2002)
- Judged entries for a Junior/Senior High School science fair (1997)

REFERENCES

Available upon request.

EDUCATION

B.S., Chemical Engineering with Honors, Bucknell University, Lewisburg, Pennsylvania, 1992

EXPERIENCE OVERVIEW

Ms. Mayer is a chemical engineer with over thirteen years of experience in cost modeling and cost-benefit analyses. She has prepared several independent cost estimates for clean up for license termination, and reviewed a number of decommissioning funding plans. She recently prepared the cost benefit analysis for the Generic Environmental Impact Statement for NRC's clearance rule. She has also prepared cost models to evaluate the cost impacts of various proposed rulemakings including changes to EPA's LDR program, the addition of several industrial sectors to EPA's Toxic Release Inventory reporting system, and entombment of nuclear reactors as a decommissioning alternative.

PROJECT EXPERIENCE

Review of Decommissioning Cost Estimates/Decommissioning Funding Plans

Cost Estimate Review for Fuel Enrichment Facilities, U.S. NRC, 2004-Present.

Ms. Mayer has supported NRC in review of decommissioning cost estimate, decommissioning funding plan and the cost estimate in the GEIS for one or two proposed fuel enrichment facilities, and has reviewed the decommissioning cost estimate and decommissioning funding plans for a second facility. These reviews include evaluation for inclusion of required elements, determination if individual unit costs are reasonable, and appropriate adjustment to cost estimates to account for inflation and/or facility operational changes.

Decommissioning Cost Estimate/ Decommissioning Funding Plan Review, U.S. NRC, 2000-Present.

Ms. Mayer has supported NRC in review of over a dozen decommissioning cost estimates and decommissioning funding plans under 10 CFR Parts 30, 40, 70, and 72. These reviews included ensuring all necessary required elements were included, determining of whether individual unit costs and total costs were reasonable, and determining if appropriate adjustment to cost estimates to account for inflation and/or facility operational changes were included. For each review, Ms. Mayer prepared a memorandum listing deficiencies and potential deficiencies.

Fuel Cycle Facility Licensing Procedures Deposition Support, US NRC, 2004-Present.

Ms. Mayer attended the depositions of expert witnesses on the costs of decommissioning a fuel cycle facility as a technical expert, and provided feedback to NRC's legal counsel. Ms. Mayer also attended expert witness training for depositions and may be called to act as an expert witness.

Requests for Additional Information in Fuel Cycle Facility Licensing Procedures, US NRC 2004-Present.

For the licensing procedures associated with the LES fuel cycle facility, Ms. Mayer has reviewed decommissioning cost estimates, presented potential deficiencies to NRC, and reviewed both NRC's draft Requests for Additional Information (RAIs) and the potential licensee's responses to those RAIs.

Review of PCB Commercial Storage Applications, U.S. EPA, 1998-Present.

Ms. Mayer is managing ICF Consulting's support in reviewing PCB commercial storage applications for EPA's OPPT, to ensure that closure plans meet the requirements of TSCA in order for facilities to receive operating approval from EPA. She has both conducted reviews herself and supervises a team of reviewers. Each review includes providing a summary of deficiencies and recommendations for additional information necessary for permit approval, as well as verifying the closure cost estimate to determine if the costs of carrying out all of the activities described in the closure plan are covered.

Other Cost Estimates

Independent Cost Estimate for Radioactive Contamination Cleanup, U.S. NRC, 2002.

For US NRC, Ms. Mayer reviewed existing characterization data for a contaminated site in eastern Oklahoma, and contributed to a summary characterization document. She also reviewed cost estimates provided by the facility, offered comment, and prepared an independent cost estimates for cleanup of the site under an unrestricted release scenario.

Independent Cost Estimate for Radioactive Contamination Cleanup, U.S. NRC, 2001.

For US NRC, Ms. Mayer reviewed existing characterization data and cost estimates for a contaminated site in central Pennsylvania, provided comment, and prepared an independent cost estimates for cleanup of the site under five different scenarios, including restricted release and unrestricted release. This cost estimate used comparisons of contaminant levels with derived concentration guidance levels to determine the extent of contamination that had to be removed for buildings, groundwater, soil, and vegetation. She participated in a site visit to better understand the conditions of almost 20 buildings and numerous areas of soil contamination.

Screening Level Analysis of Restricted Release Site Cleanups, U.S. NRC, 2001.

For NRC, Ms. Mayer conducted a screening level analysis to model the costs of remediating six sites to restricted release levels. She helped develop feasible release scenarios and applied generic cost assumptions to input data provided by NRC. This work was used as the basis for STP-04-003.

Support for Rulemaking Planning

Entombment, U.S. NRC, 2001-2002.

Ms. Mayer conducted a cost analysis of proposed changes to the Entombment scenario of nuclear reactor decommissioning. She calculated costs to model reactors decommissioning under decontamination, safe storage, and entombment scenarios to determine if entombment was an economically feasible alternative. For this modeling, she considered both the current regulatory requirements and the proposed regulatory requirements.

Cost Benefit Analysis for Controlling the Disposition of Solid Materials, U.S. NRC, 2003-Present.

Ms. Mayer prepared the cost-benefit analysis for the Draft Generic Impact Statement for Controlling the Disposition of Solid Materials. Focusing on solid materials from light water reactors, she is modeling the costs and benefits of allowing this material to "clear" under each of four regulatory alternatives and 5 dose option levels. She is prepared the Regulatory Analysis based on this cost-benefit analysis. She has modeled the incremental values and impacts over a 50-year timeframe relative to the no action baseline by evaluating each of the 18 attributes that must be analyzed under NUREG BR/0814.

Regulatory Analysis for Fire Protection Manual Action Rule, 2004.

Ms Mayer prepared the draft Regulatory Analysis for changes to 10 CFR Part 50 dealing with operator manual actions. In this analysis, she examined the effect of the rule with and without an interim enforcement policy. Her analysis also considered the effect of some licensees not being in full compliance with existing regulations.

Regulatory Analysis of IAEA Safety Standards, U.S. NRC, 1999-2000.

Ms. Mayer evaluated the regulatory implications of NRC adoption of the IAEA ST-1 provisions pertaining to uranium hexafluoride (UF₆) in proposed revisions to 10 CFR Part 71. Specifically, she evaluated the difference between the international standard referenced by IAEA (ISO 7195) and the national standard referenced by existing regulations (ANSI N14.1), as well as other differences in regulatory requirements. She then estimated the amount of UF₆ shipped, and the cost of necessary changes in management, and the environmental costs and benefits.

Summary of Analysis of Public Comments

NRC Clearance Rule Comment Summary, 1999.

Ms Mayer assisted in summarizing comments received on the NRC Clearance rule. In particular, she summarized comments pertaining to restricted release of materials, as an alternative to unrestricted release.

Phase IV Land Disposal Restrictions, 1997.

Ms. Mayer helped manage ICF's work in summarizing over 600 comments on EPA's Phase IV LDR rule. For this effort, she helped develop the issue outline, provided specifications for the Lotus Notes system used in the comment summary process, and responded to technical questions from staff reading comment letters to best categorize comments. She also helped summarize the major issues raised by the commenters. Ms. Mayer helped prepare several technical background documents that were used by EPA to respond to commenters concerns as well as revising another technical background document to incorporate facility specific information provided in the public comment process.

Environmental Analysis

Environmental Assessment of IAEA Safety Standards, U.S. NRC, 1999-2000.

Ms. Mayer evaluated the environmental implications of NRC adoption of the IAEA ST-1 provisions pertaining to uranium hexafluoride (UF₆) in proposed revisions to 10 CFR Part 71. Specifically, she evaluated the difference between the international standard referenced by IAEA (ISO 7195) and the national standard referenced by existing regulations (ANSI N14.1), as well as other differences in regulatory requirements. She then estimated the amount of UF₆ shipped, and the cost of necessary changes in management, and the environmental costs and benefits.

Environmental Assessment of Geological and Seismological Characteristics for and Design of Dry Cask Independent Spent Fuel Storage Installations (10 CFR Part 72).

Ms. Mayer helped evaluate the environmental implications resulting from proposed changes to 10 CFR Part 72, including changes to the design earthquake and other design requirements for ISFSIs.

Selected Company Reports

Decommissioning Cost Estimate For Safety Light Corporation Bloomsburg, PA, 2001.

Decommissioning Cost Estimate For Fansteel Inc. Muskogee, OK, 2002.

Economic Analysis for Final Rule: Revisions to the Underground Injection Control Regulations for Class V Injection Wells, 1999.

Application of Phase IV Land Disposal Restrictions to Newly Identified Mineral Processing Wastes, Regulatory Impact Analysis, April 1998.

Regulatory Analysis of IAEA Safety Standards, 2000.

Regulatory Analysis for Controlling the Disposition of Solid Materials: Draft Report, 2005

Regulatory Analysis of Post-fire Operator Manual Actions Rule - 10 CFR Part 50 - Appendix R: Draft Report, 2004

Group II Cost Estimates And Financial Capability Assessment For Staff Response To SRM-SECY-00-180 Draft Report, 2002 (Basis of STP-04-003)

CRAIG M. DEAN

EDUCATION

1984-85	Graduate Study, Economics and Statistics, American University
1976-1979	J.D., Georgetown University Law Center
1964-1969	M.A., (Ph.D. less dissertation), Russian Studies, Columbia University
1960-1964	B.A., <u>cum laude</u> , History, Carleton College

EXPERIENCE

Mr. Dean joined ICF in January 1984, and is a Project Manager. He is an attorney and regulatory analyst, with an extensive background in financial assurance. His experience includes development and implementation of financial assurance requirements for the Environmental Protection Agency, the Nuclear Regulatory Commission, and several states. Since 1986, Mr. Dean has provided support to the NRC for the development of financial assurance regulations, program implementation, case work, training, and special projects involving financial assurance.

Financial Assurance Regulations of 10 CFR Parts 30, 40, 50, 70, and 72

Since 1986, Mr. Dean has been providing support to the NRC in analysis of financial assurance submissions, evaluation of financial assurance issues, development of guidance documents and delivery of training on financial assurance, licensing reviews, and enforcement. Projects have included the following:

- Review of Financial Assurance Submissions from NMSS Licensees.
Since promulgation of the NRC regulations on financial assurance for decommissioning of materials licensees in 1988, Mr. Dean has provided support to NRC in the review and evaluation of non-standard financial assurance submissions from licensees for costs of decommissioning licensed nuclear materials facilities. The submissions have included both decommissioning cost estimates and financial instruments. Mr. Dean has participated directly in the reviews, and has also supervised other ICF staff performing reviews and provided quality assurance.
- Financial Assurance Program Assessment.
Mr. Dean managed major components of a multi-year analysis in 1986-1987 of financial assurance requirements of the NRC for low-level radioactive waste, mixed low-level and RCRA waste, uranium mill tailings, and source, special nuclear, and byproduct licensees, including financial mechanisms, decommissioning cost estimates, reporting and recordkeeping requirements, bankruptcy problems, financial test issues, overall regulatory structure, and guidance. The assessment compared the NRC regulatory framework with financial assurance requirements of other federal agencies, particularly the EPA. Mr. Dean is currently managing a two-year contract to provide technical assistance to NMSS related to financial assurance for decommissioning and subsurface soil and groundwater monitoring of materials and non-power reactor facilities.

- Analysis of the Implications of Electric Utility Deregulation on Nuclear Reactor Decommissioning Financial Assurance.

Mr. Dean prepared a detailed study of the development of NRC policy on decommissioning financial assurance for nuclear power reactors to assess the implications of utility deregulation. He prepared a detailed chronological analysis of the development of NRC's policy concerning whether financial assurance should be required, the level of assurance (e.g., "reasonable assurance") required, the amounts of such assurance, the types of financial instruments to be allowed to provide assurance, the respective responsibilities of the NRC and other regulatory bodies, such as state PUCs and FERC, with respect to financial assurance, and related topics.
- Financial Assurance Training for NRC Regional and Headquarters Staff, and Agreement State Staff.

Mr. Dean prepared and presented training in July-August 1989 to four NRC Regions on financial assurance for decommissioning, including overview of financial mechanisms, review of cost estimates, implementation procedures, and data sources. He also presented training to NRC Headquarters staff from Office of Research, Office of Nuclear Materials Safety and Safeguards, Office of General Counsel, and Commission staff. The training was repeated in September 1992 to five NRC Regions and Headquarters staff, in August 1995 to three Regions and Headquarters staff, and in 1998 to three Regions (one by teleconference), Headquarters staff, and staff from three Agreement States.
- Financial Assurance Workshops for NRC Agreement States Staff.

Mr. Dean developed and presented a workshop on design and implementation of financial assurance for decommissioning to representatives of 28 States at the NRC annual meeting of Agreement States in October 1991. He also developed and presented a two-day training program in July 1993 sponsored by NRC's Agreement States Office for staff from 14 Agreement States. Training consisted of overview of financial assurance concepts and procedures for technical review of financial assurance submissions, including cost estimates and financial mechanisms, from nuclear materials licensees.
- Review of Decommissioning Cost Estimates and Financial Assurance Mechanisms for Proposed Fuel Enrichment Facilities.

Mr Dean is currently managing reviews of cost estimates and financial mechanisms submitted by Louisiana Energy Services (LES) and U.S. Enrichment Company (USEC) in support of their license applications.
- Financial Assurance Compliance Support to NMSS.

Mr. Dean has managed or participated in support to NMSS and to NRC's Office of General Counsel in special enforcement situations involving the financial ability of materials licensees to carry out necessary decommissioning activities. Topics evaluated have included corporate ownership and piercing the corporate veil of a holding company involved in bankruptcy to determine if associated companies could be sources of financial assurance for decommissioning, evaluation of the financial condition of several firms in bankruptcy or reporting financial distress and assessments of their ability to pay financial assurance if needed, review of financial mechanisms either proposed or in use by licensees, and other topics.

- Financial Assurance Compliance Support to NRR.
Mr. Dean has provided support to NRR for the review of the terms and conditions of trust funds submitted by reactors, including a review in 2005 of proposed amendments to non-qualified decommissioning trust agreements for Turkey Point and St. Lucie nuclear plants. He has also reviewed tax issues pertaining to decommissioning trust funds established for nuclear power reactors, including evaluation of a private letter ruling addressing the tax liability of a licensee for reactor decommissioning financial assurance.

Analysis of Bankruptcy Issues Affecting Financial Assurance

- Evaluation of Vulnerability of Financial Assurance Mechanisms in Bankruptcy.
In support of the Environmental Protection Agency's evaluation of various financial mechanisms for use to provide financial assurance for closure and post-closure care of hazardous waste management facilities, Mr. Dean prepared a comprehensive analysis of the vulnerability of financial tests, letters of credit, trust funds, and surety bonds in reorganization and liquidation. In particular, he evaluated the effects of the automatic stay provision, legal decisions allowing environmental claims and/or administrative cost claims to avoid the automatic stay; the likelihood of government claims that are subject to the automatic stay to later be given preference over other claims; and the effects of the cram down provision on the likelihood of recovery if government claims are not given priority. He also evaluated the law pertaining to the bankruptcy or reorganization of parent and subsidiary corporations and the law of parent to subsidiary ("downstream"), subsidiary to parent ("upstream") and subsidiary to subsidiary ("cross-stream") corporate guarantees.
- Bankruptcy Analysis Support to NRC.
Mr. Dean has provided support to both NRR and NMSS staff for the analysis of bankruptcy issues. For NRR, he prepared an evaluation of nuclear power reactor ownership structures and their effects on NRC's reactor decommissioning financial assurance requirements that included an examination of the bankruptcy vulnerabilities of different forms of business organization, including corporations and partnerships as well as new forms of organization such as limited partnerships, limited liability partnerships (LLPs), limited liability limited partnerships (LLLPs), and limited liability companies (LLCs). For NMSS, he supervised the preparation of a summary of bankruptcy law as it was likely to affect NMSS financial assurance; identified sources of information on the likelihood that a firm that emerges from reorganization will reenter bankruptcy and the time periods in which their reentry is most likely to occur; and evaluated financial assurance submissions by the Fansteel corporation that involved bankruptcy issues.

Analysis of Business Organization Issues Affecting Financial Assurance

- Corporate Guarantees.

For the EPA, Mr. Dean researched the law on corporate guarantees and developed the terms and conditions of the corporate guarantee used in 40 CFR Parts 264 and 265 for financial assurance for closure and post-closure care of hazardous waste facilities. These corporate guarantee terms and conditions were subsequently adopted for financial assurance for underground storage tanks, and, by the NRC, for decommissioning financial assurance of facilities licensed by NMSS. For the EPA, Mr. Dean also reviewed the impacts of state insurance law on corporate guarantees for liability coverage.

- Evaluation of Power Reactor Ownership Structures.

For NRC/NRR, in response to a critical study released by the STAR Foundation of the increasing use of limited liability companies and multi-tiered holding companies to own nuclear power plants, Mr. Dean prepared a comprehensive working paper describing the basic attributes of corporations, partnerships (including limited liability partnerships and limited liability limited partnerships), and limited liability companies in terms of their organic statutes (Uniform Partnership Act, Uniform Limited Partnership Act, Uniform Limited Liability Company Act, etc.) as well as other governing law. The paper compared their key organizational attributes in terms of characteristics or actions most likely to affect financial assurance (e.g., limited liability, property ownership and distribution, and dissolution of the entity). The paper evaluated whether complex holding companies or other forms of organization that include limited liability subsidiaries pose a risk to the NRC of failing to provide reasonable financial assurance for decommissioning. The paper also reviewed the use of organizational terms in 10 CFR Part 50 and recommended changes to reflect the increased variety of business organizational structures in current use by reactor owners.

- Evaluation of Licensee's Use of Limited Liability Companies.

Mr. Dean prepared a detailed set of draft Requests for Additional Information submitted by the Office of Nuclear Reactor Regulation to Exelon Energy Corporation dealing with Exelon's use of numerous limited liability companies (LLCs) to hold trust funds for nuclear reactor decommissioning. Mr. Dean also participated in numerous teleconferences with Exelon staff, accountants, and attorneys, and NRC staff to receive Exelon's verbal explanations and determine if additional information was required. Mr. Dean then prepared a written analysis that formed the basis for a part of the Safety Evaluation Report on the licensee's proposed transactions, which involved license transfers and changes in control of the decommissioning trust funds.

Decommissioning Technology

- Evaluation of Institutional Controls for Decommissioning Facilities.

Mr. Dean has provided support to several federal agencies, including EPA and the Department of Energy, for the evaluation of potential institutional controls for decommissioning facilities. For the DOE, he managed a study of potential long-term controls for weapons-program sites contaminated with high-level radioactive materials and evaluated studies of institutional controls at particular DOE sites prepared by the Environmental Defense Fund. For EPA, he prepared analyses of such institutional controls as deed notices, covenants, easements, and similar restrictions for use at hazardous waste management facilities and brownfields sites.
- Review of Restricted Release Decommissioning Scenarios at Selected NRC Sites.

Mr. Dean prepared a comparison of restricted release scenarios, including site setting, constituents of concern, release criteria (DCGLs), sludges, structures, soils, groundwater, drummed wastes and solid wastes on site, disposal cell design, institutional controls and land use restrictions, offsite disposal alternatives, estimated costs, and expected duration of restrictions, for several sites, including Sequoyah Fuels, Shieldalloy Metallurgical Corporation, Molycorp, Inc., and Fansteel, Inc., as input to the remedial design for the SafetyLight site.
- Development of Independent Decommissioning Cost Estimate for NMSS Licensee Site.

Mr. Dean participated in the evaluation of decommissioning alternatives for the SafetyLight (SLC) site located in Bloomsburg, PA. In particular, he prepared the component of the revised cost estimate developed by ICF for the site that addressed institutional controls for the site, he participated in the review and evaluation of alternative scenarios for restricted and unrestricted release, and he reviewed the final report prepared by ICF.

Preparation of Draft NRC Rulemaking and Guidance Documents on Financial Assurance

- Rulemaking Support for Financial Assurance Requirements for NMSS Licensee Decommissioning.

Mr. Dean managed support to NMSS for the review of a petition for rulemaking by Westinghouse and General Electric requesting revised financial assurance requirements for large firms. The project involved quantification of the degree of assurance provided by all financial assurance mechanisms currently authorized by NRC and comparison to the degree of assurance provided by proposed financial test mechanism. (Cited as an example in NUREG/BR-0184, "Regulatory Analysis Technical Evaluation Handbook.") The project culminated in development of the financial test for financial assurance currently used by the NRC. Support for the rulemaking included development of draft text for the Federal Register notice, preparation of a Regulatory Analysis, OMB clearance document, and comment summary and analysis. Mr. Dean also managed a related project to address decommissioning by licensees that are not-for-profit entities, such as hospitals and universities, or that cannot qualify for the bond component of the financial test because they do not issue bonds. The report was published as NUREG/CR-6514, *Analysis of Potential Self-Guarantee Tests for Demonstrating Financial Assurance by Non-Profit Colleges, Universities, and Hospitals, and by Business Firms That Do Not Issue Bonds*, June 1997, and formed the basis for

rulemaking action by NMSS. Support for that rulemaking also included development of draft text for the Federal Register notice, preparation of a Regulatory Analysis, OMB clearance document, and comment summary and analysis.

- Rulemaking Support for Financial Assurance Requirements for Power Reactor Decommissioning.

Mr. Dean participated in a review of public comments on an NRC proposal to revise the financial assurance requirements for power reactors, proposed revisions to the trust fund requirements in 10 CFR Part 50, provided support for the preparation of a rule amending the requirements for nuclear power reactor decommissioning trust funds, and assisted NRC in a review of existing guidance.

- Financial Assurance Guidance.

Mr. Dean provided support for the development of guidance materials implementing NRC requirements for financial assurance for decommissioning of licensed facilities, including NUREG-1336, Rev. 1, *Standard Format and Content Guide for Financial Assurance Mechanisms Required for Decommissioning Under 10 CFR Parts 30, 40, 70, and 72*, July 1989 and NUREG-1337, Rev. 1, *Standard Review Plan for the Review of Financial Assurance Mechanisms for Decommissioning Under 10 CFR Parts 30, 40, 70, and 72*, August 1989, Regulatory Guide 3.66, *Standard Format and Content Guide for Financial Assurance Mechanisms Required for Decommissioning Under 10 CFR Parts 30, 40, 70, and 72*, September 1998, and NUREG-1727, NMSS Decommissioning Standard Review Plan, September 2000.

Support for Financial Assurance Requirements of the Environmental Protection Agency

- Financial Assurance for Hazardous Waste Treatment, Storage, and Disposal Facilities (TSDFs).

Between 1980 and 1983, while employed by the Government Research Corporation, Mr. Dean supported the development of financial assurance requirements by the Environmental Protection Agency under the Resource Conservation and Recovery Act (RCRA) for hazardous waste TSDFs. He participated in meetings with private attorneys and experts from the American Bankers Association and other trade organizations on trust funds, surety bonds, letters of credit and other financial instruments. He also participated in the development of a financial test for financial assurance. Mr. Dean also participated in the development of guidance on the preparation of decommissioning cost estimates for TSDFs.

- Financial Assurance for Underground Storage Tanks and Municipal Waste Disposal Facilities.

Beginning in 1984, at ICF, Mr. Dean provided support to the EPA for the development of financial assurance requirements for leaking underground storage tanks containing petroleum and for municipal landfills. He also worked on the development of standards for limiting lender liability for environmental cleanup costs at facilities containing underground storage tanks.

PROFESSIONAL AFFILIATIONS

Member of the Bar of the District of Columbia (Admitted to Practice, 1979)

SELECTED PUBLICATIONS/PRESENTATIONS

NUREG/CR-6514, *Analysis of Potential Self-Guarantee Tests for Demonstrating Financial Assurance by Non-Profit Colleges, Universities, and Hospitals, and by Business Firms That Do Not Issue Bonds* June 1997.

"Financial Assurance for Low-Level Radioactive Waste Disposal Facilities: Factors Affecting the Type, Levels, and Duration of Requirements," presented at WASTE MANAGEMENT '89, Tucson, Arizona March 1, 1989.

"EPA Regulations: Mixed Waste, RCRA and Low-Level Waste," presented at the seminar on Liability Coverage for Low-Level Radioactive Waste Disposal Facilities at the quarterly meeting of the Low-Level Radioactive Waste Forum, April 27-29, 1987.

"RCRA Reauthorization: What It Means For Your Company," speech presented at Hazardous Materials Expo '85, Chicago, Illinois, August 1985.

"Review of Financial Responsibility Regulations," paper presented at RCRA Financial Responsibility and Closure/Post-Closure Plans Seminar, sponsored by Government Institutes, Inc., Washington, D.C., June 1981.

"The Design of Hazardous Waste Management Financial Responsibility Programs," paper presented at Third National Conference on Hazardous Materials Management, Anaheim, California, March 1981.

Student Topics Editor, "The Tax Lawyer," Journal of the American Bar Association, Tax Section (published jointly with Georgetown University Law Center), 1978-1979.

CURRICULUM VITAE

Donald E. Palmrose, Ph.D.

Senior Safety Analyst

Advanced Systems Technology and Management, Inc.

8300 Old Courthouse Rd., Suite 210

Vienna, VA 22182

Telephone: 703-821-2185

Fax: 703-821-0455

Summary of Qualifications

Dr. Palmrose has twenty-five years of management and technical expertise in Risk Assessments, National Environmental Policy Act (NEPA) assessments and documentation, Nuclear Safety Analysis, Radiation Protection, Criticality Safety, and Thermal-Hydraulic Analysis. Dr. Palmrose has been a project manager, technical lead, and trainer for the evaluation of the risk from the use of byproduct material by industry, medical applications, and research supporting the U.S. Nuclear Regulatory Commission (NRC) Office of Nuclear Material Safety and Safeguards (NMSS). He has participated in the preparation of several key NEPA documents for the U.S. Department of Energy (DOE) and the NRC that include construction and operation of new fuel cycle facilities, decommissioning of shutdown facilities; the processing and deposition of transuranic wastes, and in developing strategies encompassing the transport and disposition of plutonium-bearing material within the DOE complex. At various times, he has been a team member for audits, 10 CFR 830 reviews, and training for activities that include operational readiness reviews, safety analysis reports, documented safety analyses, safety evaluation reports, and risk assessments. He has six years of managerial and operational experience on nuclear power plants and is a specialist in development and application of computer analysis for radiological dose assessments and of nuclear power plant operations for nuclear safety.

Education

Ph.D. Nuclear Engineering, Texas A&M University, May 1993.

M.S. Nuclear Engineering, Texas A&M University, May 1986.

B.S. Nuclear Engineering, Oregon State University, June 1979.

Professional Experience

Advanced Systems Technology and Management (AdSTM), Inc.

Senior Safety Analyst, July 2005-Present

Dr. Palmrose serves as a safety expert and contributor for several U.S. Federal government agencies, including the Federal Motor Carrier Safety Administration (FMCSA) and the U.S. Nuclear Regulatory Commission (NRC). He is developing a quality assurance review plan for FMCSA along with supporting a review of the regulatory effectiveness of Field Operations along the Southern and Northern Borders. For the NRC, he is supporting the developmental assessment of the TRACE thermal-hydraulics code including the comparison of TRACE code results to test facility data.

Advanced Technologies and Laboratories (ATL) International, Inc.
Senior Nuclear Safety Engineer, March 2000-July 2005

Dr. Palmrose has served as project manager and a technical contributor in several NRC risk assessments concerning the nuclear fuel life cycle and the use of byproduct material. In general, the risk assessments have been in support of NRC programs for risk-informed decision-making of byproduct material uses. There were two risk studies, or assessments, concerning the change in risk if petitions for rule making would be implemented. One petition was to allow the irradiator facility operator to be off-site during operations and the second was to remove radiography associated equipment from 10 CFR Part 34.20. Another byproduct material risk assessment evaluated the potential impacts of enforcement or rulemaking changes involving chemical agent detectors or monitors that use nuclear byproduct material sealed sources. Two related projects were involved improving the NRC staff's understanding of the risk assessments developed in NUREG/CR-6642, "Risk Analysis and Evaluation of Regulatory Options for Nuclear Byproduct Material Systems." Dr. Palmrose led the development of a handbook about NUREG/CR-6642 and an associated training course (P-405, "Byproduct Materials System of Risk Analysis and Evaluation in NMSS") that was given to the NRC staff at Headquarters and the four Region offices. A related NUREG/CR-6642 task consisted of developing an approach to uncertainty analysis of this nuclear byproduct material risk study for the purpose of supporting a revision of NMSS inspection guidance. Dr. Palmrose led a NMSS-sponsored project in gathering risk information concerning the life cycle of spent nuclear fuel, especially for dry storage and transportation risks from NRC, industry, and other governmental technical basis documents. The project report not only presented an overview of the spent nuclear fuel life cycle and annual risks as available but also presented recommendations and suggested process steps that the NRC could pursue to better risk-inform this arena of NMSS responsibility.

Dr. Palmrose has been a key technical contributor in performing NEPA evaluations relating to radiation health effects, alternative actions, site conditions, operational history, and remediation technologies. This work includes an Environmental Impact Statement (EIS) for the decommissioning of the Sequoyah Fuels Corporation Facility, a former uranium conversion plant nearby Gore, Oklahoma; an EIS for the construction and operation of a uranium enrichment facility, and Environmental Assessments (EAs) for the license renewal of a wet-basin independent spent fuel storage installation (ISFSI), and a gaseous centrifuge test facility. He has been involved in several NEPA-

required Supplement Analyses and draft Amended Record of Decisions in support of the timely closure of the Rocky Flats Environmental Technical Site (RFETS) involving the safe transportation, storage, and disposition of plutonium-bearing material to either the Savannah River Site (SRS) or to the Waste Isolation Pilot Project (WIPP). For his work on RFETS projects, he received a letter of appreciation on July 2, 2002 from DOE's Office of Nuclear Material and Spent Fuel.

Dr. Palmrose has been a technical contributor in the reviews and revisions of NRC Regulatory Guides and Standard Review Plans for: (1) dry cask storage systems and facilities in support of 10 CFR Part 72; (2) current 10 CFR Part 71; and (3) proposed 10 CFR Part 71 rule changes. He provided technical support for a safety evaluation report regarding potential purification processes in a mixed oxide fuel fabrication facility.

Dr. Palmrose has participated in eight independent reviews of Documented Safety Analyses (DSAs) of Los Alamos National Laboratory (LANL) facilities to ensure these DSAs are produced in accordance with 10 CFR 830, current DOE Orders and Standards, and LANL guidance and checklists. The LANL facilities reviewed include the Beryllium Technology Facility (BTF); the Bolas Grande Project; the existing Chemistry and Metallurgy Research (CMR) Facility; the General Tank's area; the Los Alamos Neutron Science Center (LANSCE); the Radioassay and Nondestructive Testing (RANT) facility; the TA-54 and Transuranic Waste Characterization Modular Units; and the Waste Characterization, Reduction, and Repackaging (WCRR) facility. The reviews addressed proper accident identification, accident analysis, identification of structures, systems, and components that are safety-class and safety-significant and associated technical safety requirements for safe operation. The reviews included verifying and/or independently confirming the quantitative accident analysis in accordance with applicable DOE orders, standards and handbooks (i.e., DOE-O-420.1A, DOE-STD-3009-94Ch2, and DOE-HDBK-3010-94). This included calculations of material-at-risk and accident consequences using the five-factor formula of DOE-HDBK-3010-94.

Dr. Palmrose coordinated the developed of the environmental section of the Technical Basis Document on the U.S. Department of Energy (DOE) Portsmouth Gaseous Diffusion Plant as a member of ATL's radiation dose reconstruction team for the National Institute for Occupational Safety and Health (NIOSH). He is currently assessing the source term and developing the external dosimetry section of the Technical Basis Document for DOE's former Pinellas Plant.

Dr. Palmrose has supported the DOE in nuclear criticality safety as part of nuclear safety analyses and reviews. He prepared a nuclear criticality safety program report tailored for DOE's Office of River Protection at Richland, WA. This document recommended an oversight program of contractors' criticality programs to ensure the safe remediation of the Hanford Tank Farms in according with DOE Order 420.1 and other DOE Standards and memoranda. As a team member for a nuclear safety review of DOE's East Tennessee Technology Park (ETTP) contractor, he critiqued the

performance the nuclear criticality safety and training programs for integration into line operations; for complying with ANSI/ANS national standards and DOE orders, directives, policies, and standards.

Sciencetech, Inc., 1996-2000

Risk Assessment and Thermal-Hydraulics Group, Senior Engineer, Thermal-Hydraulic Analysis Principal Investigator

Dr. Palmrose provided technical and program support to industry and several offices of DOE, to the U.S. Nuclear Regulatory Commission Office of Nuclear Reactor Regulation (NRR), Office of Nuclear Reactor Research (RES), and Office of Nuclear Materials, Safety, and Safeguards (NMSS). He has performed risk analysis of nuclear byproduct material systems licensed by the NRC for use in industrial, medical, and research applications and documented in NUREG/CR-6642. He gathered data, performed risk and consequence analyses, and documented the results for twelve of forty systems for NUREG/CR-6642. Under a DOE international safety program, he was a team member providing advice, guidance, and review of deliverables to a trio of Ukrainian companies developing an integrated safety analysis for the Zaporizhzhya Unit 5 VVER-1000 nuclear power plant based on U.S. safety standards and criteria. Dr. Palmrose provided technical assistance to a nuclear utility in the analysis of licensing application for spent fuel storage of a decommissioned nuclear power plant. He has performed thermal-hydraulic safety analysis and project management for RES and DOE using the RELAP5/MOD3 and the TRAC-PF1/MOD2 thermal-hydraulic codes including operating commercial PWRs, scaled experimental facility (ROSA/AP600), advance reactor designs (AP600), research reactors (Brookhaven National Laboratory High Flux Beam Reactor), and for supporting pressurized thermal shock analysis.

Lockheed-Martin Idaho Technologies Co. and EG&G Idaho, Inc., 1991-1996

NRC Thermal-Hydraulics Analysis Unit and National Nuclear Regulatory Support Office, Staff Engineer

He performed various safety analyses for DOE and NRC using various code packages or by creating special analytical codes to analyze operating commercial pressurized water reactors (PWRs), scaled experimental facilities, advance and conceptual reactor designs, and research reactors. This work also includes the performance of a criticality accident analysis for a nuclear fuels storage facility presenting the potential radiological effects during personnel evacuation.

Texas A&M University, Department of Nuclear Engineering, 1984-1991

Non-Teaching Assistant, Research Assistant, and Research Reactor Technical Support Staff

As a Non-Teaching and Research Assistant for the Department of Nuclear Engineering, he graded, prepared lectures, and performed various other teaching and research activities with special emphasis on fusion and thermal-hydraulic courses. He also

performed various technical support services at the Texas A&M University Science Center for a Training, Research, and Isotope, General Atomics (TRIGA) research reactor in 1987.

U.S. Navy and U.S. Naval Reserves, 1979-1995

Officer

Active duty service in the Surface Nuclear Propulsion Program, 1979-1984

Reserve assignments with Office of Naval Research and Engineering Duty units, 1984-1995

Active duty service in the Surface Nuclear Propulsion Program under ADM Hyman Rickover. Responsible for directing the daily activities of up to 120 men in the maintenance and operation of nuclear and non-nuclear mechanical systems under dynamic operating conditions. —1 Division Officer on U.S.S. Mississippi (CGN-40) from October 1980 to November 1982. Qualified as a Surface Warfare Officer in November 1982. Auxiliaries Officer on U.S.S. Enterprise (CVN-65) from February 1983 to March 1984. Transferred from active duty to the reserves in late March 1984. Reserve assignments with Office of Naval Research and Engineering Duty units. Retired from U.S. Naval Reserves on September 1, 1995.

Specific Technical Expertise

Safety Analysis —Performed accident and safety analysis for public and occupational health and safety for all exposure pathways for committed effective dose equivalent (CEDE) and total effective dose equivalent (TEDE) evaluated to current regulatory criteria and standards. Experience with applying the RESRAD, GENII, and other environmental dispersion codes that apply Gaussian plume and other dispersion methodologies. Specific applications are as follows: Performed an integrated and multi-dimensional activation and shielding analysis of a potential experimental fusion device. Determined the potential radiological effects on personnel evacuation for a criticality accident at a nuclear fuels storage facility at the INEL. Conducted a risk analysis of nuclear byproduct material systems licensed by the NRC for use in industrial, medical, and research applications. Assisted in the analysis of licensing application for spent fuel storage of a decommissioned nuclear power plant. Reviewed licensee applications submitted to the NRC. Reviews of required 10 CFR 830 Documented Safety Analyses (DSAs) of LANL facilities to ensure these DSAs are produced in accordance with current DOE Orders and Standards, and LANL guidance and checklists.

Thermal-Hydraulic Analysis — Thermal-hydraulic safety analysis using various code packages (example: the Reactor Excursion and Leak Analysis Program Version 5 or RELAP5) or by creating special analytical codes. Developed a computer program based on noncondensable gas and steam mixture behavior to calculate the maximum system pressure for a long term loss of a shutdown PWR's residual heat removal system. Modeled and analyzed various nuclear power plants with the RELAP5/MOD3

and the TRAC-PF1/MOD2 thermal-hydraulic codes including operating commercial PWRs (H. B. Robinson Unit 2), scaled experimental facilities (ROSA/AP600, SPES, and PMK-NVH), advance reactor designs (AP600), and research reactors (Univ. of Rhode Island research reactor and Brookhaven National Laboratory High Flux Beam Reactor). Thermal-hydraulic Principal Investigator for an U.S. Nuclear Regulatory Commission programs on pressurized thermal shock study to support regulatory guide changes and for integral test facility calculations using RELAP5/MOD3. Technical manager of a New York Power Authority contract for Independent V&V of the SOLOMON code.

Training — Manager, technical lead, and principal trainer for NRC Course P-405, "Byproduct Materials System of Risk Analysis and Evaluation in NMSS," U.S. Nuclear Regulatory Commission given to NRC Headquarter and Region Office staff during calendar years of 2002 and 2003. Developed and presented practical application of thermal-hydraulic analysis in a RELAP5 training course. Taught and organized undergraduate laboratory course and occasional main lectures in support of several engineering courses while a graduate student at Texas A&M.

Professional Associations

American Nuclear Society, Member

Publications and Presentations

"Feasibility of Recoil Enhanced Tritium Release from Fusion Blankets Containing Solid Lithium Compounds," Masters of Science Thesis, Texas A&M University, (May 1986).

"Enhancing Tritium Release from Diffusion Limited Solid Lithium Compounds" (co-author), American Nuclear Society Annual Meeting, Dallas, Texas (June 1987).

"TAU: A Design for a Thousand Astronomical Unit Voyage" (co-author), American Nuclear Society Annual Meeting, Dallas, Texas (June 1987).

"Development of a Space Reactor Systems Code at Texas A&M University" (co-author), American Nuclear Society Annual Meeting, Dallas, Texas (June 1987).

"Enhancing Tritium Release from Diffusion Limited Solid Lithium Compounds," Fusion Technology (co-author), Vol. 15, No. 2, Part 1, pp. 193-203 (March 1989).

"Nuclear Radiation Analysis of the IGNITEX Experiment" (co-author), 16th IEEE International Conference On Plasma Science, Buffalo, New York, IEEE 89-CH-2760-7, 59 (May 1989).

"The Impact of Dose Rates Due to Decay Photons of the Design of the IGNITEX Device" (co-author), 13th International Symposium on Fusion Engineering, Knoxville, Tennessee, 1, 720 (October 1989).

"Assessment of Structural Activation in the Operation of the Fusion Ignition Experiment IGNITEX" (co-author), 17th IEEE International Conference on Plasma Science, Oakland, California, IEEE 90-CH 2857-1, 94 (May 1990).

"Activation and Decommissioning Considerations for the Fusion Ignition Experiment IGNITEX" (co-author), Ninth Topical Meeting on the Technology of Fusion Energy, Oak Brook, Illinois (October 1990) and published in Fusion Technology (co-author), Vol. 19, No. 3, Part 2B, pp. 1931-1937 (May 1991).

"A Model for Calculation of RCS Pressure During Reflux Boiling Under Reduced Inventory Conditions and Its Assessment Against PKL Data" (co-author), Proceedings of the United States Nuclear Regulatory Commission for the Nineteenth Water Reactor Safety Information Meeting, NUREG/CP-0119 Vol. 3, pp 329-351 (April 1992).

Thermal-Hydraulic Processes During Reduced Inventory Operation with Loss of Residual Heat Removal (co-author), NUREG/CR-5855 EGG-2671 (April 1992).

"Development of a Multi-Dimensional Coupled Neutron-Gamma Shielding Package for an Entry Level Workstation" (co-author), Proceedings of the Topical Meeting on New Horizons in Radiation Protection and Shielding, Pasco, Washington (April 26 - May 1, 1992).

"RCS Pressure Under Reduced Inventory Conditions Following a Loss of Residual Heat Removal" (co-author), AIChE Symposium Series, No. 288, Vol. 88, pp 267-274 (1992).

"A Multi-Dimensional Activation and Shielding Analysis Code Package for a Workstation," Doctor of Philosophy Dissertation, Texas A&M University, (May 1993)

"Modeling of a Horizontal Steam Generator for the Submerged Nuclear Power Station Concept" (co-author), 1993 RELAP5 International Users Seminar, Boston, Massachusetts (July 1993).

"An Experimental and Analytical Investigation of Loss of Residual Heat Removal Transients in a Babcock and Wilcox Type Reactor" (co-author), 29th National Heat Transfer Conference, Atlanta, Georgia August 8-11, 1993, ASME, HTD-Vol. 245, NE-Vol. 11, pp 111 (August 1993).

"Modeling Horizontal Steam Generators with RELAP5," 1994 RELAP5 International Users Seminar, Baltimore, Maryland (August 1994).

"Potential Failure of Steam Generator Tubes Following a Station Blackout" (co-author), American Nuclear Society 1994 Winter Annual Meeting, Washington, D.C. (November 1994).

Scaling and Design of LSTF Modifications for AP600 Testing (co-author), NUREG/CR-6066 (November 1994).

"Application of RELAP5 and TRAC-P to PTS," RELAP5 Users Meeting, Annapolis, Maryland (June 1997).

Risk Analysis and Evaluation of Regulatory Options for Nuclear Byproduct Material Systems (contributor), Final Draft NUREG/CR-6642 (November 1999).

"Reducing the Effects of Secondary System Transients for Pressurized Thermal Shock," Accepted Paper ICONE-8 Conference, Baltimore, MD, April 2000.

Supplement Analysis for Storage of Surplus Plutonium Materials in the K-Area Material Storage Facility at the Savannah River Site, DOE/EIS-0229-SA-2, U.S. Department of Energy, Assistant Secretary for Environmental Management, Washington, D.C., February 2002.

NRC Course P-405, "Byproduct Materials System of Risk Analysis and Evaluation in NMSS," U.S. Nuclear Regulatory Commission, 2002-2003.

Environmental Assessment of the USEC American Centrifuge Lead Cascade Facility, U.S. Nuclear Regulatory Commission, January 27, 2004.

Technical Basis Document for the Portsmouth Gaseous Diffusion Plant – Occupational Environmental Dose, ORAUT-TKBS-0015-4 Rev. 00, March 17, 2004.

Draft Environmental Impact Statement for the Decommissioning of the Sequoyah Fuels Corporation Uranium Conversion Facility at Gore, Oklahoma, (to be published).

Environmental Impact Statement for the Proposed National Enrichment Facility in Lea County, New Mexico, Draft Report for Comment, NUREG-1790, (September 2004).

Final Environmental Impact Statement for the Proposed National Enrichment Facility in Lea County, New Mexico, NUREG-1790, (June 2005).

October 11, 2005

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of)	
)	
LOUISIANA ENERGY SERVICES, L.P.)	Docket No. 70-3103
)	
(National Enrichment Facility))	ASLBP No. 04-826-01-ML

NRC STAFF REBUTTAL TESTIMONY REGARDING DISPOSAL

- Q.1. Please state your name, occupation and by whom you are employed.
- A.1. (TJ) Timothy C. Johnson. I am the U.S. Nuclear Regulatory Commission (NRC) Project Manager overseeing the licensing of the proposed Louisiana Energy Services, L.P. (LES) uranium enrichment facility near Eunice, New Mexico. I have been the PM for the project since its inception in January 2002, when LES initiated discussion with NRC for the project.
- A.1. (JM) Jennifer Mayer. I am employed as a consultant by ICF Consulting. I am providing this testimony under a technical assistance contract with the NRC.
- A.1. (CD) Craig Dean. I am employed as a consultant by ICF Consulting. I am providing this testimony under a technical assistance contract with the NRC.
- A.1. (JP) James Park. I am the NRC Project Manager for the environmental review of the application for construction and operation of the proposed uranium enrichment facility submitted by LES.
- A.1. (DP) Donald E. Palmrose, Ph.D. I am employed by Advanced Systems Technology and Management Incorporated. I am providing this testimony under a technical assistance contract with the NRC.

Q.2. Have you previously submitted testimony in this proceeding?

A.2. (TJ, JP, DP) Yes, we provided pre-filed direct testimony in this proceeding on September 15, 2005, on behalf of the NRC Staff. In that testimony, we described our individual responsibilities related to the NRC Staff's review of the application by Louisiana Energy Services, L.P. (LES) to construct and operate a uranium enrichment facility in Lea County, New Mexico, to known as the National Enrichment Facility (NEF). Statements of our professional qualifications were attached to that testimony.

Q.3. What was the purpose of your previous testimony?

A.3. (TJ, JM, CD, JP, DP) The purpose of our joint direct testimony was to provide the NRC Staff's views concerning the admitted contentions regarding the plausibility of LES's proposal to dispose of the triuranium oxide (U_3O_8) produced by the deconversion process.

Q.4. What is the purpose of this testimony?

A.4. (TJ, JM, CD, JP, DP) To provide our views on NIRS/PC's pre-filed testimony of Dr. Arjun Makhijani regarding disposal.

Q.5. Have you read the direct pre-filed testimony of Dr. Makhijani regarding the need for disposal of depleted uranium? If so, what is your opinion of Dr. Makhijani's testimony that no strategy for disposal of depleted uranium can be considered plausible without presentation of a site specific analysis demonstrated compliance with the performance objectives in 10 C.F.R. Part 61 and other environmental regulations?

A.5. (TJ, JP, DP) Yes we have. We disagree with Dr. Makhijani's conclusion on this subject. While disposal of the depleted uranium waste generated by the proposed enrichment facility can only be accomplished at a site which is licensed to accept the waste, the licensing of the waste disposal site is not part of, or necessary to, the Staff's evaluation or decision on the application for a license to construct and operate the proposed

enrichment facility. Whether disposal can be accomplished at any specific disposal site is a matter considered in the issuance of the license for that site, not this licensing action. Thus, we disagree with Dr. Makhijani's claim that a site-specific analysis of potential disposal sites must be considered as part of this licensing action. While Dr. Makhijani cites a footnote in the Department of Energy's Final Environmental Impact Statements for construction and operation of depleted uranium conversion facilities at Portsmouth, Ohio and Paducah, Kentucky, to support this position, a more thorough reading of these documents makes clear that DOE is deferring to the site specific evaluations performed for the licensing of the low level waste disposal facility. As DOE states:

This EIS evaluates the impacts from packaging, handling, and transporting conversion products from the conversion facilities to a LLW disposal facility. The disposal facility would be (1) selected in a manner consistent with DOE policies and orders and (2) authorized or licensed to receive the conversion products by either DOE (in conformance with DOE orders), the NRC (in conformance with NRC regulations), or an NRC Agreement State agency (in conformance with state laws and regulations determined to be equivalent to NRC regulations). Assessment of the impacts and risks from on-site handling and disposal at the LLW disposal facility is deferred to the disposal site's site-specific NEPA or licensing documents.

LES Exhibit 16 at 2-27; LES Exhibit 17 at 2-25 (emphasis added).

- Q.6. What is your opinion of Dr. Makhijani's testimony regarding the need for disposal of depleted uranium in a deep geological repository?
- A.6. (TJ, JP, DP) Dr. Makhijani, in his pre-filed testimony, argues that the U_3O_8 produced by the deconversion process will likely require disposal in a deep geologic repository. Although he recognizes that this depleted uranium, in the form of U_3O_8 , is not transuranic waste, Dr. Makhijani implies that it must nevertheless be subject to the same regulatory requirements because of certain comparable radiological properties,

concluding further that transuranic waste is "similar to the classification of Greater than Class C (GTCC) waste" under 10 C.F.R. § 61.55(a), presumably to demonstrate that depleted uranium must also be classified GTCC. He then states that because shallow land disposal is generally not appropriate for transuranic or GTCC waste, it would not be appropriate for the depleted uranium.

Dr. Makhijani is not correct that depleted uranium must be classified in the same manner as transuranic waste. While he points out that uranium has a long half life and is an alpha emitter like many transuranic wastes, the waste classification limits established by NRC regulations take into account numerous characteristics relating to disposal, including waste form, radioisotope characteristics, disposal site characteristics, radioisotope concentrations and the method of emplacement. NIRS/PC Exhibit 109 at S-21. Given these variables, one would expect that different types of waste would be subject to different waste controls depending on their specific characteristics.

This is exactly the case under the waste classification established by the Commission's regulations. As explained in our pre-filed direct testimony, uranium is by definition Class A waste under 10 C.F.R. § 61.55(a)(6) because it is not a radionuclide listed in the tables provided in the regulation. LES Exhibit 101. As explained in the Final Environmental Impact Statement for the regulation, the omission of uranium from those tables was based on a determination by the Commission that the types of uranium-bearing wastes being typically disposed of by NRC licensees did not present a sufficient hazard to warrant any limitation on the concentration of this naturally occurring material and did not typically contain daughter products in any quantity because of the relatively short time since the uranium was refined from ore. NIRS/PC Exhibit 169 at 5-38. In contrast, alpha emitting transuranic nuclides are listed in Table 1 and are subject to a concentration limit. LES Exhibit 101.

Thus, under the Commission's waste classification scheme, uranium is considered Class A waste, not GTCC. Dr. Makhijani's arguments on this point are, in essence, a challenge to this regulatory scheme and are therefore not addressed further in our testimony. As Class A waste, under the Commission's regulations depleted uranium may be disposed of in a shallow land disposal facility provided that the performance objectives of Part 61 for the specific disposal site are satisfied. Dr. Makhijani has provided no basis for concluding that these performance requirements cannot be met at any potential site available to LES for the disposal of depleted uranium and that this option is therefore not plausible. While he has presented a Table attempting to demonstrate that ingestion of uranium in drinking water is as dangerous as plutonium, this analysis is of no consequence if ingestion in this manner will not occur. As he has pointed out at page 15 of his testimony, "calculated doses from the disposal of uranium are strongly dependent upon the geology of the site, the soil chemistry, the site meteorology, the assumed exposure scenarios, and many other site specific factors." Because of its particular site specific characteristics, the Envirocare disposal facility, licensed by the State of Utah, is authorized to accept depleted uranium in unlimited quantities for shallow land disposal. LES Exhibit 104, Staff Exhibit 44.

Q.7. How was it determined whether Envirocare can accept depleted uranium for shallow land disposal?

A.7. (TJ, JP, DP) Envirocare has been issued a license to accept waste containing uranium by the State of Utah. The issuance of this license was necessarily premised upon a site specific analysis of the potential health effects of shallow land disposal of uranium at the Envirocare site and compliance with the State's performance requirements which are essentially equivalent to those of 10 C.F.R. Part 61, Subpart C. Staff Exhibit 45 at 3-2. Among other things, these performance objectives provide that radioactive releases in

ground and surface water, air, soil, plants or animals must not exceed certain limits. See, 10 C.F.R. § 61.41. LES Exhibit 101. Factors which the State considered in its evaluation included the unsuitability of the site for residential or farming use due to site conditions such as low precipitation, high evapotranspiration, the lack of suitable irrigation and high salinity of the soil and ground water. LES Exhibit 104. Because of these site-specific factors, the possibility that uranium could be ingested through residential, agricultural or intruder pathways was not considered to be realistic. LES Exhibit 104, Staff Exhibit 45 at ES-4. Therefore, the premise for Dr. Makhijani's dose assessment - which assumes ingestion of uranium and other radionuclides in drinking water - would not be applicable for this particular site. The State regulatory authority has stated that Envirocare is authorized to accept depleted uranium in unlimited quantities. LES Exhibit 104, Staff Exhibit 44.

- Q.8. Based on the foregoing, what is your opinion of Dr. Makhijani's claim that the cost of deep geological disposal rather than shallow land disposal should be included in the LES cost estimate?
- A.8. (TJ, JM, CD, JP, DP) We believe that because depleted uranium is Class A waste and that shallow land disposal is feasible for the waste generated by the proposed enrichment facility; specifically at the Envirocare facility. Therefore, it was reasonable to premise LES's cost estimate on shallow land disposal. Of course, should circumstances arise such that LES chooses to utilize deep geological disposal, we would expect LES to revise its cost estimate to reflect this change in its required decommissioning cost updates.
- Q.9. What is your opinion of Dr. Makhijani's testimony regarding the acceptability of the WCS agreement as a basis for estimating the cost of decommissioning?

A.9. (TJ, JM, CD) While the Memorandum of Agreement between LES and WCS is not a binding agreement, there is no requirement that binding agreements must be in place in order to document decommissioning costs, including those for waste disposal. Further, contrary to Dr. Makhijani's claim, we do not consider the MOA to be vague. In fact, the MOA is very specific as to the actions that are expected of each party and contains a specific range for the cost estimate for disposal costs. While these costs could be subject to change in the future, there is no reason to expect that they will necessarily be higher. The Texas Compact Commission, which would be responsible for establishing the exact price for disposal, could establish a price which is lower than that expected by WCS. Based on our knowledge of the nature of the waste to be disposed of and our experience in reviewing cost estimates for disposal of similar waste, we believe that the cost estimate provided in the MOA is reasonable and conservative.

Q.10. Does this conclude your testimony?

A.10. (TJ, JM, CD, JP, DP) Yes.

1 MS. CLARK: I would like to now identify
2 the exhibits that we would like to admit in connection
3 with this testimony.

4 The first one is exhibit number 43,
5 entitled NRC process to identify decommissioning sites
6 with inadequate funding for remediation.

7 (Whereupon, the above-
8 referenced to document was
9 marked as Staff Exhibit No. 43
10 for identification.)

11 MS. CLARK: Staff exhibit number 44 is a
12 letter from D. Finerfrock of the State of Utah,
13 Department of Environmental Quality, to Paul Lohaus,
14 of the NRC, dated September 19, 2005.

15 (Whereupon, the above-
16 referenced to document was
17 marked as Staff Exhibit No. 44
18 for identification.)

19 MS. CLARK: We had also submitted a
20 prefiled exhibit number 45, the Baird report,
21 concerning the evaluation of potential public health
22 impacts associated with radioactive waste disposal at
23 a site near Clive, Utah.

24 I believe, however, that has been
25 admitted, already, as NIRS/PC exhibit number 170?

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 CHAIR BOLLWERK: That is my understanding,
2 as well. All right, then the record should reflect
3 that Staff exhibits 43 and 44, as described by
4 Counsel, are marked for identification.

5 And a motion, then, for admission has been
6 made, I believe. No? We are waiting for the magic
7 words.

8 MS. CLARK: I'm sorry. I request that
9 these be admitted into the record of this proceeding.

10 CHAIR BOLLWERK: All right. The motion
11 for admission of these two exhibits has been made.
12 Any objections?

13 (No response.)

14 CHAIR BOLLWERK: Hearing none, then Staff
15 exhibits 43 and 44, as described by counsel, are
16 admitted into evidence.

17 (The document referred to,
18 having been previously marked
19 for identification as Staff
20 exhibit Nos. 43 and 44 were
21 received in evidence.)

22 MS. CLARK: I would like to begin by
23 directing some questions to Mr. Johnson.

24 CHAIR BOLLWERK: So we are going to have
25 some surrebuttal, whatever we call it?

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25

MS. CLARK: Yes.

EXAMINATION BY MS. CLARK OF

DONALD PALMROSE

JAMES PARK

JENNIFER MAYER

CRAIG DEAN

TIMOTHY C. JOHNSON

MS. CLARK: Mr. Johnson, Dr. Makhijani, in his testimony, has referenced the Staff policy statement dated in 1991, regarding the potential disposal of DUF6 tails from an enrichment facility.

Was this policy statement issued in relation to the pending application for the CEC enrichment facility?

WITNESS JOHNSON: I'm sorry, could you repeat the question?

MS. CLARK: Do you know if the circumstances that prompted that policy statement had to do with the pending application of the CEC facility?

WITNESS JOHNSON: Yes, I do.

MS. CLARK: Could you explain?

WITNESS JOHNSON: Yes. 10CFR Part 61 was developed based on a pathway analysis that applied the proposed Part 61 requirements to determine if those

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 requirements, as applied to a series of referenced
2 sites, would meet the overall performance objectives
3 that ultimately became subpart C of 10CFR Part 61.

4 These specific analyses, and discussions,
5 were documented in the Final Environmental Impact
6 Statement that supported the rulemaking at the time.

7 Part 61 is a performance based regulation
8 with the ultimate test in determining whether a
9 proposed site would be suitable for disposal as to
10 whether or not it could meet the overall performance
11 objectives in subpart C to Part 61.

12 When Part 61 was promulgated the drafters
13 did not anticipate changes being made, in the future,
14 to the waste classification system. Instead it would
15 remain an overall general guide to the suitability of
16 waste for disposal, using near-surface disposal
17 methods.

18 And the drafters also recognized that
19 there may be future changes that could come about.
20 That is new waste streams that may be added, new
21 disposal methods.

22 And they left, within the regulation, the
23 flexibility to deal with those changes. For example,
24 in section 61.58 it authorizes the evaluation of
25 alternative waste classification or waste forms to be

1 used if the overall performance objectives in Part 61
2 subpart C could be met.

3 When Part 61 was promulgated there was
4 consideration of uranium given in the rulemaking. But
5 it was limited to those types of waste that were a
6 part of the commercial source term at the time.

7 And as we've said before, that source term
8 did not include waste from enrichment operations,
9 because those operations, at the time, were DOE
10 activities.

11 In the early '90s the NRC Staff was asked
12 to address the disposition of waste from enrichment
13 operations. And as referenced by the statement in Dr.
14 Makhijani's testimony, from the Executive Director of
15 operations, the NRC's position was that some near-
16 surface disposal facilities may not be suitable for
17 large quantities of depleted uranium from enrichment
18 operations.

19 And to demonstrate compliance with the
20 overall subpart C objectives, that on a site specific
21 basis, pathway evaluations should be performed to
22 verify compliance with the performance objectives in
23 subpart C.

24 The NRC's position hasn't changed since
25 that time. And, in fact, the kind of evaluation that

1 Dr. Makhijani is asking for was actually performed by
2 the State of Utah in licensing the Envirocare
3 facility.

4 And because Envirocare has some unique
5 site characteristics, very saline groundwater, saline
6 soil concentrations, low rainfall rates, and high
7 evapotranspiration rates, the use of groundwater or
8 the site for agricultural purposes was deemed
9 unrealistic by the State of Utah.

10 MS. CLARK: Now, Mr. Johnson --

11 WITNESS JOHNSON: And it was on that basis
12 that they --

13 MS. CLARK: I'm sorry.

14 WITNESS JOHNSON: -- determined that
15 disposal of large quantities of depleted uranium would
16 still meet the overall performance objectives in
17 subpart C.

18 JUDGE ABRAMSON: And, Mr. Johnson, how
19 does that fit with the Commission's directive to you,
20 in their most recent, or to the Staff in their most
21 recent ruling to look at Part 61 and see whether it
22 needs any revision to deal with large quantities of
23 depleted uranium?

24 Do you think that it has already been done
25 in this section 61.58, in the process that has been

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 developed, or have you thought about --

2 WITNESS JOHNSON: Well, I think that the
3 question of how to deal with it, whether a change is
4 needed in the Rule or not, is a question the
5 Commission is asking.

6 Whether or not these kinds of evaluations
7 could be done under the equivalent of 61.58, or in the
8 initial licensing of a disposal facility where the
9 conditions of issuing a license are that it ultimately
10 meet the performance objectives in subpart C.

11 Now, there are a number of different ways,
12 possible options for addressing what the Commission
13 has asked for, and we are not in a position, at this
14 point, to say what the approach will be.

15 But those certainly would be options for
16 addressing the Commission's request for us to review
17 how depleted uranium from enrichment operations should
18 be handled.

19 JUDGE ABRAMSON: But if I understand you
20 correctly you are saying that Part 61, in its current
21 incarnation, does allow the Staff to evaluate and
22 license, or an agreement state to evaluate and license
23 the disposal of large quantities of DU?

24 And you've described a method that the
25 State of Utah has employed in this case, in the

1 Envirocare case.

2 WITNESS JOHNSON: Yes.

3 JUDGE ABRAMSON: Is that your
4 understanding?

5 WITNESS JOHNSON: Part 61 has that
6 flexibility to do that.

7 MS. CLARK: Okay, and we may talk more
8 about Envirocare a little bit later. But I wanted to
9 sort of move chronologically, back to the early 1990s.

10 Dr. Makhijani notes that after this 1991
11 statement a pathway analysis was conducted by Sandia.
12 Was this analysis done at the request of the NRC
13 Staff?

14 WITNESS JOHNSON: Yes, it was.

15 MS. CLARK: And do you know what the
16 purpose of requesting that analysis was?

17 WITNESS JOHNSON: The purpose was to
18 evaluate a referenced site in the Louisiana compact
19 area, for the disposition of waste from the Claibourne
20 enrichment center.

21 MS. CLARK: Was this in order to determine
22 whether shallow land disposal would be a potential
23 option for that?

24 WITNESS JOHNSON: Yes.

25 MS. CLARK: And did they use a specific

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 site, or a generic site?

2 WITNESS JOHNSON: They used a generic
3 reference site.

4 MS. CLARK: And do you know where they
5 obtained the parameters for that referenced site,
6 generally?

7 WITNESS JOHNSON: I don't know all of the
8 details of where the parameters came from. But they
9 were selected to be representative of the southeastern
10 site with a shallow groundwater table.

11 MS. CLARK: In the context of what we've
12 been talking about here, would this be considered a
13 dry site, or a wet site?

14 WITNESS JOHNSON: This would be considered
15 a wet site.

16 MS. CLARK: And what was the outcome of
17 this analysis?

18 WITNESS JOHNSON: The outcome is that for
19 the site parameters that were evaluated, that for that
20 particular site large quantities of depleted uranium
21 would not be suitable for disposal at that facility.

22 MS. CLARK: And based on that assessment,
23 what did the Staff conclude with regard to the
24 disposal options available to the Claibourne
25 enrichment center?

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 WITNESS JOHNSON: The conclusion was that
2 it was unlikely that a disposal facility, as
3 envisioned by that site, would be acceptable for
4 disposal of large quantities of depleted uranium.

5 MS. CLARK: Thank you. Next I would like
6 to direct some questions to Dr. Palmrose. Dr.
7 Palmrose, in connection with your work in assisting
8 the Staff in preparing the environmental reviews for
9 the National Enrichment Facility, did you review the
10 Final Environmental Impact Statement for the CEC?

11 WITNESS PALMROSE: Yes, I did.

12 MS. CLARK: At this time I would like to
13 mark for identification some relevant pages from the
14 Final Environmental Impact Statement.

15 CHAIR BOLLWERK: This would then be Staff
16 46. And since this doesn't have a cover page on it,
17 I will have to have you describe it.

18 MS. CLARK: Yes. Dr. Palmrose, could you
19 review these pages, and do you recognize them?

20 WITNESS PALMROSE: Yes, I do.

21 MS. CLARK: Could you state what they
22 represent?

23 WITNESS PALMROSE: They are the pages from
24 the CEC Final Environmental Impact Statement
25 concerning disposal of U308, providing the main text

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 of the report, the summary of the analysis, and then
2 the appendix A description of the calculations and
3 overall results.

4 MS. CLARK: In the CEC what type of
5 disposal was evaluated for the depleted uranium?

6 WITNESS PALMROSE: They did rely on the
7 Sandia study for near-surface disposal, then also
8 provided an analysis for geologic disposal.

9 MS. CLARK: Did you review the results,
10 the information regarding the analysis of geological
11 disposal?

12 WITNESS PALMROSE: Yes, I did.

13 MS. CLARK: And did you use those analyses
14 for the purpose of preparing the National Enrichment
15 Facility environmental impact statement?

16 WITNESS PALMROSE: Yes.

17 MS. CLARK: Looking at the environmental
18 impact statement for the CEC, does it explain what
19 models were used in determining the environmental
20 impacts for geological disposal?

21 MS. CLARK: Yes, it does.

22 MR. LOVEJOY: Excuse me, Your Honor. I
23 had understood, from a conversation we had yesterday,
24 that this issue was going to be tried on a separate
25 track. That was the explanation that the Court gave.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 Now, if we are going into the geological
2 disposal representation, and the description in the
3 draft and final environmental impact statements, I
4 just did not understand that that was the track that
5 we were taking.

6 CHAIR BOLLWERK: Well, my assumption was
7 that the parties weren't prepared to move forward.
8 But if there is something, if this has changed, how
9 long are we talking about here, in terms of testimony?

10 MS. CLARK: Well, I think where we are
11 going with this is that Dr. Palmrose will explain the
12 number, the error in the numbers that occurred in the
13 Draft Environmental Impact Statement, and that was
14 corrected in the final.

15 This, I don't expect, would take more than
16 15 minutes.

17 JUDGE ABRAMSON: Mr. Lovejoy?

18 MR. LOVEJOY: Well, if he is just going to
19 explain the math error that was committed, and then
20 later corrected, that is okay. We had much deeper
21 problems with the analysis.

22 JUDGE ABRAMSON: And it seems to me that
23 to the extent that this lays the foundation for future
24 work, that is fine too. But I don't think we are
25 intending to try this here.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 I thought the parties said they weren't
2 ready. And the Staff, in fact, said they weren't
3 ready yesterday.

4 MR. LOVEJOY: That was my impression.

5 CHAIR BOLLWERK: Well, again, if we are
6 talking about a couple of minutes, here, to lay some
7 foundation which eventually would be part of the
8 record for a summary disposition motion, that is fine.

9 I mean, my understanding of the concerns
10 that NIRS/PC had were not only with the math that was
11 done, but also with the underlying numbers, and also
12 the availability of the background information, as it
13 were.

14 And maybe that can be even worked out, off
15 the record, at some point. I don't know.

16 JUDGE ABRAMSON: Yes, and it seems to me
17 you can write down what the source of the error
18 correction was, and then they have a chance to look at
19 it, rather than consuming time here.

20 Having accepted the concept that there are
21 things that have to be done outside this proceeding.

22 MS. CLARK: Well, I think on this specific
23 issue we see that the scope of this contention is very
24 narrow. And I believe that on this specific issue --

25 JUDGE ABRAMSON: On terms of the math

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 error?

2 MS. CLARK: In terms of the, yes, of the
3 allegation that the Staff did not do an adequate
4 evaluation, then I think we can get sufficient
5 testimony, that I believe we can resolve this issue.

6 I know that Mr. Lovejoy has a different
7 view of that.

8 JUDGE ABRAMSON: So does the Board.
9 Weren't we clear yesterday? Maybe you can repeat,
10 Judge Bollwerk, what we said.

11 CHAIR BOLLWERK: No, again, if the problem
12 is an exchange of information, and the basis for the
13 underlying -- I don't know how we are going to resolve
14 that here, but we can -- let me put it this way.

15 I don't have a problem with spending a
16 couple of minutes here, very briefly, laying whatever
17 foundation you want, and then we can see where we go
18 from there. But I don't think it is going to get
19 resolved today.

20 MR. LOVEJOY: Our problem, as the Board
21 says, goes beyond the arithmetic.

22 JUDGE ABRAMSON: And that is what we said,
23 quite clearly, yesterday. That once the arithmetic
24 was -- it was quite clear, to us, that there was an
25 alleged error, and there was an alleged omission.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 And that fixing the error would have then
2 put NIRS/PC in a position of having the right to
3 submit an amended contention challenging whatever it
4 saw, now, from the correct, in the results from the
5 corrected error.

6 And our idea, the Board's view, as
7 expressed yesterday was that we were going to collapse
8 that process, so that we don't spend time fixing the
9 error, and then having to have another contention that
10 we are going to let the parties deal with that,
11 generally, which is the allegation that this didn't
12 take a sufficiently hard look in this area.

13 So if what you want to do now is to just
14 show how the error, what the error was, and how it was
15 fixed, fine. Let's do that. But don't proceed with
16 the impression that we are going to resolve this whole
17 thing here.

18 MS. CLARK: Fine. My view of the
19 allegation of omission was that the Staff had not
20 provided, done independent analysis and, instead, had
21 relied on information in the CEC.

22 And I believe that as we, and I think this
23 was an issue that we dealt with, even in this previous
24 hearing, I think it is clear that the Staff is
25 entitled to rely on other environmental analysis

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 provided they do a sufficient look, and assure
2 themselves that the analysis seems adequate.

3 So that is, and I think the testimony on
4 that could be relatively brief.

5 CHAIR BOLLWERK: All right, I don't have
6 a problem, again, putting that in. But it may not be
7 sufficient to resolve it, that is all I think we are
8 saying.

9 MS. CLARK: I understand, yes.

10 CHAIR BOLLWERK: And if Mr. Lovejoy wants
11 to cross examine he may be able to get some additional
12 information that may make it clearer that it can't be
13 resolved today, I don't know.

14 MR. LOVEJOY: We object to the idea that
15 the Staff can rely on EIS studies that they don't
16 understand and can't support.

17 CHAIR BOLLWERK: Well, that may be --

18 MS. CLARK: We do too.

19 CHAIR BOLLWERK: It sounds like there is
20 agreement there, so we will move on. Go ahead and
21 develop the testimony. And, again, if you could be
22 brief about it, that would be useful. And then we
23 will see where we are at.

24 And maybe Mr. Lovejoy wants to cross
25 examine on this, it may be that he simply prefers to

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 deal with it at a different time.

2 MR. LOVEJOY: I prefer not to be drawn in
3 into what someone may later claim was a thorough study
4 of the issue, because we still don't have the basis
5 for the numbers, and I don't think we ever will.

6 JUDGE ABRAMSON: Well, why don't we let
7 her, why don't we let counsel for the Staff spend a
8 few minutes going through what they think is their
9 basic position, and then to the extent that counsel
10 wants to put more in writing, they should do so, and
11 then we will deal with it later, outside the context
12 of the --

13 JUDGE KELBER: I would like to point out
14 that as far as the environmental impact of disposal in
15 an agreement state, that impact analysis, including in
16 their requisite hard look, has been done by the State
17 of Utah.

18 The question, really, that the Commission
19 asked is what is the Staff doing, in general. We can
20 argue that on paper. For the purposes of this hearing
21 we need not pursue that in detail, at this time.

22 MS. CLARK: Okay. I think this will only
23 take a few minutes.

24 CHAIR BOLLWERK: Fine.

25 MS. CLARK: I just want to elicit

1 testimony from Dr. Palmrose about what he did.

2 CHAIR BOLLWERK: Right.

3 JUDGE ABRAMSON: We have now spent more
4 time than we think it is going to take.

5 MS. CLARK: Dr. Palmrose, looking at the
6 environmental impact statement for the CEC, does the
7 environmental impact statement explain what models
8 were used to calculate impacts of geological disposal?

9 WITNESS PALMROSE: Yes.

10 MS. CLARK: Does the environmental impact
11 statement state what parameters were used in
12 performing that calculation?

13 WITNESS PALMROSE: Yes, it does,
14 parameters for the groundwater, calculated
15 solubilities and flow path parameters.

16 MS. CLARK: Did you, or your colleagues,
17 evaluate the information regarding the modeling, and
18 the parameters, when you reviewed this environmental
19 impact statement?

20 WITNESS PALMROSE: Yes, we had a technical
21 staff hydrologist review the information in the CEC
22 final evaluation, to see if it was still adequate.

23 MR. LOVEJOY: Excuse me, Your Honor. This
24 is more than about how they corrected the math.

25 JUDGE KELBER: We understand that. They

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 are laying the groundwork, let her proceed.

2 MS. CLARK: I only have a couple more
3 questions. What did you determine, based on that
4 review?

5 WITNESS PALMROSE: That it was adequate
6 for applying to the proposed NEF.

7 MS. CLARK: So you found that the models
8 were appropriate?

9 WITNESS PALMROSE: Yes.

10 MS. CLARK: Did you determine that the
11 parameters were also appropriate?

12 WITNESS PALMROSE: Yes, the hydrologist
13 confirmed that the parameters were still valid.

14 CHAIR BOLLWERK: Who is the hydrologist?

15 WITNESS PALMROSE: In this case Mr. Alan
16 Toblin.

17 JUDGE ABRAMSON: Who was a witness in the
18 spring?

19 WITNESS PALMROSE: That is my
20 recollection, that he was the one that reviewed it.

21 MS. CLARK: So based on that analysis did
22 you use the numbers in the environmental impact
23 statement for the CEC and take those numbers and use
24 them in the NEF environmental impact statement?

25 WITNESS PALMROSE: Yes, they were applied

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 for the proposed NEF.

2 MS. CLARK: Now, there has been an
3 allegation here that those numbers are incorrect. And
4 I believe at some point you did discover that there
5 was a mistake in the numbers, is that correct?

6 WITNESS PALMROSE: That is correct.

7 MS. CLARK: Could you please sort of walk
8 us through the numbers, and just to explain where the
9 mistake was, and how it was made?

10 WITNESS PALMROSE: Yes. The summary of
11 the analysis with the overall dose results that is
12 presented on page 4-67, for the geologic deep
13 disposal.

14 MS. CLARK: Could you please tell us
15 specifically what you are talking about? Maybe read
16 the --

17 WITNESS PALMROSE: Yes, on page 4-67 of
18 the CEC final evaluation, the last full paragraph,
19 presents the overall results from the analysis. And
20 in there they provide the results for the different
21 pathways.

22 And for the river scenario, at the Basalt
23 site, they provide, in the last sentence, they provide
24 the estimate for the drinking water. And in this CASE
25 the values for the millirem dose was incorrect.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 And that was a value that was carried
2 forward to the proposed NEF analysis.

3 MS. CLARK: So are you talking about the
4 last sentence, which begins, in the year of maximum
5 exposure at the sandstone basalt site, is that the
6 sentence you are referring to?

7 WITNESS PALMROSE: No, the sentence
8 beginning with: for the river scenario at the basalt
9 site expected dose estimates to be 1.6 times ten to
10 the minus 9 sieverts (1.6 times ten to the minus 14th
11 millirem).

12 In other words, those two values are
13 incorrect.

14 JUDGE ABRAMSON: And they were incorrectly
15 put into this paragraph initially, in the CEC?

16 WITNESS PALMROSE: That is correct.

17 JUDGE ABRAMSON: And so you fixed, you
18 corrected that number based on what? Based on the
19 Sandia study, or based on --

20 WITNESS PALMROSE: No, went back and
21 reverified that the total numbers, back in Appendix A,
22 the --

23 MS. CLARK: Dr. Palmrose, were these
24 numbers drawn from another table in the appendix?

25 WITNESS PALMROSE: They were supposed to

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 be.

2 MS. CLARK: So this is a total, is that
3 correct, this is a total number?

4 WITNESS PALMROSE: The number in page 4-67
5 is the total value.

6 MS. CLARK: And the total, the elements
7 that make up that total are found in what table?

8 WITNESS PALMROSE: They are found on the
9 tables at the end of Appendix A, for this particular
10 one, on page A-15.

11 MS. CLARK: Okay. Looking at table, is
12 that table A.8, estimated doses for river scenario?

13 WITNESS PALMROSE: Correct.

14 MS. CLARK: Can you show us which column
15 that number should be the sum of?

16 WITNESS PALMROSE: It would be the second
17 column from the right, the one titled, underneath
18 sandstone/basalt site, drinking water dose.

19 MS. CLARK: And what is the total of those
20 numbers?

21 WITNESS PALMROSE: The total of those
22 numbers is 1.6 times ten to the minus 14th sieverts
23 per year. And that value was incorrectly ascribed into
24 the text on page 4-67.

25 As you note, there are no totals provided

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 in that table 8.8.

2 MS. CLARK: And so when you used these
3 numbers, in the NEF environmental impact statement,
4 did you take them from the text?

5 WITNESS PALMROSE: Yes, I used the
6 millirem value from the text.

7 JUDGE ABRAMSON: And that is the error you
8 have corrected?

9 WITNESS PALMROSE: That is correct, sir.

10 MS. CLARK: And then you realized that was
11 incorrect?

12 WITNESS PALMROSE: Yes.

13 MS. CLARK: And did you make the
14 appropriate changes in the Final Environmental Impact
15 Statement?

16 WITNESS PALMROSE: Yes.

17 MS. CLARK: Okay, thank you.

18 JUDGE KELBER: So let me summarize the
19 error that was made was a transposition of the dose in
20 sieverts, to a dose in millirem?

21 WITNESS PALMROSE: That is correct, in the
22 CEC Final Environmental Impact Statement.

23 JUDGE KELBER: Thank you.

24 JUDGE ABRAMSON: Now, let me just make
25 sure I understand this, how this process went, and

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 then Mr. Lovejoy obviously has some comments about
2 this.

3 The Staff took the CEC Final Environmental
4 Impact Statement analysis of geological disposal, and
5 used it for its analysis in the LES, is that correct?

6 WITNESS PALMROSE: Yes, sir.

7 JUDGE ABRAMSON: And you made an attempt
8 to get comfortable with that analysis, but that
9 analysis rested upon some work that was done by a
10 contractor, in the days of the CEC work?

11 WITNESS PALMROSE: That is correct.

12 JUDGE ABRAMSON: And were any of those
13 people involved with a contractor here now?

14 WITNESS PALMROSE: Yes. It was, at the
15 time, the project manager was Dr. Abe Zeitoun, who was
16 also the project manager for the CEC Final
17 Environmental Impact Statement.

18 JUDGE ABRAMSON: Well, I think this opens
19 -- Mr. Lovejoy?

20 MR. LOVEJOY: Well, Your Honor, more than
21 a year ago I requested, in discovery, the data, the
22 files that generated the results in the CEC case. And
23 I got an answer back saying they are gone.

24 And so in that situation we are unable to
25 test the results, we are unable to reproduce them.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 They are remarkably at variance with the results
2 obtained in the Kozak study done by Sandia in
3 connection with the same facility.

4 And now we have, you know, in this known
5 situation, where the source, the support is
6 unavailable, the Staff is putting on a witness who
7 puts in xerox copies of a few pages from the
8 environmental impact statement and says, well, I can
9 understand it.

10 Well, what am I supposed to do?

11 JUDGE KELBER: May I make a suggestion?
12 That in short order, I'm not sure, Judge Bollwerk is
13 much more acquainted with what is a reasonable time,
14 you present written testimony, input from Mr. Rice,
15 your hydrologist that you mentioned yesterday, and
16 Staff get similar testimony, presumably from Mr.
17 Toblin, on the hydrology of this particular site that
18 is mentioned in the Claibourne case, and present how
19 they did their calculations.

20 And that is enough.

21 CHAIR BOLLWERK: That is called a summary
22 disposition motion, which is where I thought this was
23 headed, to begin with.

24 Mr. Toblin, you said he gave you an
25 analysis. Did he give you a written analysis?

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 WITNESS PALMROSE: No, we discussed his
2 review of the CEC Final Environmental Impact
3 Statement.

4 CHAIR BOLLWERK: So this was over the
5 phone, then, it wasn't anything in writing?

6 WITNESS PALMROSE: No, this was a face to
7 face conversation.

8 CHAIR BOLLWERK: Or a meeting?

9 WITNESS PALMROSE: Right.

10 JUDGE ABRAMSON: And you mentioned to me
11 that the Staff scientist, who was involved with CEC is
12 still here, and advised you on --

13 WITNESS PALMROSE: No, that is incorrect.
14 I was just saying that the project manager for that
15 program was the same one that was working underneath
16 the draft.

17 JUDGE ABRAMSON: I'm sorry, the project
18 manager for CEC helped you with the LES, is that
19 correct?

20 WITNESS PALMROSE: Yes.

21 JUDGE ABRAMSON: And is he technically
22 familiar with what the contractor did on CEC, or is he
23 a bureaucrat?

24 WITNESS PALMROSE: No, he was the
25 contractor project manager.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 JUDGE ABRAMSON: He was the guy who
2 supervised what Sandia did?

3 WITNESS PALMROSE: No, he was the one who
4 supervised the development of the CEC Final
5 Environmental Impact Statement.

6 JUDGE ABRAMSON: Well, it seems to me that
7 is the source of the information that Mr. Lovejoy
8 needs to have, to be able to challenge it.

9 MR. LOVEJOY: Well, if I may say, this
10 information was requested in discovery, about a year
11 ago. I remember answers to interrogatories came in
12 November 10th of 2004, from Staff, saying they applied
13 some factor to the results shown in the Claibourne
14 environmental impact statement, and that is all they
15 know, they don't have the underlying data.

16 I assume if they did have the underlying
17 data, it would have been obtained and provided in
18 discovery. We have worked on this, Your Honor.

19 JUDGE ABRAMSON: No, I'm not suggesting
20 you haven't worked on it, I'm trying to figure out
21 what the right process is here. Obviously we are not
22 going to resolve this at this moment.

23 CHAIR BOLLWERK: If you want to, if you
24 can consider this in the realm, I won't say free
25 discovery, but nonetheless you have gotten some

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 information here today about the situation.

2 So at some point you can cross examine
3 these witnesses, if you want, about what you just
4 heard. But it strikes me there needs to be more done
5 here.

6 MR. LOVEJOY: I sincerely do not wish to
7 be bound by the results of this hearing, without
8 getting the information that now someone is saying is
9 available.

10 MS. CLARK: Well, keep in mind that this
11 was conducted over ten years ago. And I don't expect
12 that we could possibly reproduce the underlying
13 calculations that were done to develop it.

14 Now, it is the position of the Staff that
15 this whole enquiry is completely unnecessary. I think
16 there is no question, and we will file motions on this
17 matter, that the Staff is entitled to rely on other
18 federal NEPA documents, including environmental impact
19 statement.

20 The Staff is not required to recreate the
21 calculations. We can rely on those evaluations, and
22 upon a review that the models and parameters are
23 correct.

24 CHAIR BOLLWERK: That is your position,
25 and that would be the basis for a summary disposition

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 motion. As a matter of law you win because you are
2 relying on the proper documents.

3 MS. CLARK: Right.

4 CHAIR BOLLWERK: And I thought potentially
5 this is where this might be headed at one point. All
6 right, is there any other questions you have on this
7 matter?

8 MS. CLARK: No, I would like to move on
9 and discuss the development of the Draft Environmental
10 Impact Statement for the NEF.

11 CHAIR BOLLWERK: Is there anything else
12 that you want to say?

13 JUDGE ABRAMSON: Well, it seems to me is
14 that what I would expect to see in response to such a
15 motion is a response that says, well here is our
16 analysis, and it disagrees enormously with what you
17 are claiming you have. And then we sort it out.

18 JUDGE KELBER: I'm sorry, the Staff says
19 they are entitled to rely on past environmental impact
20 statements. They are not defending an analysis, they
21 are saying they have an environmental impact
22 statement.

23 If, in fact, there was a serious error in
24 that environmental impact statement, it should have
25 been brought forward at that time. If there is an

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 error in any current environmental impact statement,
2 it should be brought forward.

3 It has been alleged that there is an
4 error, there are no calculations to be presented. The
5 person who was supposed to have detected it is not
6 here. I think we cannot pursue that at this meeting.

7 JUDGE ABRAMSON: That is right.

8 CHAIR BOLLWERK: Let me do one other thing
9 as a procedural matter. Let's go ahead and mark Staff
10 exhibit 46 for identification, which is described as
11 pages from the CEC FEIS, and I don't have a date on
12 that. It is 1994.

13 (Whereupon, the above-
14 referenced to document was
15 marked as Staff Exhibit No. 46
16 for identification.)

17 JUDGE ABRAMSON: That is the NUREG number,
18 or is that --

19 MS. CLARK: NUREG 1484.

20 CHAIR BOLLWERK: And I understand, just
21 for the record, that there were apparently other
22 portions of the CEC FEIS that were admitted in
23 February as NIRS/PC 58, but it is not clear that they
24 are the same pages.

25 MS. CLARK: Were those the draft that you

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 -- they were the final?

2 MR. LOVEJOY: It is exhibit 58.

3 CHAIR BOLLWERK: All right. I think at
4 this point we are done with this matter, and you can
5 go on with whatever additional information you want to
6 do.

7 MS. CLARK: I would ask that this be
8 admitted into evidence.

9 MR. LOVEJOY: For the purposes described
10 by the Board it may be admitted. The matter is not
11 going to be concluded here today.

12 CHAIR BOLLWERK: All right. Any objection
13 from --

14 (No response.)

15 CHAIR BOLLWERK: Then Staff exhibit 46 is
16 admitted.

17 (The document referred to,
18 having been previously marked
19 for identification as Staff
20 exhibit No. 46 was admitted in
21 evidence.)

22 MS. CLARK: Dr. Palmrose, in the Draft
23 Environmental Impact Statement what options did you
24 consider for the potential disposal of depleted
25 uranium?

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 WITNESS PALMROSE: I considered all
2 reasonable options for disposal of depleted uranium,
3 whether it be near-surface disposal, or geologic.

4 MS. CLARK: Did you select any option, or
5 eliminate any option?

6 WITNESS PALMROSE: No, I did not.

7 MS. CLARK: I believe that Dr. Makhijani
8 has referred to some statements in the environmental
9 impact statement in which you stated that you assumed
10 that Envirocare would be the disposal site.

11 WITNESS PALMROSE: That is an incorrect
12 statement. We presented Envirocare as an example of
13 a demonstration where near-surface disposal --

14 MS. CLARK: Well, let me stop you for a
15 second. Are you saying it is incorrect that you said
16 that you would assume Envirocare, did you say that you
17 would assume that Envirocare would be the disposal
18 option?

19 WITNESS PALMROSE: No, we did not assume
20 that it would be the disposal option, the disposal
21 site.

22 MS. CLARK: Hold on one second.

23 (Pause.)

24 MS. CLARK: Do you have the NIRS/PC
25 exhibits up there?

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 WITNESS PALMROSE: Yes.

2 MS. CLARK: Could you get number 152,
3 please?

4 I'm looking at pages 2-32 to 2-33. At that
5 time there is no statement about an assumption.
6 However, if you would turn to Staff exhibit 36?

7 WITNESS PALMROSE: Okay.

8 MS. CLARK: And I'm looking at page 2-33,
9 at the, in the last paragraph at the top of the page,
10 I mean, the first paragraph at the top of the page.

11 WITNESS PALMROSE: On 2-33?

12 MS. CLARK: Yes. I'm reading from the
13 sentence where it says, due to the need for separate
14 regulatory actions prior to disposal at WCS, it is
15 assumed that depleted U308 generated from the
16 adjacent, or off-site private conversion process would
17 be disposed at another disposal site, licensed to
18 accept this material.

19 For example, under its radioactive
20 materials license, issued by the State of Utah,
21 Envirocare is authorized to accept, for disposal, the
22 quantities of depleted uranium oxides expected to be
23 generated by the conversion of the proposed NEF's
24 DUF6.

25 As used in that context, what did you mean

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 when you said that you would assume that disposal
2 would be at a licensed facility?

3 MR. LOVEJOY: I'm sorry, I'm not hearing
4 all the question, and I'm afraid that -- can you
5 describe exactly where you are reading from? My copy
6 may be differently paginated than yours.

7 MS. CLARK: This is Staff exhibit, if you
8 look at Staff exhibit 36, it is page 2-33. I'm sorry.

9 MR. LOVEJOY: Okay.

10 MS. CLARK: So if you could just explain,
11 Dr. Palmrose, what your thinking was when you made
12 that statement?

13 WITNESS PALMROSE: That disposal of the
14 depleted uranium would have to occur in a licensed
15 facility. And the licensed facility would have to
16 meet the performance requirements of 10CFR Part 61.

17 And that for an example of where that is
18 possible, we provide the statement that Envirocare has
19 been licensed by the State of Utah, to accept disposal
20 of the quantities of depleted uranium oxide expected
21 to be generated by the proposed NEF.

22 MS. CLARK: When you asses the potential
23 radiological impacts for disposal, at a shallow land
24 facility, did you use Envirocare as a reference site?

25 WITNESS PALMROSE: That is correct.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 MS. CLARK: Could you explain what is
2 meant by a reference site?

3 WITNESS PALMROSE: A reference site would
4 be a site where it would be possible to meet all the
5 performance criteria of Part 61 to safely dispose of
6 the depleted uranium, where the environmental impacts
7 would be small.

8 MS. CLARK: When you determined that
9 Envirocare was a potential site, were you aware of the
10 analysis that had been conducted in the Department of
11 Energy programmatic environmental impact statement?

12 WITNESS PALMROSE: Yes, I was.

13 MS. CLARK: Now, I know that in the
14 previous proceeding, in this case, you stated that you
15 had relied on some portions of the PEIS, specifically
16 with regard to impacts of deconversion.

17 But in the context of disposal did you
18 rely on the analysis in the PEIS to asses the impacts
19 of shallow land disposal of DU?

20 WITNESS PALMROSE: No, I --

21 MR. LOVEJOY: Objection. That misstates
22 his previous testimony. The witness testified that he
23 did not rely on the DOE PEIS because it did not
24 contain the most recent analyses. That was his
25 previous testimony.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 MS. CLARK: Well, I don't think -- I think
2 we can strike that, I don't think it is really
3 relevant to this issue, so I will ask you, just with
4 regard to disposal impacts.

5 Did you rely on the analysis in the
6 programmatic environmental impact statement to assess
7 the radiological impacts of disposal?

8 WITNESS PALMROSE: No, I did not.

9 MS. CLARK: Now, you said that you
10 recognized that any disposal would have to be at a
11 licensed low level waste facility, is that correct?

12 WITNESS PALMROSE: Yes.

13 MS. CLARK: Would that be a facility
14 licensed by the NRC, or the State?

15 WITNESS PALMROSE: Either by the NRC or an
16 agreement state.

17 MS. CLARK: And in either case would the
18 performance criteria of Part 61 have to be satisfied?

19 WITNESS PALMROSE: Yes, that is correct.

20 MS. CLARK: Do the performance criteria in
21 Part 61 limit the amount of radiological releases from
22 the disposal site?

23 MR. LOVEJOY: Excuse me, may I ask counsel
24 to be specific about the performance criteria being
25 referred to? I hate to interrupt, but very much of the

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 direct testimony, prefiled testimony, from this
2 witness and others on the panel, focused on how the
3 material is in class A.

4 And I thought that getting to the chase,
5 so to speak, we were not going to rely on waste
6 classification here, especially in light of the
7 Commission's decision.

8 And if we are focusing on the subpart C
9 issues, I think it should be so said.

10 MS. CLARK: Very well. I'm referring to
11 them in different ways. I'm referring to the waste
12 classification, in that context, as the waste
13 classification. When I'm talking about performance
14 requirements I'm referring to the requirements in
15 subpart C of Part 61.

16 MR. LOVEJOY: Thank you.

17 JUDGE ABRAMSON: So you want to repeat
18 your question to the witness, please?

19 MS. CLARK: Yes. Do the performance
20 criteria, on Part 61, establish limits for the
21 radiological releases from low level waste disposal
22 sites?

23 WITNESS PALMROSE: Yes, it does.

24 MS. CLARK: Can you tell us what those
25 dose limits are? Do you need, would you like me to

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 show you the CFR?

2 WITNESS PALMROSE: Yes.

3 JUDGE ABRAMSON: Do we need that, counsel,
4 or can we just get on with it? And we can all read the
5 CFR.

6 MS. CLARK: Very well. Well, I think I
7 would like to have it on the record.

8 JUDGE ABRAMSON: Okay.

9 MS. CLARK: Just a moment, please.

10 (Pause.)

11 MS. CLARK: I believe they are in 61.41.

12 WITNESS PALMROSE: Yes. Where it states
13 that the concentration of radioactive material, which
14 may be released to the general environment and
15 groundwater, surface water, air, soil, plants or
16 animals, must not result in an annual dose exceeding
17 an equivalent of 25 millirems to the whole body, 75
18 millirems to the thyroid, and 25 millirems to any
19 other organ of any member of the public.

20 Reasonable efforts should be made to
21 maintain releases of radioactivity, in effluents, to
22 the general environment, as low as reasonably
23 achievable.

24 MS. CLARK: Thank you. In your
25 professional opinion would radiological releases, at

1 or below those limits, constitute a small
2 environmental impact?

3 WITNESS PALMROSE: Yes, it would, it would
4 meet the regulations.

5 MR. LOVEJOY: Objection. The Rule speaks
6 in terms of dose, not release.

7 MS. CLARK: All right, then I will alter
8 my question somewhat.

9 In your professional opinion would
10 releases that would result in doses at or below those
11 limits, constitute small environmental impact?

12 WITNESS PALMROSE: Yes.

13 MS. CLARK: On that basis did you conclude
14 that the radiological impacts from a disposal, from
15 disposal at a licensed facility would be small?

16 WITNESS PALMROSE: Yes.

17 MS. CLARK: Is that the underlying basis
18 for your conclusion in the Draft Environmental Impact
19 Statement, that the radiological impacts from disposal
20 would be small?

21 WITNESS PALMROSE: Yes, it is.

22 MS. CLARK: Thank you.

23 JUDGE ABRAMSON: From disposal of DU in a
24 shallow land burial that was licensed?

25 WITNESS PALMROSE: That is correct, Your

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 Honor.

2 MS. CLARK: I have a couple of questions
3 for Mr. Park.

4 In performing environmental assessments,
5 does the Staff also take into account potential
6 impacts of non-radiological releases?

7 WITNESS PARK: Yes, we do.

8 MS. CLARK: Are these types of releases
9 frequently regulated by the state, or local
10 governments?

11 WITNESS PARK: They may be, yes.

12 MS. CLARK: Are they sometimes regulated
13 by other federal agencies, like EPA?

14 WITNESS PARK: Yes.

15 MS. CLARK: For example, would certain
16 types of liquid effluents commonly be regulated by
17 local governments?

18 WITNESS PARK: Often that is regulated by
19 the EPA, and with state oversight, or regulation.

20 MS. CLARK: Would this also commonly be
21 the case for air emissions?

22 WITNESS PARK: It is my understanding
23 that, yes, that is the same case.

24 MS. CLARK: When we are facing a situation
25 where we are assessing the environmental impacts of

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 these types of releases, that are regulated by other
2 governmental entities, is it the NRC practice to rely
3 on those entities to establish appropriate regulatory
4 limits that would result in no more than small
5 environmental impacts?

6 WITNESS PARK: I'm sorry, could you --

7 MS. CLARK: I know it is a complicated
8 question. Well, when we asses environmental impacts,
9 and we know that the particular releases are regulated
10 by other governmental entities, do we look to whether,
11 do we do an independent analysis of the environmental
12 impacts, or do we rely on the regulations that those
13 governmental entities have in place?

14 WITNESS PARK: In my experience we rely on
15 the regulations of the other federal agencies, the
16 limits and guidelines that have been set, and the
17 reviews of those entities, for those impacts.

18 MS. CLARK: So, in other words, do we
19 defer to those regulations in the respect that we
20 determine that if the facility is operated in
21 compliance with those regulations, the impacts will be
22 small?

23 WITNESS PARK: Again, in my experience,
24 yes, that is the case.

25 MS. CLARK: Is that because we rely on

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 those other governmental entities to establish
2 appropriate regulatory limits?

3 WITNESS PARK: Yes.

4 MS. CLARK: Thank you. Next I would like
5 to direct a few questions to Mr. Johnson. Dr.
6 Makhijani has stated that he has performed a pathway
7 analysis which demonstrates that shallow land
8 disposal, for depleted uranium, will not be feasible.

9 Is this consistent with your understanding
10 of the current license at the Envirocare site?

11 WITNESS JOHNSON: No, that isn't. The
12 Envirocare site was given approval, by the State of
13 Utah, for disposal of large quantities of depleted
14 uranium.

15 MS. CLARK: Did you contact the State of
16 Utah to ascertain whether this is true?

17 WITNESS JOHNSON: Yes. Because this has
18 been a long-standing issue we did want to verify with
19 the State our understanding of their license
20 conditions. And in our conversations with them, which
21 are documented in a telephone summary, as well as a
22 letter that was provided recently, I believe it was
23 dated October 14th.

24 The State of Utah acknowledged to us that
25 Envirocare is licensed to accept large quantities of

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 depleted uranium.

2 MS. CLARK: When you talked to the State,
3 and did you tell them that you were asking in the
4 context of disposal of the quantities of depleted
5 uranium that would be generated by the NEF?

6 WITNESS JOHNSON: Yes, we told them that
7 we were trying to gather information related to the
8 LES application.

9 MS. CLARK: And did you ask the state why
10 it was that they were able to accept such large
11 quantities of depleted uranium?

12 WITNESS JOHNSON: Yes, we did. And their
13 response was because of the unique site
14 characteristics involving very saline groundwater, on
15 the order of, they have total dissolved solids
16 contents on the order of 30 to 80,000 milligrams per
17 liter, EPA drinking water recommendations are 500
18 milligrams per liter, for example.

19 But this water would be unsuitable for
20 human consumption, or for irrigation. In addition the
21 soils are saline, which makes it unsuitable for
22 growing crops. There is also a very low rainfall and
23 high evapotranspiration rates.

24 And these factors all were considered in
25 the State of Utah's decision that the intruder

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 pathways that are normally evaluated for low level
2 waste disposal facilities, would be unrealistic for
3 this particular site.

4 And, consequently, the state judged that
5 this facility could meet the overall performance
6 objectives in subpart C of Part 61.

7 MS. CLARK: When you referred to the
8 intruder pathways, are these the pathways that we are
9 talking about, when we do the pathway analysis to
10 determine compliance with the performance criteria in
11 Part 61?

12 WITNESS JOHNSON: Yes.

13 MS. CLARK: Do you know what specific
14 pathways were eliminated from consideration?

15 WITNESS JOHNSON: All the intruder
16 pathways.

17 MS. CLARK: All the intruder pathways?

18 WITNESS JOHNSON: Yes.

19 MS. CLARK: Are you familiar with the term
20 intruder agriculture pathway?

21 WITNESS JOHNSON: Yes, I am.

22 MS. CLARK: Could you please explain to
23 us, briefly, what that is?

24 WITNESS JOHNSON: Under this pathway an
25 intruder, an inadvertent intruder comes on to the

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 site, develops a residence, drills a well, takes up
2 groundwater for use for his own consumption, as well
3 as for irrigation of foods, which he grows on-site.

4 The agricultural pathway relates to the
5 exposures that the intruder would receive from
6 consumption of food grown on the site, in waste
7 material, in contaminated soil, that is irrigated by
8 contaminated groundwater.

9 MS. CLARK: Given the fact that all
10 intruder pathways have been excluded, when doing the
11 performance analysis under Part 61, would you consider
12 potential doses from drinking groundwater at the site?

13 WITNESS JOHNSON: Well, if the groundwater
14 is unsuitable for consumption, it is reasonable to
15 eliminate that as a pathway for exposure.

16 MS. CLARK: And I think as you have
17 discussed before, would it be appropriate to consider
18 radiation received from consuming food grown at the
19 site?

20 WITNESS JOHNSON: Yes, if it is not
21 practical to grow food, then it is reasonable to
22 eliminate that as a pathway.

23 MS. CLARK: Thank you. Now, Dr. Makhijani
24 has also referred to a possession limit in the
25 Envirocare license. At this time I would like to

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 mark, for identification, license amendment 22 to the
2 Envirocare license.

3 MR. LOVEJOY: This was previously marked,
4 at least, as NIRS/PC exhibit 179, I believe. So it is
5 in the set.

6 CHAIR BOLLWERK: Okay. Why don't we go
7 ahead, if it is already in a set, and marked, why
8 don't we go ahead and just use their number, if you
9 don't have an objection to that?

10 MS. CLARK: That is fine.

11 CHAIR BOLLWERK: All right. We haven't
12 compared the two, but I suspect this is the whole
13 license amendment?

14 MR. LOVEJOY: We got it off the web.

15 CHAIR BOLLWERK: Okay. Why don't we go
16 ahead and use NIRS/PC 179, if that is all right with
17 the Staff?

18 JUDGE KELBER: It is 179?

19 CHAIR BOLLWERK: Right.

20 JUDGE ABRAMSON: It is the entire package,
21 this has 31 pages, it looks like it is the whole
22 package, Mr. Lovejoy?

23 MR. LOVEJOY: I believe it is.

24 MS. CLARK: Now, I believe that the limit
25 that Dr. Makhijani is referring to is item K in the

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 license. Could you please explain what that refers
2 to?

3 JUDGE ABRAMSON: What page is that on?

4 MS. CLARK: It is on the second page, item
5 K.

6 WITNESS JOHNSON: It is item 6K, and what
7 this is, is a possession limit for Envirocare to
8 possess a source that was built for them,
9 specifically, to calibrate an instrument for measuring
10 depleted uranium in containers that would be accepted
11 for disposal.

12 This would be a verification measurement
13 of the manifest information that would be provided by
14 a generator.

15 MS. CLARK: Does this constitute a
16 disposal limit?

17 WITNESS JOHNSON: No, it was intended only
18 to indicate that Envirocare, under its license, can
19 possess those particular source.

20 MS. CLARK: I'd like to direct your
21 attention to Staff exhibit 44. Do you have that up
22 there? That is --

23 WITNESS JOHNSON: I don't have it.

24 CHAIR BOLLWERK: Do we want to go ahead
25 and mark 179 for identification? We are going to go

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 ahead and mark 179 for identification, NIRS/PC, which
2 is --

3 WITNESS JOHNSON: Yes, I do have a copy of
4 this.

5 CHAIR BOLLWERK: For the record let's go
6 ahead and mark NIRS/PC 179, which is the Envirocare of
7 Utah amendment 22, adopted June 13, 2005, for
8 identification.

9 (Whereupon, the above-
10 referenced to document was
11 marked as NIRS/PC Exhibit No.
12 179 for identification.)

13 MS. CLARK: Mr. Johnson, do you recognize
14 this letter?

15 WITNESS JOHNSON: Pardon?

16 MS. CLARK: Do you recognize this letter?

17 WITNESS JOHNSON: Yes.

18 MS. CLARK: Can you tell us the
19 circumstances surrounding this letter?

20 WITNESS JOHNSON: Yes. We wanted to
21 clarify, with the State of Utah, exactly the purpose
22 of the entry item 6K for this source. And in this
23 letter they explain that it is a calibration source
24 that is possessed by Envirocare, and it does not
25 relate to limits for disposal of depleted uranium.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 MS. CLARK: Okay, thank you very much. I
2 think that is all the questions I have.

3 CHAIR BOLLWERK: All right, any --

4 MS. CLARK: I would ask that NIRS/PC 179
5 be admitted into the record.

6 CHAIR BOLLWERK: Any objection?

7 (No response.)

8 CHAIR BOLLWERK: There being none, then
9 NIRS/PC exhibit 179, the Envirocare Utah amendment 22
10 is admitted into evidence.

11 (The document referred to,
12 having been previously marked
13 for identification as NIRS/PC
14 Exhibit No. 179 was admitted in
15 evidence.)

16 CHAIR BOLLWERK: Let me see if LES has any
17 cross examination of this panel?

18 MR. CURTISS: I was just wondering if 4
19 had been previously admitted.

20 CHAIR BOLLWERK: This is Staff exhibit 44?
21 Yes.

22 MR. CURTISS: Good. We don't have any
23 further questions.

24 CHAIR BOLLWERK: All right. I think it is
25 up to you, yes.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 MR. LOVEJOY: Thank you, Your Honor. Let
2 me just clear the deck here a little bit.

3 (Pause.)

4 EXAMINATION BY MR. LOVEJOY OF

5 DONALD PALMROSE

6 JAMES PARK

7 JENNIFER MAYER

8 CRAIG DEAN

9 TIMOTHY C. JOHNSON

10 MR. LOVEJOY: Dr. Palmrose, if I
11 understand your testimony, you undertook to
12 investigate the licensing status of Envirocare under
13 the Utah statutes and regulations, is that right?

14 WITNESS PALMROSE: The Staff informed me
15 that they had been licensed for accepting unrestricted
16 volumes of depleted uranium.

17 MR. LOVEJOY: And that was the basis on
18 which you concluded that the impacts of that activity,
19 that disposal, would be small, right?

20 WITNESS PALMROSE: Yes, because it met the
21 performance criteria of Part 61 as applied by an
22 agreement state.

23 MR. LOVEJOY: Well, you ascertained that
24 an agreement state reported to you that they had
25 applied such criteria, as they had, for a near-surface

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 disposal facility, and that Envirocare site met those
2 criteria, right?

3 WITNESS PALMROSE: That information came
4 through the NRC Staff, yes.

5 MR. LOVEJOY: So you, yourself, to begin
6 with have not conducted a performance assessment of
7 the Envirocare site?

8 WITNESS PALMROSE: That is correct.

9 MR. LOVEJOY: And your staff has not
10 conducted a performance assessment of the Envirocare
11 site?

12 WITNESS PALMROSE: Which staff are you
13 referring to?

14 MR. LOVEJOY: Any staff that you are
15 cooperating with on this matter.

16 WITNESS PALMROSE: No, because they are a
17 licensed facility.

18 MR. LOVEJOY: And you have not reviewed
19 the performance assessment that Utah has performed,
20 correct?

21 WITNESS PALMROSE: I reviewed it for this
22 hearing.

23 MR. LOVEJOY: And what did you review?

24 WITNESS PALMROSE: I looked, I reviewed
25 the document to see if certain scenarios, and

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 questions that are potentially going to come up,
2 raised for their information.

3 MR. LOVEJOY: What document?

4 WITNESS PALMROSE: That was the 1990
5 study.

6 MR. LOVEJOY: The Baird report, you
7 reviewed that?

8 WITNESS PALMROSE: Yes, I did, I reviewed
9 certain parts of it during this hearing.

10 MR. LOVEJOY: But you didn't review that
11 before the draft of the Final Environmental Impact
12 Statement was issued, correct?

13 WITNESS PALMROSE: That is correct.

14 MR. LOVEJOY: When you reviewed that
15 report did you find that it was of scientifically
16 responsible job, with scientifically reasonable
17 results?

18 WITNESS PALMROSE: I didn't have time to
19 review it to that length of detail.

20 MR. LOVEJOY: So you are not here to
21 explain or defend the results contained in any
22 performance assessment?

23 WITNESS PALMROSE: No, that performance
24 assessment was evaluated by the State of Utah, and
25 accepted by the State of Utah.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 MR. LOVEJOY: Well, has Staff reviewed
2 that analysis, do you know?

3 WITNESS JOHNSON: The Staff did look at
4 that document, the June 1990 report from Rogers and
5 Associates, and we had our modeling people also look
6 at it.

7 The modeling people were involved in a
8 telephone call with the State of Utah, in which their
9 input became a part of that telephone conference
10 summary.

11 MR. LOVEJOY: Mr. Johnson, are you here to
12 explain or support a performance assessment of the
13 Envirocare site?

14 WITNESS JOHNSON: I can explain it in
15 general. Again, we did not duplicate the analyses but
16 we did review the report, and as indicated in the
17 telephone summary, the Staff agreed with the overall
18 conclusions that decisions regarding the intruder
19 pathway were reasonable.

20 CHAIR BOLLWERK: I think we are confusing
21 which report is which, here. I mean, the Baird report
22 as opposed to some sort of initial performance
23 assessment that was done? I'm confused, I guess.

24 WITNESS JOHNSON: I'm referring to a 1990
25 report performed by Rogers and Associates under

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 contract with the State of Utah, which was the
2 principal basis for the original licensing of the
3 Envirocare facility.

4 JUDGE ABRAMSON: And is that what is being
5 referred to as the Baird report?

6 MR. LOVEJOY: I believe so. I think it
7 has been marked as an exhibit.

8 JUDGE ABRAMSON: The Baird report?

9 MR. LOVEJOY: Exhibit 170.

10 JUDGE ABRAMSON: But now let me just make
11 sure I understand what you just said, because I think
12 you said you concurred with their conclusions
13 regarding intruder pathways.

14 Do you mean you concurred with the Baird
15 report's conclusions, or do you mean you concurred
16 with the State of Utah's conclusions to eliminate the
17 intruder pathways?

18 WITNESS JOHNSON: We felt it was
19 reasonable that the intruder pathways would be
20 unrealistic, and could be eliminated.

21 JUDGE ABRAMSON: One other question. Did
22 this review, the Staff review that you are describing,
23 go on before the issuance of either the draft or the
24 Final Environmental Impact Statement, and was it used
25 as input for it, or was it separate and related only

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 to this matter?

2 WITNESS JOHNSON: It went into -- this
3 review was done in the March/April time frame of this
4 year, and that review was factored into the
5 environmental impact statement, as well as our safety
6 evaluation.

7 MR. LOVEJOY: When you, and your staff,
8 looked at the Baird report, you reviewed the whole
9 report, the 1990 report, correct?

10 WITNESS JOHNSON: Yes.

11 MR. LOVEJOY: And did you reach a
12 judgement as to whether that report was scientifically
13 reasonable?

14 WITNESS JOHNSON: Yes, we did.

15 MR. LOVEJOY: And what did you think?

16 WITNESS JOHNSON: I'm sorry?

17 MR. LOVEJOY: What did you think? Did you
18 conclude that it was?

19 WITNESS JOHNSON: We felt that it was
20 scientifically reasonable, that it addressed the
21 appropriate pathways, and was done with a model that
22 was considered acceptable.

23 This is the pathway model which had been
24 developed for EPA in their evaluations of a generally
25 applicable standard for low level waste disposal.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 MR. LOVEJOY: And the results in the Baird
2 report, did you consider those reasonable?

3 WITNESS JOHNSON: We felt that the results
4 of the Baird report were reasonable, as well as the
5 conclusion that it was appropriate to drop the
6 intruder pathways because they were unrealistic
7 because of the unique site characteristics of the
8 Envirocare site.

9 JUDGE ABRAMSON: But the conclusion was
10 not in the Baird report, that was a conclusion by the
11 state agency, correct?

12 WITNESS JOHNSON: Correct.

13 JUDGE ABRAMSON: So we need to keep in
14 mind that the Baird report was technical report that
15 provided some calculations?

16 WITNESS JOHNSON: Yes.

17 JUDGE ABRAMSON: And you found those
18 calculations okay?

19 WITNESS JOHNSON: Yes.

20 MR. LOVEJOY: Did you, or your staff,
21 attempt to reproduce any of the calculations in the
22 Baird report?

23 WITNESS JOHNSON: No.

24 MR. LOVEJOY: You spoke about some
25 analyses done in 1991, I think, by Sandia laboratories

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 in connection with the Claibourne case?

2 WITNESS JOHNSON: Yes.

3 MR. LOVEJOY: What was the time frame of
4 those analyses?

5 WITNESS JOHNSON: It was in the early
6 1990s.

7 MR. LOVEJOY: The question, I should be
8 clearer, what was the time frame examined in those
9 studies, of the performance of waste disposal?

10 WITNESS JOHNSON: I don't recall. I think
11 it was probably 1,000 years. But I believe the
12 evaluation also looked at longer periods of time,
13 although I don't recall exactly.

14 MR. LOVEJOY: Do you have the NIRS/PC
15 exhibits near there?

16 WITNESS JOHNSON: What was the number,
17 again?

18 MR. LOVEJOY: I'm looking for it, it is in
19 the 130 range, but I can't remember the exact one.
20 Yes, 128.

21 WITNESS JOHNSON: All right, I have it.

22 MR. LOVEJOY: Now I have the right number.
23 Looking at page 14 of the Kozak report, and the
24 description of table 14 at the top of that page?

25 WITNESS JOHNSON: Yes.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 MR. LOVEJOY: Does that indicate that the
2 doses examined in this table, anyway, were taken to
3 the time of secular equilibrium?

4 WITNESS JOHNSON: The doses are
5 legitimate, is that your question?

6 MR. LOVEJOY: That they were taken to the
7 time of secular equilibrium. And it says,
8 parentheses, T --

9 WITNESS JOHNSON: Yes.

10 MR. LOVEJOY: -- times ten to the six?

11 WITNESS JOHNSON: Yes.

12 MR. LOVEJOY: And was this, when it was
13 done, a scientifically reasonable study?

14 WITNESS JOHNSON: I'm sorry?

15 MR. LOVEJOY: Was this a scientifically
16 reasonable study?

17 WITNESS JOHNSON: Yes, it was.

18 MR. LOVEJOY: And did you consider the
19 results of the Kozak study to be scientifically
20 reasonable?

21 WITNESS JOHNSON: Yes.

22 MR. LOVEJOY: In the performance standards
23 that apply to waste disposal under 10CFR Part 61, is
24 there a time limit?

25 WITNESS JOHNSON: The time that the Part

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 61 evaluations were taken out to, were 10,000 years.

2 JUDGE ABRAMSON: I'm sorry?

3 MR. LOVEJOY: Would you cite the
4 regulation that --

5 WITNESS JOHNSON: Well, it is not in the
6 regulation, but the analyses that were done, to
7 support the rulemaking, were done to 10,000 years.

8 MR. LOVEJOY: The regulation does not have
9 a time a limit, does it?

10 WITNESS JOHNSON: No, it does not have a
11 time limit in it.

12 MR. LOVEJOY: So it would take an
13 amendment to the regulation to introduce a limit like
14 10,000 years, wouldn't it?

15 WITNESS JOHNSON: No, that wasn't what I
16 meant. I said the analyses that were done, as part of
17 the Final Environmental Impact Statement that
18 supported the ruling, were done out to 10,000 years.

19 No specific requirement was placed in the
20 rulemaking.

21 MR. LOVEJOY: Well, is it your view that
22 an analysis of the performance of a near-surface
23 disposal site should extend, at least, to 10,000
24 years?

25 WITNESS JOHNSON: There are a number of

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 opinions on that. The agency really hasn't taken a
2 position, although we have not objected to states that
3 have evaluated it for a period of 1,000 years.

4 And the reason for that is that once you
5 get into these time frames, the exposure scenarios
6 begin to have very large uncertainties. And to
7 predict what the technology, or lifestyles, or the way
8 we live over those time frames, are very uncertain.

9 And the longer you carry out these
10 analyses, the larger these uncertainties become. So
11 there is kind of a limit to the meaningfulness of
12 carrying it out into these time frames.

13 MR. LOVEJOY: Has the agency made any
14 assessment of the nature of the uncertainties going
15 out past 1,000 years?

16 WITNESS JOHNSON: Well, not explicitly,
17 other than to recognize that there are substantial
18 uncertainties when making these projections over these
19 kinds of time frames.

20 MR. LOVEJOY: So is this just kind of a
21 horseback judgement that somebody has made, that after
22 1,000 years it is too hard?

23 WITNESS JOHNSON: No, I think it is a
24 reasonable judgement that when we project over these
25 time frames, that there will be large uncertainties.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 MR. LOVEJOY: Are you aware that this
2 issue has been examined in connection with other waste
3 disposal projects, such as the waste isolation pilot
4 plan, are you aware of that?

5 WITNESS JOHNSON: No, I'm not aware of the
6 process for the waste isolation pilot plan.

7 MR. LOVEJOY: Are you aware of the process
8 for the Yucca Mountain repository?

9 WITNESS JOHNSON: I'm not, I don't have
10 any direct information on that, or knowledge of it.

11 MR. LOVEJOY: So you wouldn't know how
12 they have dealt with issues like identification of a
13 period of performance?

14 WITNESS JOHNSON: Well, other than to say
15 that the people involved in our agency management,
16 we've concluded that there are large uncertainties
17 when you carry out these reviews in those time frames.

18 JUDGE ABRAMSON: Can I ask a question
19 here? This all relates to what Part 61, to the fact
20 that there is no time limit set in Part 61.

21 So my question, Mr. Johnson, is are you
22 familiar with the process by which Part 61 is
23 interpreted by a state, or the interaction between,
24 that the NRC and the state -- in other words, there
25 is, once they become an agreement state they have to

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 have certain levels of their regulatory compliance,
2 and have to do something --

3 WITNESS JOHNSON: They have to determine
4 the compatibility. And the NRC reviews, as part of
5 the original agreement state process, reviews the
6 compatibility of their licensing program with that of
7 NRC.

8 And, periodically, rereviews it to ensure
9 that the state's program remains compatible.

10 JUDGE ABRAMSON: And do you know if the
11 state of Utah's program has any time limits in its
12 evaluation, in its equivalent of Part 61?

13 WITNESS JOHNSON: Yes, the most recent
14 review, I don't know what the date of it was, but the
15 most recent review was that Utah had a compatible
16 regulatory process with that of NRC.

17 JUDGE ABRAMSON: Had a compatible process.
18 Do they have a time limit in their equivalent of Part
19 61?

20 WITNESS JOHNSON: I don't know, I believe
21 the evaluations that were done for Utah were done to
22 1,000 years. And I'm not aware that the NRC objected
23 to that time limit.

24 JUDGE ABRAMSON: Thank you.

25 MR. LOVEJOY: Are you aware that subpart

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 C, in 61.42, states that design operation and closure
2 of the land disposal facility must ensure protection
3 of any individual inadvertently intruding into the
4 disposal site, and occupying the site, or contacting
5 the waste, at any time?

6 WITNESS JOHNSON: Yes.

7 MR. LOVEJOY: After active institutional
8 controls over the disposal site are removed?

9 WITNESS JOHNSON: Yes.

10 MR. LOVEJOY: You are aware of that, okay.
11 And it would take an amendment to the regulations to
12 change that to at any time within 1,000 years, or
13 10,000 years, wouldn't it?

14 WITNESS JOHNSON: I believe that to make
15 that change would require a rule change, yes.

16 MR. LOVEJOY: At any time doesn't mean for
17 1,000 years, does it?

18 JUDGE ABRAMSON: We have the point.

19 MR. LOVEJOY: Good. Okay, let's look at
20 the Baird report. Do you have NIRS/PC Exhibit 170?

21 WITNESS JOHNSON: Yes.

22 MR. LOVEJOY: Okay. On page ES 4 it says,
23 down toward the bottom of that page, that exposure
24 pathway doses based on assumed one picocurie per gram
25 radionuclide concentrations in a waste were

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 calculated.

2 For each of the exposure pathways shown in
3 table E1 -- and that's the process that was used in
4 this report, right?

5 WITNESS JOHNSON: I'm sorry?

6 MR. LOVEJOY: Exposure pathway doses based
7 on assumed one picocurie per gram radionuclide
8 concentrations in the waste were calculated for each
9 of the exposure pathways shown in table E1, correct?

10 WITNESS JOHNSON: Yes, that's correct.

11 MR. LOVEJOY: And table E1 is over on the
12 next page, right?

13 WITNESS JOHNSON: Yes.

14 MR. LOVEJOY: And it includes as exposure
15 scenarios intruder construction, intruder agriculture,
16 intruder explorer, and then maximum off-site
17 individual, and on-site worker, right?

18 WITNESS JOHNSON: Yes, there's a series of
19 pathways that were evaluated.

20 MR. LOVEJOY: And the dots in table E1
21 indicate which pathways were analyzed with respect to
22 each scenario, right?

23 WITNESS JOHNSON: I believe that's
24 correct.

25 MR. LOVEJOY: And the premise of this

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 study was -- one of the premises was the dose limit of
2 25 millirems per year, correct?

3 WITNESS JOHNSON: For the pathways where
4 that particular limit applied, that's correct. But
5 that, the 25 millirem, didn't necessarily apply to all
6 of these pathways.

7 For example, I believe they applied 500
8 millirem or 100 millirem a year to some of the other
9 intruder pathways.

10 MR. LOVEJOY: Okay. Were they attempting
11 to follow standards applicable to -- under subpart C?

12 WITNESS JOHNSON: Yes.

13 MR. LOVEJOY: Okay. So they calculated
14 the doses that would be received if the waste had a
15 concentration of one picocurie per gram, correct?

16 WITNESS JOHNSON: Yes. And what they --
17 yes, that's correct. It was based on one picocurie
18 per gram, and from that they could scale up to
19 whatever the limit the state ultimately chose for
20 those -- for the appropriate pathway.

21 MR. LOVEJOY: And are those limits then
22 shown in page -- on page 514 on table 5-4?

23 WITNESS JOHNSON: Yes, I believe that is
24 correct.

25 MR. LOVEJOY: And for example, the limit

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 for U-238 would be 7.1, ten to the plus two picocuries
2 per gram, right?

3 WITNESS JOHNSON: Yes.

4 MR. LOVEJOY: And so this would be a
5 concentration well below what we would anticipate in
6 depleted uranium, correct?

7 WITNESS JOHNSON: Yes, that's correct.

8 MR. LOVEJOY: Okay.

9 WITNESS JOHNSON: And as part of the State
10 evaluation, those pathways were eliminated because
11 they were ultimately deemed to be unrealistic because
12 of the site conditions.

13 MR. LOVEJOY: Have you looked at any other
14 instances where performance of a waste disposal site
15 was examined? Have you ever looked at the process of
16 scenario selection or, what I think they called in the
17 WIPP case, the selection of features, events, and
18 processes? Have you ever looked at that?

19 WITNESS JOHNSON: I mean in general, I
20 guess I'm not really exactly sure what your question
21 is, but when NRC prepared its Part 61 regulation,
22 there was a substantial evaluation as to what the
23 appropriate pathways for review should be.

24 And the discussions involved a number of
25 things including getting input from a number of

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 different parties on coming to the conclusion as to
2 what would be the reasonable pathways to evaluate in
3 the modeling.

4 MR. LOVEJOY: That was the modeling that
5 gave rise to Part 61, the general regulation, correct?

6 WITNESS JOHNSON: Yes.

7 MR. LOVEJOY: And in that modeling they
8 were looking for, I think, kind of limiting scenarios,
9 right?

10 WITNESS JOHNSON: Well, they were looking
11 at reasonable exposure pathways for intruders and for
12 workers.

13 MR. LOVEJOY: Okay. But I'm talking about
14 something coming from a little different viewpoint,
15 and that is the question of in selection of the
16 scenarios, the list of scenarios that needs to be
17 examined when you're judging the performance of a
18 particular site. Did you ever study that process?

19 WITNESS JOHNSON: Well again, I'm not
20 really clear what you are referring to, but there are
21 a general set of pathways that are commonly used
22 within performance assessment models for low level
23 waste sites.

24 And how they are specifically applied to
25 an individual site would depend on the individual site

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 conditions. But overall, the principal models that
2 have been used for performance assessment for low
3 level waste sites include a suite of pathway analyses
4 that have been deemed to be reasonable for evaluation.

5 MR. LOVEJOY: And is that the suite that
6 was listed in the Baird report?

7 WITNESS JOHNSON: Yes.

8 MR. LOVEJOY: But does the set of
9 scenarios analyzes in the Baird report, for example,
10 include instances of erosion, removing some of the
11 surface?

12 WITNESS JOHNSON: I believe the assumption
13 was that -- well, yes. I believe that erosion was
14 included in some of these pathways. But this
15 particular facility was specifically designed to use
16 the same cover system that is required for mill
17 tailings, 11(e)2 byproduct material, where the design
18 objective is 1,000 years, to the extent that is
19 reasonably achievable.

20 MR. LOVEJOY: And the only -- the tests
21 under the Baird report were only run to 1,000 years,
22 right?

23 WITNESS JOHNSON: I'm sorry?

24 MR. LOVEJOY: Were the dose calculations
25 made at the point of 30 years and then 1,000 years?

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 WITNESS JOHNSON: The calculations that
2 Rogers and Associates performed were run for 1,000
3 years.

4 MR. LOVEJOY: So there was no erosion
5 scenario that went beyond 1,000 years?

6 WITNESS JOHNSON: That's my understanding.

7 MR. LOVEJOY: Okay. Now in the
8 examination of a potential disposal site, is it
9 conventional to look at questions like, for example,
10 resources on the site that might attract intruders?

11 WITNESS JOHNSON: I'm sorry, could you
12 repeat that?

13 MR. LOVEJOY: Is it conventional to look
14 into the question of resources on a site that might
15 attract intruders?

16 WITNESS JOHNSON: Is it conventional to
17 look at --

18 MR. LOVEJOY: In the examination of the
19 disposal site.

20 WITNESS JOHNSON: To look at resources on
21 the site?

22 MR. LOVEJOY: Yes.

23 WITNESS JOHNSON: Yes.

24 MR. LOVEJOY: It is. Do you know if that
25 was done in this instance with respect to --

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 WITNESS JOHNSON: Yes, I believe the State
2 of Utah looked at that.

3 MR. LOVEJOY: What use has the Envirocare
4 site been put to historically before it was owned by
5 Envirocare?

6 WITNESS JOHNSON: The first use of the
7 site was for disposal of a large quantity of mill
8 tailings that was originally in Salt Lake City. And
9 it was transported to this site for disposal under, at
10 the time, an NRC license.

11 The next step, I believe Envirocare got a
12 license to disposal of naturally occurring radioactive
13 material, and then ultimately got approval for
14 disposal of low level waste.

15 It also has approval to dispose of mixed
16 waste, certain mixed waste.

17 MR. LOVEJOY: Mr. Johnson, before
18 Envirocare even existed, was the site used for any
19 purpose?

20 WITNESS JOHNSON: I'm not aware that it
21 was used for anything. I believe this Baird report
22 talks about some people hunting in that area. But I'm
23 not aware that there were any historical uses of that
24 site.

25 MR. LOVEJOY: So there was no sign-up

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 sheet for hunters or something like that. In the
2 absence of that you just assumed that no one had ever
3 been there.

4 WITNESS JOHNSON: I don't believe that
5 there was a sign-up sheet, no.

6 JUDGE KELBER: Excuse me. I'd like to
7 focus on this question of intruder pathways a little
8 bit. The -- in the case of the disposal of depleted
9 uranium, the uranium and its daughters are all alpha
10 emitters, is that correct?

11 WITNESS JOHNSON: Yes. There's also some
12 gammas that are emitted by the daughters as well.

13 JUDGE KELBER: Some gammas. The dose from
14 an alpha particle is included in the 25 millirem,
15 standard, for example?

16 WITNESS JOHNSON: Yes. What would be
17 assumed is that groundwater, for example, would be
18 contaminated. It could have uranium concentrations in
19 it.

20 And the pathways would be evaluated for
21 ingestion of that material.

22 JUDGE KELBER: For ingestion?

23 WITNESS JOHNSON: Right.

24 JUDGE KELBER: A hunter wearing boots or
25 moccasins would be shielded from alpha particles,

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 correct?

2 WITNESS JOHNSON: From the direct
3 exposure.

4 JUDGE KELBER: Yes.

5 WITNESS JOHNSON: But potentially could be
6 exposed from airborne inhalation.

7 JUDGE KELBER: If there were airborne --
8 yes.

9 WITNESS JOHNSON: Right.

10 JUDGE KELBER: So the pathways that are
11 possible are airborne inhalation or groundwater?

12 WITNESS JOHNSON: Yes. The scenario of,
13 you know, a hunter coming on to the site and maybe
14 being exposed to some surface contamination.

15 JUDGE KELBER: He might have to stay there
16 for a year to get this dose.

17 WITNESS JOHNSON: We would probably have
18 to stay there for -- well it would depend on what the
19 contamination limits are, or contamination is, and
20 what the scenario is.

21 But if the cap functions the way it's
22 supposed to there would be very little surface
23 contamination on the site.

24 JUDGE KELBER: Yes. What I'm trying to
25 get at is that middle paragraph on page 3-15 of the

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 Baird report where they point out that the
2 concentration limits for radium and gross alpha
3 emitters is in groundwater, is essentially what you
4 have said.

5 WITNESS JOHNSON: What page was that,
6 please?

7 JUDGE KELBER: It's 3-15.

8 WITNESS JOHNSON: It's 3-15?

9 JUDGE KELBER: Just -- the paragraph just
10 above the title 3.5 proposed BRC standards.

11 WITNESS JOHNSON: Yes.

12 JUDGE KELBER: So I think we can safely
13 limit our discussion to ingestion pathways.

14 WITNESS JOHNSON: Certainly for the
15 groundwater situation it would be an ingestion
16 pathway.

17 JUDGE ABRAMSON: Let me pick this up for
18 a second. As I understand it, groundwater has a great
19 deal of salinity.

20 WITNESS JOHNSON: It has what?

21 JUDGE ABRAMSON: A great deal of salinity?

22 WITNESS JOHNSON: Yes. The total
23 dissolves solids contents are on the order of 30,000
24 to 80,000 milligrams per liter.

25 JUDGE ABRAMSON: And is that related to

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 the historical origin of that region?

2 WITNESS JOHNSON: Yes.

3 JUDGE ABRAMSON: And how long do we
4 suspect -- do we have any knowledge about how long
5 that groundwater has had that kind of salinity?

6 WITNESS JOHNSON: I'm sure -- it's for
7 thousands of years. Originally this area, I believe,
8 was a seabed.

9 JUDGE ABRAMSON: The origin of the Great
10 Salt Lake in the neighborhood?

11 WITNESS JOHNSON: Yes, right.

12 JUDGE ABRAMSON: And do we have any reason
13 to suspect that the salinity might change absent some
14 enormous change in climate?

15 WITNESS JOHNSON: Well I think the climate
16 is dictated because that particular area is in the
17 rain shadow of the Sierra Mountains. So unless that
18 geologically changes I would expect the climate
19 conditions to remain the same.

20 JUDGE ABRAMSON: So when we look at the
21 fact that the State of Utah made the judgment that the
22 groundwater pathway for intrusion could be eliminated
23 as a risk because of the salinity, do we have any
24 reason to believe that might not be true for the
25 foreseeable future?

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 The salinity of the groundwater is likely
2 to be very high for a very long period?

3 WITNESS JOHNSON: Yes. I believe that is
4 part of the State of Utah's rationale.

5 MR. LOVEJOY: So the hunter with the boots
6 on, if the waste were uncovered by erosion, he would
7 be exposed to direct exposure dose from the uranium,
8 wouldn't he?

9 WITNESS JOHNSON: Well again, it depends
10 on what your scenario is and how you evaluate it. But
11 under your assumption that the cap no longer exists
12 and some of this material would be exposed, yes.

13 MR. LOVEJOY: And he would be inhaling
14 material, probably, and --

15 WITNESS JOHNSON: Assuming there was
16 someone there to inhale it.

17 MR. LOVEJOY: Yes.

18 WITNESS JOHNSON: Yes.

19 MR. LOVEJOY: Well, shouldn't you so
20 assume since it's been used for hunting and recreation
21 in the past?

22 WITNESS JOHNSON: I think it's unlikely
23 that this area would result in serious exposures
24 because of the unlikely nature of someone being there
25 for long periods of time.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 JUDGE ABRAMSON: I think we all understand
2 the proposition that over some period of time it's
3 possible that the cap will be gone. And it is
4 possible that somebody will wander onto the site.

5 And it's clear that the regulations do not
6 state a time limit, and that we are into the same
7 question that Yucca Mountain regulators were into with
8 respect to what's an appropriate dose limit in the
9 far, far future.

10 And I think that we don't need to pursue
11 that in the course of this hearing. Nobody knows, and
12 we understand the issue you're raising.

13 JUDGE KELBER: As Mr. Johnson has pointed
14 out, the uncertainties are very large. If one wants
15 to discuss, for example, radiation effects on humans,
16 say, 10,000 years from now, one has to guess at how we
17 will evolve, what type of nutrients we will have given
18 the possibilities of high radiation doses from things
19 like wars.

20 We might, for example, evolve into a race
21 as hardy as cockroaches in respect to radiation. Or
22 we might become cockroaches. So that sort of
23 speculation does not inform a discussion about the
24 costs of disposal of uranium.

25 CHAIR BOLLWERK: Is it time to take a

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 break here?

2 JUDGE ABRAMSON: Well, let me just ask,
3 before we take a break -- obviously we have to get on
4 to the question of cost. And I'd like to know how
5 much more we're going to do on the question of the
6 breadth of there -- or on the sufficiency of the hard
7 look. Do you have an idea, Mr. Lovejoy?

8 MR. LOVEJOY: I would say some, but not a
9 huge amount. I don't --

10 JUDGE ABRAMSON: Should we try to complete
11 that before we take a break?

12 MR. LOVEJOY: I think it might be good to
13 take a break. And it might actually turn out faster
14 that way.

15 JUDGE ABRAMSON: Can't argue that line --
16 but a short break.

17 CHAIR BOLLWERK: We'll try to do this in
18 about ten minutes.

19 (Whereupon, the above-entitled matter
20 went off the record at 9:50 a.m. and
21 went back on the record at 10:00 a.m.)

22 CHAIR BOLLWERK: All right, let's go back
23 on the record. I believe we're here after our break
24 to continue the cross examination by Mr. Lovejoy of
25 the Staff panel on disposal.

1 MR. LOVEJOY: Thank you, Your Honor.
2 Thinking about agricultural use, are there places on
3 earth that where at one time desert which are now
4 being farmed?

5 WITNESS JOHNSON: Yes, there are. And
6 that's primarily because of the availability of large
7 quantities of water that can be used for irrigation.

8 MR. LOVEJOY: And water has been brought
9 over long distances sometimes to irrigate or to
10 support humans, hasn't it?

11 WITNESS JOHNSON: I believe so.

12 MR. LOVEJOY: Yes. And you can't exclude
13 that possibility, correct?

14 WITNESS JOHNSON: I suppose there is a
15 possibility that that could occur.

16 JUDGE KELBER: Excuse me. Does that
17 include sufficient water to wash the salt out of the
18 soil? I understood the witness to say that the
19 salinity of the soil was such that you could not grow
20 vegetation there. Is that correct?

21 WITNESS JOHNSON: Well, I think the
22 conclusion of the State of Utah is that it would be
23 very difficult to grow food in that particular soil,
24 and certainly you would need a fairly large quantity
25 of water to irrigate it.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 And the water used for irrigation is also
2 saline. Now whether or not you transported water over
3 hundreds of miles in the quantities needed --

4 JUDGE ABRAMSON: Mr. Johnson, excuse me.
5 Let's cut this off. We all recognize that technology
6 is going to change, that there's current technology,
7 a lot can happen in a thousand year or million years.

8 Let us not go down this path here. We
9 understand the premise that the reg has no date in it,
10 and that things are uncertain. And let's just go on
11 with this.

12 There's no advantage to any of us trying
13 to speculate on what can or cannot happen.

14 MR. LOVEJOY: All right. Well -- just one
15 other question here.

16 CHAIR BOLLWERK: All right, go ahead.

17 MR. LOVEJOY: An intruder doing
18 construction, say, of residences or commercial
19 facilities could penetrate through the surface cover,
20 couldn't he?

21 WITNESS JOHNSON: Well, I believe the
22 State of Utah, their opinion is because there's no
23 suitable water supplies, it would be difficult to grow
24 food there, that that would make the site unsuitable
25 for an intruder even coming on and building a

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 residence.

2 MR. LOVEJOY: So they're just assuming
3 that the site will never be used.

4 WITNESS JOHNSON: Yes, that's correct.

5 MR. LOVEJOY: And they didn't examine
6 erosion of the surface at all?

7 WITNESS JOHNSON: Well I believe they
8 assumed some erosion, but I believe they took credit
9 for the fact that the cover would be designed
10 consistent with the requirements for 11(e)2 byproduct
11 material.

12 MR. LOVEJOY: Was that specific assumption
13 recorded somewhere, about the 11(e)2 material cover?

14 WITNESS JOHNSON: Yes. It's discussed in
15 the Baird report.

16 MR. LOVEJOY: Okay. Have you looked at
17 the analyses done by Dr. Makhijani and Dr. Smith that
18 were filed in this case? There was a couple of them.

19 WITNESS JOHNSON: Yes, I have.

20 MR. LOVEJOY: Okay. Did you look at the
21 analysis of exposure to -- direct exposure and
22 inhalation doses to someone entering the site where
23 the waste has been uncovered?

24 MS. CLARK: Mr. Lovejoy, could you give us
25 a reference?

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 MR. LOVEJOY: Sure. I'm looking at
2 Exhibit -- NIRS/PC Exhibit 224 page 16, there's a
3 table. I'm advised that the calculations here assume
4 that the waste has been exposed from erosion. Did you
5 look at the table at all?

6 WITNESS JOHNSON: Did I look at this?

7 MR. LOVEJOY: Did you look at it in
8 reviewing the report?

9 WITNESS JOHNSON: Yes.

10 MR. LOVEJOY: Well did you notice that it
11 says in the text below, the paragraph just below the
12 table, significantly if we consider just the two mean
13 erosion rates, and sum the doses from the external and
14 inhalation pathways, that we find that it would take
15 just 1.44 to 2.87 hours on the site to violate the 25
16 millirem per year dose limit.

17 So does this correspond to your
18 hypothetical hunter wearing boots wandering onto the
19 site after there's been erosion?

20 WITNESS JOHNSON: At these time frames,
21 again, that was -- I don't -- I didn't try to
22 duplicate the analyses that were performed here. I
23 assume that they're correct.

24 MR. LOVEJOY: So it would --

25 WITNESS JOHNSON: But the assumption is

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 that all the cover erodes but the waste is still
2 there, and someone who comes onto the site at the --
3 whatever the assumptions of there original
4 concentrations were is still intact.

5 And I don't disagree that someone who
6 could come onto the site at the years that you're
7 referring to, under the scenario that you've
8 projected, would obtain these doses.

9
10 I think the question is how realistic is
11 that scenario as it applies to the Envirocare
12 facility.

13 JUDGE KELBER: Mr. Johnson, can a person
14 handle depleted uranium?

15 WITNESS JOHNSON: Have I personally?

16 JUDGE KELBER: No, can a person handle
17 depleted uranium, just pass it back and forth in their
18 hands without endangering their life, their health?

19 WITNESS JOHNSON: I believe the product
20 that would be generated in deconversion would be
21 something that could be handled, but obviously the
22 processes would try to minimize the handling to
23 minimize the doses.

24 JUDGE KELBER: I understand that. Having
25 handled depleted uranium myself, I understand that.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 Would alpha particle travel more than about an inch in
2 the air before it was effectively absorbed?

3 WITNESS JOHNSON: That's about the limit
4 for alpha particle exposure.

5 JUDGE KELBER: Okay, so that the main
6 pathway for this proposed hunter would be ingestion of
7 -- inhalation?

8 WITNESS JOHNSON: Probably be inhalation,
9 although Dr. Makhijani, I think, would have to explain
10 in detail the pathways that he used for doing this.

11 But my assumption is that for -- as
12 described here, the critical pathways would involve
13 inhalation.

14 JUDGE ABRAMSON: Did Dr. Makhijani have a
15 time frame associated with this analysis?

16 WITNESS JOHNSON: Well, if you look at the
17 table on the far right column, it talks about the
18 year, the peak doses, so we're talking 25,000 to
19 100,000 years.

20 JUDGE ABRAMSON: So this is a 25,000
21 years, so it's after the 1,000 years that has been
22 traditionally used, or that we think the State of Utah
23 used?

24 WITNESS JOHNSON: Yes.

25 JUDGE ABRAMSON: But within the no time

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 limit that we understand is in the current Part 61
2 regulation?

3 WITNESS JOHNSON: That's what the
4 regulation says.

5 JUDGE KELBER: And the assumption is that
6 though the cap has eroded --

7 JUDGE ABRAMSON: Yes, it's gone.

8 JUDGE KELBER: -- and the material that
9 has been deposited, the depleted uranium oxide, stays
10 in place.

11 WITNESS JOHNSON: I believe that's my
12 reading of what this report is. I think Dr. Makhijani
13 would have to confirm that.

14 JUDGE ABRAMSON: We can ask those
15 questions of Dr. Makhijani.

16 JUDGE KELBER: I think we will.

17 MR. LOVEJOY: Would you look at NIRS/PC
18 Exhibit 273, Mr. Johnson?

19 WITNESS JOHNSON: That was 273?

20 MR. LOVEJOY: Two seventy-three.

21 WITNESS JOHNSON: All right, I have the
22 exhibit.

23 MR. LOVEJOY: Over on page 6 I see a
24 reference to license receipt limits. Were you aware
25 that, at one time anyway, there were license receipt

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 limits in the Envirocare license?

2 WITNESS JOHNSON: Yes, there was.

3 MR. LOVEJOY: And do you understand that
4 they were connected, maybe indirectly, to the analyses
5 contained in the Baird report?

6 WITNESS JOHNSON: It was -- it wasn't
7 directly calculated from the Baird report, but the
8 evaluations that were done by the State of Utah
9 ultimately concluded that -- and almost -- that
10 depleted uranium could be accepted up to that limit,
11 yes.

12 MR. LOVEJOY: And those limits would have
13 interfered with use of the site for depleted uranium
14 from enrichment activities, right?

15 WITNESS JOHNSON: I'm sorry?

16 MR. LOVEJOY: it would have prevented use
17 of the site for depleted uranium from enrichment
18 activities, the license receipt limits?

19 WITNESS JOHNSON: I guess I'm not really
20 clear on what your question is.

21 MR. LOVEJOY: Okay. Weren't there limits
22 on the concentrations of uranium that could be
23 received at the Envirocare site?

24 WITNESS JOHNSON: Yes. And I believe it
25 was 370,000 picocuries per gram.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 MR. LOVEJOY: And that would have
2 interfered with use of the site for depleted uranium
3 from enrichment facilities?

4 WITNESS JOHNSON: Yes.

5 MR. LOVEJOY: Okay. Did you revenue this
6 document?

7 WITNESS JOHNSON: I mean I've looked at a
8 couple of the sections that you discussed yesterday,
9 but I have not fully reviewed the document.

10 MR. LOVEJOY: When did you look at this
11 document?

12 WITNESS JOHNSON: When did I look at it?

13 MR. LOVEJOY: Yes.

14 WITNESS JOHNSON: Yesterday when you were
15 discussing it with the LES witnesses.

16 JUDGE ABRAMSON: Where are we going with
17 this, Counselor? I mean what's the history of the
18 current -- of the license at Envirocare got to do with
19 this?

20 MR. LOVEJOY: Well, for one thing, Dr.
21 Palmrose has assumed that anything with a license is
22 okay. But this does actually go to the performance
23 assessments done at Envirocare, done by Utah.

24 JUDGE KELBER: The State of Utah is not
25 here to defend themselves. Do we want to address

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 that?

2 CHAIR BOLLWERK: Let's let the questions
3 go forward and see where we're at.

4 MR. LOVEJOY: Was the first time you
5 looked at this document yesterday?

6 WITNESS JOHNSON: Yes, it is.

7 MR. LOVEJOY: And on page 8 I see the
8 discussion under results of Envirocare discussions --

9 WITNESS JOHNSON: Yes.

10 MR. LOVEJOY: -- of a new Amendment 11 in
11 the year 2000. And it says the new Amendment 11 added
12 provisions to the RML authorizing construction and
13 operation of a new class A disposal cell to which
14 isotope specific LRLs do not apply.

15

16 Do you remember reading that when you
17 reviewed this?

18 WITNESS JOHNSON: No, I don't.

19 MR. LOVEJOY: Okay. But in any event it's
20 your understanding that there is some part of the
21 Envirocare facility to which those LRLs don't apply,
22 right?

23 WITNESS JOHNSON: Well I believe that's
24 correct under the most recent license amendment, that
25 there is no limit for depleted uranium in terms of its

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 isotopic concentration.

2 MR. LOVEJOY: Okay.

3 WITNESS JOHNSON: That's the information
4 that we received from the State of Utah.

5 MR. LOVEJOY: Okay, there's a discussion
6 starting on page 11 entitled number 6, historical
7 views of the U.S. Nuclear Regulatory Commission. You
8 can read any part of this that you wish, but I'm going
9 to draw your attention to specific parts. Did you
10 read this yesterday?

11 WITNESS JOHNSON: I didn't read this
12 particular section.

13 MR. LOVEJOY: Okay. Over on page 12,
14 starting in the middle of the carryover paragraph, it
15 says in 1995 during a scoping process for DOE's
16 Programmatic Environmental Impact Statement concerning
17 long-term management of UF6, the NRC Staff repeated
18 it's opinion that DU308 is a likely chemical form for
19 disposal, however, they also advised DOE that although
20 DU308 could be disposed of in limited quantities in
21 conventional near surface disposal facilities, large
22 quantities such as would be derived from the nation's
23 enrichment tailings inventory suggest the possible
24 need for a unique disposal facility such as a mined
25 cavity or an exhausted uranium mine. Is that

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 statement accurate?

2 WITNESS JOHNSON: I believe it was
3 accurate at the time the information was probably
4 provided to Dr. Croff, but it does not recognize the
5 current fact that Utah is licensed to receive depleted
6 uranium in concentrations and quantities without limit
7 at this point in time.

8 JUDGE ABRAMSON: Mr. Johnson, did you or
9 somebody that you continue to work closely with have
10 involvement with those statements on behalf of the
11 Staff?

12 WITNESS JOHNSON: I personally didn't.

13 JUDGE ABRAMSON: Do you know the people
14 who did?

15 WITNESS JOHNSON: No, I don't.

16 JUDGE ABRAMSON: Were they working with
17 you?

18 WITNESS JOHNSON: No, I don't know them.

19 JUDGE ABRAMSON: So can you substantiate
20 that the Staff said that? I'm not questioning the
21 validity of it, I'm trying to understand what your
22 knowledge is of this particular statement.

23 WITNESS JOHNSON: I don't know the
24 specific circumstances of who Dr. Croft talked to.
25 However, I mean is it somewhat consistent with the

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 position that I talked about in the initial testimony
2 where NRC feels that there may be some low level waste
3 disposal sites that large quantities of depleted
4 uranium would be unacceptable for disposal in near
5 surface techniques, and that you would have to
6 specifically evaluate the particular facility to
7 determine it's suitability for large quantities of
8 depleted uranium.

9 MR. LOVEJOY: Well, do you understand that
10 NRC has changed the position stated here that although
11 DU308 could be disposed of in limited quantities in
12 conventional near surface facilities, large quantities
13 such as would be derived from the nation's enrichment
14 tailings inventory suggest the possible need for a
15 unique disposal facility such as a mined cavity or an
16 exhausted uranium mine.

17 Has that position been changed based on
18 the --

19 WITNESS JOHNSON: Well I believe the
20 position of the NRC was taken by the paragraph that's
21 referenced in Dr. Makhijani's testimony by the
22 executive director of operations where they
23 specifically noted that there may be facilities that
24 large quantities of disposal would not be acceptable,
25 and that you would have to specifically evaluate on a

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 pathway analysis bases the suitability of that waste.

2 But the NRC's position has never been that
3 near surface disposal can never be acceptable.

4 MR. LOVEJOY: has the NRC changed its
5 position based on actions by the Utah regulatory
6 authorities?

7 WITNESS JOHNSON: No, I think it supports
8 that position that if you do site specific analyses
9 and -- it may be that large quantities of depleted
10 uranium can be acceptable.

11 MR. CURTISS: Mr. Chairman, could I just
12 ask a timing question? We're revisiting an issue here
13 that -- we're three and a half hours into this. And
14 we're revisiting an issue that I thought was explained
15 --

16 CHAIR BOLLWERK: Two and a half

17 MR. CURTISS: Seven -- or eight o'clock --

18 CHAIR BOLLWERK: I think we started at
19 eight, but maybe --

20 MR. CURTISS: It seems like three and a
21 half, I guess. We're revisiting an issue that I
22 thought was addressed about an hour and a half ago,
23 and it's explained in this very paragraph under
24 paragraph six on the previous page that the Staff's
25 conclusions and views at the time were based upon

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 their analysis of a humid site.

2 It says that here witnesses explained that
3 in a CEC context. We're revisiting an issue here that
4 I thought was addressed earlier. And Counsel is
5 certainly welcome to do that, but I'd like to have an
6 uninterrupted opportunity for cross examination of
7 their witness.

8 And if we're going to complete that before
9 lunch, it sounds like we may have a late afternoon
10 lunch.

11 CHAIR BOLLWERK: Well -- I think the point
12 has been made. I think the Board understands what
13 your position is and what the Staff's position is. If
14 there's any other questions I don't know where we're
15 going with this, but --

16 MR. LOVEJOY: Okay, let me proceed. Mr.
17 Johnson, does this statement that I just read, does
18 that refer to the humid site?

19 WITNESS JOHNSON: I'm sorry?

20 MR. LOVEJOY: Does the statement I read
21 refer to a humid site.

22 JUDGE ABRAMSON: Wet.

23 WITNESS JOHNSON: Does it eliminate a
24 humid site?

25 MR. LOVEJOY: Does it refer to a humid

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 site?

2 JUDGE ABRAMSON: Wet as opposed to dry.

3 CHAIR BOLLWERK: Not humid as opposed to
4 human, right.

5 WITNESS JOHNSON: Is your question does it
6 eliminate a humid site from consideration?

7 MR. LOVEJOY: Does it speak of a humid
8 site in speaking of what NRC advised DOE?

9 MS. CLARK: Are you asking Mr. Johnson --

10 WITNESS JOHNSON: I don't know what Dr.
11 Croft's basis for these statements -- these are his
12 statements. They aren't mine. They aren't the NRC's.

13 And as I stated before, NRC's position
14 hasn't changed since the executive director of
15 operations statement that there may be some low level
16 waste disposal sites where large quantities of
17 depleted uranium are unacceptable.

18 But that doesn't mean that all near
19 surface disposal facilities would be unacceptable.

20 JUDGE ABRAMSON: I think we can take
21 paragraph 6 for what it says. And it's a report of
22 somebody of what he believes the NRC's view was. This
23 is an Oakridge report by technical people at Oakridge.

24 And I don't think we need to belabor.
25 What this witness says, he didn't make the statements

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 and doesn't know anybody who did.

2 MR. LOVEJOY: Okay. I'll come back to
3 this subject and I'll make every effort to --

4 JUDGE KELBER: All right, let me remind
5 you that the statement contains a speculative
6 sentence. I believe the word is could. It doesn't
7 say it must, it doesn't say it shall.

8 It doesn't express any application. It
9 says it could. This indicates that the Staff was
10 willing to -- to me, that the Staff was willing to
11 look at an application.

12 But the Staff felt that it could not
13 generically approve the disposal in low level waste.
14 That's what the meaning of the word could is. And I
15 think if you intend to return to that statement you
16 will be dragging this out indefinitely.

17 By the time you get finished we may all be
18 radiation resistant.

19 CHAIR BOLLWERK: Let's move on.

20 MR. LOVEJOY: Mr. Johnson, did you review
21 the paragraph starting on -- the first full paragraph
22 on page 13?

23 WITNESS JOHNSON: Which page, 14?

24 MR. LOVEJOY: Page 13, paragraph begins
25 with the word it was noted.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 WITNESS JOHNSON: All right.

2 MR. LOVEJOY: Had you read that
3 previously?

4 WITNESS JOHNSON: Yes, I did.

5 MR. LOVEJOY: Okay. This paragraph states
6 it was noted that the performance assessment for
7 Envirocare's class A disposal cell license amendment
8 is based on the spectrum of low level waste typical of
9 waste accepted at other commercial low level waste
10 disposal sites.

11 And the potentially large amount of DU
12 product now being considered for disposal was not
13 encompassed in this spectrum of waste. Were you aware
14 of that, considering that --

15 WITNESS JOHNSON: Again, this refers to a
16 report prepared in the year 2000, which I had not
17 reviewed. But if Dr. Croft says that that's what the
18 basis of that study was, then I have no basis for
19 objecting to his statement.

20 MR. LOVEJOY: Okay. Were you told
21 differently by anyone about performance assessments at
22 the Envirocare site concerning the source term?

23 WITNESS JOHNSON: Well, I don't know. I
24 think before you can make sense of this conclusion, I
25 think you have to look at what the context of the 2000

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 report was, and the fact that that report didn't
2 change the State of Utah's conclusion that unlimited
3 quantities of depleted uranium could be disposed of at
4 the facility.

5 JUDGE KELBER: Mr. Johnson, let's dispose
6 of this. Could you read the paragraph on page 13 that
7 starts with -- in italics, issue resolution?

8 WITNESS JOHNSON: Okay.

9 JUDGE KELBER: Does the last sentence say
10 that the issue will presumably be resolved between the
11 State of Utah and Envirocare if and when disposal of
12 the DU product at Envirocare is imminent, although the
13 issue could be raised by the generator of the DU
14 product?

15 WITNESS JOHNSON: I really don't
16 understand what Dr. Croff was aiming at here. But, in
17 my view --

18 JUDGE KELBER: Regardless of his
19 intentions, has the issue been resolved between the
20 State of Utah and Envirocare?

21 WITNESS JOHNSON: Yes, and I believe it
22 was resolved in the discussions that we've had and in
23 a letter dated September 19th where the State of Utah
24 indicated it could accept depleted uranium without a
25 quantity limit.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 JUDGE KELBER: So the issue has been
2 resolved in the manner suggested by Dr. Craft?

3 WITNESS JOHNSON: That's my view.

4 JUDGE KELBER: That's mine too.

5 MR. LOVEJOY: Mr. Johnson, has there been
6 a performance assessment which included large
7 quantities of depleted uranium from enrichment
8 facilities?

9 Has there been a performance assessment of
10 the Envirocare site?

11 WITNESS JOHNSON: Yes, and I believe it's
12 based on the 1990 study in which the intruder
13 pathways, which would be the limiting pathways if you
14 were going to evaluate disposal depleted uranium, were
15 eliminated because of the unique site conditions at
16 Envirocare that would make those pathways unrealistic.

17 JUDGE KELBER: As Yogi Bear would say,
18 this is deja vu all over again.

19 WITNESS JOHNSON: I'm sorry?

20 JUDGE KELBER: This is deja vu all over
21 again. That very same statement was made several
22 hours ago this morning. Can we get down to something
23 different?

24 MR. LOVEJOY: Okay. So you wouldn't rely
25 on a study that involved conventional commercial low

1 level waste, is that right?

2 WITNESS JOHNSON: Well, again, I don't
3 know what the purpose of that study was. It could
4 have been that the state of Utah just wanted to look
5 at the kind of wastes that had already been disposed
6 of and do a performance assessment of it.

7 But it clearly did not change their view
8 that large quantities of depleted uranium regarding
9 its disposal. And that's been confirmed to us by the
10 state of Utah.

11 MR. LOVEJOY: Let me ask you to refer to
12 NIRS/PC Exhibit 193. You've spoken about an NRC
13 position paper. And I just want you to confirm that
14 this is the one you're talking about.

15 WITNESS JOHNSON: Okay.

16 MR. LOVEJOY: Do you have 193?

17 WITNESS JOHNSON: Yes, I do.

18 MR. LOVEJOY: This is what's been called,
19 I think, SECY 91-019.

20 WITNESS JOHNSON: Yes.

21 MR. LOVEJOY: And is this the position
22 paper you're talking about?

23 WITNESS JOHNSON: Yes. And I believe
24 that's the position paper that Dr. Makhijani refers to
25 in his prepared testimony.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 MR. LOVEJOY: And it says, and I'm looking
2 at the attachment toward the top, that NRC did not
3 consider disposal of large quantities of depleted
4 uranium from an enrichment facility in the waste
5 streams analyzed.

6 And it's talking about issuing part 61
7 because there was no commercial source at the time.
8 Therefore, analysis of the disposal of depleted
9 uranium tails from an enrichment plant facility at a
10 part 61 low level waste disposal facility should be
11 conducted similar to the pathway analysis conducted in
12 support of part 61.

13 That's the position you're talking about
14 as the Commission's position?

15 WITNESS JOHNSON: Yes.

16 MR. LOVEJOY: Okay. And that hasn't
17 changed, you say.

18 WITNESS JOHNSON: No, it has not changed.

19 MR. LOVEJOY: Okay. Let me just look at
20 a couple more. I need to check whether it's been
21 admitted. Would you look at NIRS/PC Exhibit 256?
22 This has not yet been admitted.

23 This is September 22, 1992 letter by the
24 Committee to Louisiana Energy Services. And we offer
25 it in evidence, just to speed things up.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 CHAIR BOLLWERK: All right. Exhibit 256,
2 which is a letter from John Hickey to WH Arnold,
3 September 22nd, 1992 has been identified for the
4 record.

5 (Whereupon, the above-
6 referenced to document was
7 marked as NIRS/PC Exhibit No.
8 256 for identification.)

9 CHAIR BOLLWERK: And a motion has been
10 made that it be admitted. Any objections?

11 (No verbal response.)

12 CHAIR BOLLWERK: Hearing none, then the
13 NIRS/PC Exhibit 256 is admitted into evidence.

14 (The document referred to,
15 having been previously marked
16 for identification as NIRS/PC
17 Exhibit No. 256 was admitted in
18 evidence.)

19 MR. LOVEJOY: And in this document it says
20 in the third paragraph, referring to our analysis, it
21 says our analysis using methodology similar to that
22 used for the part 61 EIS concludes that near surface
23 disposal of such large quantity of DU tails is not
24 appropriate both because of its potential radiological
25 impact and its chemical toxicity.

1 Was that your understanding of NRC's
2 position?

3 WITNESS JOHNSON: At the time that was the
4 -- yes.

5 MR. LOVEJOY: Has that position changed?

6 MR. HARRIS: Pardon?

7 MR. LOVEJOY: Has that position changed?

8 WITNESS JOHNSON: No. And I think it
9 refers to our analysis, which refers to the studies
10 that were done on the referenced sites that were
11 evaluated.

12 And, for those referenced sites, as has
13 been pointed out earlier, that particular evaluation
14 showed that for that particular reference site large
15 quantities of depleted uranium would not be suitable.

16 MR. LOVEJOY: Okay. Now, would you please
17 look at an Exhibit that I'm going to distribute? It's
18 a January 12th 1993 memo by the Nuclear Regulatory
19 Commission from Richard L. Bangart, subject
20 disposition of depleted uranium form Louisiana Energy
21 Services license application. Have you ever seen this
22 document?

23 WITNESS JOHNSON: I do not recall seeing
24 it.

25 MR. LOVEJOY: Okay. We would mark this as

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 Exhibit, I think, 275, maybe I'm --

2 CHAIR BOLLWERK: No, we're up to 277.

3 MR. LOVEJOY: Okay, 277. Thank you, Your
4 Honor.

5 CHAIR BOLLWERK: Surely.

6 MR. LOVEJOY: I offer the exhibit in
7 evidence.

8 CHAIR BOLLWERK: I need to see a copy of
9 it, where is it?

10 MR. LOVEJOY: Here it is.

11 CHAIR BOLLWERK: There's an exhibit, a
12 letter dated January 12th, 1993 from Mr. -- for Mr.
13 Cunningham from Mr. Bangart that would be marked as
14 NIRS/PC Exhibit 277, marked for identification.

15 (Whereupon, the above-
16 referenced to document was
17 marked as NIRS/PC Exhibit No.
18 277 for identification.)

19 CHAIR BOLLWERK: A motion has been made
20 that it be accepted into evidence. Any objections?

21 (No verbal response.)

22 CHAIR BOLLWERK: Hearing none, then
23 NIRS/PC Exhibit 277 is accepted into evidence.

24

25

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25

(The document referred to, having been previously marked for identification as NIRS/PC Exhibit No. 277 was received in evidence.)

MR. LOVEJOY: Mr. Johnson, I'm looking at the third paragraph of number 277. And I see that the text refers to -- first of all, it refers to LLWM. What does LLWM refer to within the NRC?

WITNESS JOHNSON: I believe that was the division that Richard Bangart was the Director of. He's referring to the organization.

MR. LOVEJOY: Okay. And the second sentence in that paragraph speaking of we, I take it, refers to LLWM. Is that your understanding?

MS. CLARK: I don't believe Mr. Johnson can speak to anything other than the point what appears to be the meaning from the language which, you know, unless you have -- Mr. Johnson, do you have any direct knowledge of the contents of this?

WITNESS JOHNSON: I don't have any direct knowledge. But, in reading it, I think they're again referring to the analyses that were performed at that referenced facility.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 MR. LOVEJOY: Let me just make it brief.
2 The sentence says, we also stated -- which I take it
3 includes Mr. Bangart, Director of that division --
4 that near surface disposal was not acceptable for the
5 large quantities of depleted uranium that would be
6 generated at the CEC.

7 Is that consistent with the position you
8 understood the Commission took at this time?

9 WITNESS JOHNSON: Well, I believe he's
10 referring to, again, the analyses that were performed
11 relative to the CEC facility in which a reference
12 disposal facility had been evaluated.

13 MR. LOVEJOY: Okay. But he doesn't limit
14 his position to a particular site, does he?

15 WITNESS JOHNSON: Well, I don't know.
16 He's also referring to we also stated. And I believe
17 he's referring to previous communications that had
18 occurred internally.

19 MR. LOVEJOY: Do you have NIRS/PC Exhibit
20 247? This has not yet been introduced, I don't think.
21 NIRS/PC Exhibit 247 is a letter on the letterhead of
22 the Nuclear Regulatory Commission from Robert M.
23 Bernero, January 3, 1995 addressed to Charles Bradley
24 within the U.S. Department of Energy.

25 CHAIR BOLLWERK: Do you want that marked

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 for identification?

2 MR. LOVEJOY: I'd like to mark it. I'd
3 like to offer it in evidence.

4 (Whereupon, the above-
5 referenced to document was
6 marked as NIRS/PC Exhibit No.
7 247 for identification.)

8 CHAIR BOLLWERK: All right. Exhibit 247,
9 correct?

10 MR. LOVEJOY: Yes, 247.

11 CHAIR BOLLWERK: So, 247 as identified by
12 Counsel is marked for identification.

13 CHAIR BOLLWERK: A motion has been made
14 that it be admitted into evidence. Any objections?

15 (No verbal response.)

16 CHAIR BOLLWERK: Hearing none, Exhibit
17 247, NIRS/PC Exhibit 247 is admitted into evidence.

18 (The document referred to,
19 having been previously marked
20 for identification as NIRS/PC
21 Exhibit No. 247 was admitted
22 into evidence.)

23 MR. LOVEJOY: Mr. Johnson, in this letter
24 Mr. Bernero says in the bottom part of the second
25 paragraph, and I'll quote, although DU308 could be

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 disposed of in limited quantities in conventional near
2 surface disposal facilities, very large quantities
3 derived from a significant fraction of the Nation's
4 enrichment tailings indicate the need for a unique
5 disposal facility.

6 We have assume that such a large quantity
7 in proper form might well be disposed of in a mine
8 cavity, perhaps an exhausted uranium mine providing
9 better containment for such a large quantity of
10 depleted uranium.

11 Is that your understanding of what the
12 Commission's position was in January of 1995?

13 WITNESS JOHNSON: Well, I believe that the
14 first sentence that you read is consistent with the
15 Commission's policy in that there would be need for a
16 unique disposal facility.

17 And I believe that the Envirocare
18 facility, because of its site characteristics, would
19 be that type of a unique disposal facility. I don't
20 believe that the two sentences you read preclude the
21 possibility of a near surface disposal facility being
22 used if it could demonstrate that it met the
23 performance objectives in subpart C to part 61.

24 JUDGE KELBER: Mr. Lovejoy, is your point
25 that the Staff has been wise in being cautious about

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 determining how large quantities of depleted uranium
2 may be disposed of?

3 MR. LOVEJOY: I think it --

4 JUDGE KELBER: Do you think that they
5 should have been more liberal and allowed it --
6 suggest that it may be disposed of at low level waste
7 anywhere?

8 MR. LOVEJOY: I think the Staff has
9 undertaken studies and historically has determined
10 that near surface disposal of depleted uranium is not
11 appropriate, is not safe. And they've expressed that
12 position --

13 JUDGE KELBER: I don't believe -- I know
14 Dr. Bernero quite well. And I don't believe he said
15 that. I believe that he said that they need unique
16 site characteristics.

17 JUDGE ABRAMSON: So where's the Bernero
18 letter? What document?

19 MR. LOVEJOY: That's number 247, Your
20 Honor. The mine cavity and the exhausted uranium mine
21 referred to by Dr. Bernero would not be near surface
22 sites, would they?

23 WITNESS JOHNSON: That is correct.

24 (Pause.)

25 MR. LOVEJOY: Do you have NIRS/PC Exhibit

1 257 nearby?

2 WITNESS JOHNSON: Yes, this is the Croff
3 Report.

4 MR. LOVEJOY: It's the June 2000 Croff
5 Report. And I believe this was marked and introduced
6 yesterday.

7 CHAIR BOLLWERK: Yes, it's already been
8 admitted.

9 MR. LOVEJOY: Thank you.

10 CHAIR BOLLWERK: That is correct.

11 MR. LOVEJOY: I believe on page ten of
12 this document there's a -- let me just be quick about
13 it. There's a paragraph on page ten entitled NRC
14 views. You might look at that.

15 WITNESS JOHNSON: This is the second full
16 paragraph?

17 MR. LOVEJOY: It's entitled NRC views.

18 WITNESS JOHNSON: All right.

19 MR. LOVEJOY: And it refers to statements
20 by NRC Staff. And at the last sentence it says,
21 however, they also advised DOE that although DU308
22 could be disposed of in limited quantities in
23 conventional near surface disposal facilities, large
24 quantities such as would be derived from Nation's
25 enrichment tailings inventory suggest the possible

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 need for a unique disposal facility such as a mine
2 cavity or an exhausted uranium mine.

3 That's essentially the same as the words
4 in Dr. Bernero's letter, was it not?

5 WITNESS JOHNSON: The site that you
6 referenced is where?

7 MR. LOVEJOY: It's on page ten.

8 WITNESS JOHNSON: All right. I'm reading
9 the paragraph.

10 JUDGE ABRAMSON: Sorry, which Exhibit?

11 WITNESS JOHNSON: The NRC staff views, but
12 that I think is different from what you just quoted.

13 MR. LOVEJOY: Do you have Exhibit 257?

14 WITNESS JOHNSON: Yes.

15 MR. LOVEJOY: Page ten.

16 WITNESS JOHNSON: And it begins, the NRC's
17 views concerning viability of DU disposal as DUF4
18 appear to have been based primarily on an analysis of
19 a hypothetical near surface disposal facility having
20 characteristics typical of a humid southeastern site.

21 In particular this analysis considers
22 intruders scenarios and dissolution and transport by
23 groundwater that are not as credible in arid NTS where
24 future intruder access is likely to be precluded by
25 institutional control and groundwater as found only at

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 significant depths with no recharge from the surface
2 in areas where low level waste disposal occurs. Is
3 that the paragraph you're referring to?

4 MR. LOVEJOY: No. As I said, it's the
5 paragraph headed NRC views.

6 WITNESS JOHNSON: All right, that's the
7 first full paragraph then.

8 MR. LOVEJOY: Yes, headed NRC views. And
9 the question was asked to the last sentence in that
10 paragraph. And it was really quite simple. It was
11 simply to ask whether the statement there is
12 essentially the same as the one we looked at in the
13 letter from Dr. Bernero.

14 JUDGE ABRAMSON: It's actually
15 paraphrasing what Dr. Bernero said.

16 MR. LOVEJOY: It is.

17 JUDGE ABRAMSON: So why don't we keep
18 going and be done with this? That's clear.

19 MR. LOVEJOY: Okay. Would you look at
20 NIRS/PC Exhibit 248? By my notes this has not yet
21 been identified.

22 CHAIR BOLLWERK: That is correct.

23 MR. LOVEJOY: NIRS/PC Exhibit 248 is an
24 October 18th, 2000 letter from Eric Leeds, Special
25 Projects Branch, Division of Fuel Cycle Safety and

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 Safeguards, Office of Nuclear Material Safety and
2 Safeguards addressed to the Department of Energy.

3 We ask that it be identified and admitted
4 in evidence.

5 (Whereupon, the above-
6 referenced to document was
7 marked as NIRS/PC Exhibit No.
8 248 for identification.)

9 CHAIR BOLLWERK: All right, Exhibit 248 as
10 identified by Counsel is marked for identification.

11 CHAIR BOLLWERK: A request has been made
12 to be admitted into evidence. Any objections?

13 (No verbal response.)

14 CHAIR BOLLWERK: Hearing none, then
15 Exhibit -- NIRS/PC Exhibit 248 is admitted into
16 evidence.

17 (The document referred to,
18 having been previously marked
19 for identification as NIRS/PC
20 Exhibit No. 248 was admitted
21 into evidence.)

22 MR. LOVEJOY: Have you seen this letter
23 before?

24 WITNESS JOHNSON: Yes, I have.

25 MR. LOVEJOY: Did you see it in connection

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 with the proceedings in February?

2 WITNESS JOHNSON: I'm sorry?

3 MR. LOVEJOY: Did you see it in connection
4 with the hearing we had in February? I think it came
5 out then.

6 WITNESS JOHNSON: I've been aware of it
7 since the beginning of the licensing process started.

8 MR. LOVEJOY: Okay. Over on page two in
9 the paragraph commencing with the words in the afore
10 mentioned, do you see that paragraph?

11 WITNESS JOHNSON: Yes.

12 MR. LOVEJOY: There's a statement again
13 toward the end that says shallow land, parenthesis,
14 near surface, close parenthesis, disposal was not a
15 likely option because a generic performance assessment
16 indicated the dose requirements of 10CFR part 61 could
17 be exceeded by a wide margin.

18 Was that consistent with the Agency
19 position that you've referred to that came from --

20 WITNESS JOHNSON: Yes, and I believe that
21 this sentence doesn't preclude all near surface
22 disposal facilities. It just refers to the reference
23 site that was evaluated as part of the Claibourne
24 licensing action.

25 MR. LOVEJOY: Okay. You might look at the

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 attachment on page six. This is the carry-over
2 paragraph at the top. Does it not say there -- do you
3 have that page?

4 WITNESS JOHNSON: I have page six, yes.

5 MR. LOVEJOY: Does it not say there, and
6 I quote, in addition, an arid site will change the
7 performance assessment and dose results. However, the
8 magnitude of the dose from the generic assessment
9 exceeded the regulatory limits by a significant
10 margin. It says that, right?

11 WITNESS JOHNSON: Yes, that's what it
12 says.

13 MR. LOVEJOY: Okay. And is that a
14 reference to the assessments conducted in the
15 Claibourne case?

16 WITNESS JOHNSON: Yes, it is. I believe
17 the Sandia report also looked at the reference site
18 under some arid conditions as well.

19 MR. LOVEJOY: Okay. Now, let me move to
20 the dollars and cents and just ask who is the witness
21 I should query about the cost estimates?

22 WITNESS MAYER: That's probably me.

23 MR. LOVEJOY: Okay. So, as you understand
24 it, Ms. Mayer, the cost estimates that have been
25 submitted here were based on the WCS site and the

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 Envirocare site, is that correct?

2 WITNESS MAYER: That is correct.

3 MR. LOVEJOY: There were no other sites
4 whose costs were considered, correct?

5 WITNESS MAYER: That is correct.

6 MR. LOVEJOY: Okay. And the one dollar
7 and 14 cents was derived from calculations based on
8 information from WCS, correct?

9 WITNESS MAYER: It was based on
10 information from WCS informed by other information
11 provided by Envirocare.

12 MR. LOVEJOY: And what other information?

13 WITNESS MAYER: There was an informal
14 estimate of 75 dollars per cubic foot provided to LES
15 from Envirocare, I believe, in a phone call.

16 MR. LOVEJOY: And that estimate was with
17 regard to conventional low level waste from reactors,
18 wasn't it? Decommissioning waste.

19 WITNESS MAYER: I was not on that phone
20 call, so I can't answer that question. But it's my
21 recollection that that's what Mr. Krich said
22 yesterday.

23 MR. LOVEJOY: Was that the first you found
24 out about that, that that was an estimate with respect
25 to reactor decommissioning waste?

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 WITNESS MAYER: That was probably the --
2 yes.

3 MR. LOVEJOY: Okay. And you also saw --
4 do you have LES Exhibit 103? Why don't you look at
5 that? That's the letter from Mr. Rafati.

6 (Pause.)

7 WITNESS MAYER: Okay. We've located it.

8 MR. LOVEJOY: You got this letter from
9 LES, correct?

10 WITNESS MAYER: Yes, it was provided in
11 one of their submissions.

12 MR. LOVEJOY: Now, did you check what cost
13 estimates for depleted U308 were contained in the
14 license application at the time of Mr. Rafati's
15 letter?

16 WITNESS MAYER: Not specifically. At that
17 point we had seen the dollar 14 cost estimate and we
18 had seen the earlier estimates.

19 MR. LOVEJOY: The earlier estimates
20 submitted in connection with the license application?

21 WITNESS MAYER: That is correct.

22 MR. LOVEJOY: Well, have you since checked
23 what the cost estimates contained in the license
24 application were at the time of this letter?

25 WITNESS MAYER: To the best of my

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 knowledge, the license application at the time this
2 letter was written contained the dollar 47 to two
3 dollar and some odd cent estimate.

4 However, there were other documents
5 floating around that we had seen that had the dollar
6 14 per KgU estimate.

7 MR. LOVEJOY: I see. Well, the documents
8 that were floating around, were they in the license
9 application in February?

10 WITNESS MAYER: Not to the best of my
11 knowledge, no.

12 MR. LOVEJOY: Okay. And you don't know if
13 Mr. Rafati had seen those or meant to refer to them,
14 do you?

15 WITNESS MAYER: I do not.

16 MR. LOVEJOY: Okay. And the numbers that
17 were in the application when Mr. Rafati wrote his
18 letter were well in excess of a dollar 14, correct?

19 WITNESS MAYER: They were in excess. I'm
20 not entirely sure what you mean by well in excess.

21 MR. LOVEJOY: Well, we can do the math.

22 (Pause.)

23 MR. LOVEJOY: Do you have NIRS/PC Exhibit
24 188?

25 WITNESS MAYER: Yes.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 MR. LOVEJOY: Would you look at the
2 spreadsheet that relates to waste disposal? I'm sure
3 you're familiar with it.

4 WITNESS MAYER: In 188?

5 MR. LOVEJOY: Well, 188 ought to be the
6 April 8th, 2005 letter that's proprietary.

7 WITNESS MAYER: I'm sorry. I've found it,
8 yes.

9 MR. LOVEJOY: Okay. Do you have the
10 spreadsheet?

11 WITNESS MAYER: Yes, on page LES-PRO
12 00778.

13 MR. LOVEJOY: Does this tell you anything
14 about what the disposal cost per KgU would be in case
15 grouting is used?

16 WITNESS MAYER: There are numbers on this
17 page that relate to grout. I am unsure whether they
18 are the appropriate ones to be used in the case of
19 grouting given what Mr. Krich said yesterday about the
20 fact that grouting would be done at the disposal site.

21 In other words, as I understand the way
22 they derive their cost estimate, they use the top two
23 rows of this table that show the density of [REDACTED] grams
24 per cubic centimeter and [REDACTED] grams per cubic
25 centimeters and took the average in the second to the

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 last column resulting in an approximate cost of a
2 dollar 4, I assume, once you correct for rounding.

3 MR. LOVEJOY: So, in saying, as the Staff
4 has done, that a dollar 14 is a good number, you're
5 assuming that grouting is not necessary?

6 WITNESS MAYER: We're not making an
7 assumptions about whether grouting is necessary or
8 not.

9 MR. LOVEJOY: But don't those numbers
10 assume that grouting is not necessary?

11 WITNESS MAYER: They don't assume whether
12 or not grouting is necessary or not. The top two
13 lines refer to the density of the material.

14 JUDGE ABRAMSON: Let's clarify this. They
15 do the calculation assuming that grout's not part of
16 the calculation, is that right?

17 WITNESS MAYER: That is correct.

18 JUDGE ABRAMSON: Okay. Thanks.

19 MR. LOVEJOY: And the calculation below
20 them shows [REDACTED] with grout, correct?

21 WITNESS MAYER: That is what the note in
22 the last column says.

23 MR. LOVEJOY: And you don't know whether
24 grouting is necessary or will not be necessary?

25 WITNESS MAYER: I do not.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 MR. LOVEJOY: Okay. We're finished.

2 JUDGE ABRAMSON: Good work. It's 11
3 o'clock. We may finish this topic before lunch.

4 CHAIR BOLLWERK: All right. At this point
5 then are there any additional questions?

6 MR. CURTISS: Yes, there are from LES.

7 CHAIR BOLLWERK: All right.

8 MS. CLARK: A few from the Staff as well.

9 JUDGE ABRAMSON: Do you want to wait? Do
10 you want to let LES go first?

11 MR. CURTISS: Since it's the Staff's
12 panel, I'll defer to this. They may cover some of the
13 same questions.

14 EXAMINATION BY MS. CLARK OF

15 DONALD PALMROSE

16 JAMES PARK

17 JENNIFER MAYER

18 CRAIG DEAN

19 TIMOTHY C. JOHNSON

20 MS. CLARK: Earlier, Dr. Palmrose, Mr.
21 Lovejoy characterized your statements to say that any
22 facility with a license is okay to accept disposal.

23 Isn't it correct to say that a facility
24 that's licensed but has a disposal limit that would
25 prohibit large quantities of DU, would you say that

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 that's okay for disposal?

2 WITNESS PALMROSE: No, I would not. There
3 would be a limit to the amount of material that could
4 go in there. So it would not be unlimited.

5 MS. CLARK: So, did you mean that any
6 facility that's licensed to accept quantities of DU
7 that would be expected to be generated by the NEF?

8 WITNESS PALMROSE: Yes. The disposal site
9 would have to be able to have the capacity to take all
10 the material from the NEF.

11 MS. CLARK: Under its license, correct?

12 WITNESS PALMROSE: Yes.

13 MS. CLARK: Thank you. Mr. Johnson, I'd
14 like to refer you back to NIRS/PC Exhibit 273. This
15 is the Croff Report. And, if you'll look on page
16 three.

17 WITNESS JOHNSON: All right.

18 MS. CLARK: Now, Mr. Lovejoy was asking
19 you about a limit for an activity limit for disposal
20 of depleted uranium. When I look at this table, under
21 the first issue which is entitled license receipt
22 limits, the evaluation states, as a result of a new
23 amendment to the Envirocare license, DU products are
24 acceptable for design in the class A cell at
25 Envirocare because activity limits do not apply to DU

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 placed into the class A cell.

2 Now, based on this information, does the
3 old limit that he referred to have any application to
4 disposal of waste that will be generated by the NEF?

5 WITNESS JOHNSON: Could you go back and
6 point the sentence that you're referring to again?

7 MS. CLARK: It's the first block under
8 evaluation.

9 WITNESS JOHNSON: Excuse me, what is that
10 again?

11 MS. CLARK: Have you read that?

12 WITNESS JOHNSON: What page?

13 MS. CLARK: Page three.

14 WITNESS JOHNSON: Page three.

15 (Pause.)

16 WITNESS JOHNSON: All right, under the
17 evaluation?

18 MS. CLARK: Correct.

19 WITNESS JOHNSON: Yes.

20 MS. CLARK: Okay. Given that statement,
21 is it your view that the activity limit that Mr.
22 Lovejoy referred to will have any relevance to the
23 disposal of DU generated by the NEF?

24 WITNESS JOHNSON: No, I do not. But I
25 believe, subsequent to this report being prepared, the

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 license was changed where there now is no specific
2 entity or entry for depleted uranium as a
3 concentration limit.

4 MS. CLARK: So, in other words, even if at
5 one time there was a limit, there is no longer?

6 WITNESS JOHNSON: Right. The previous
7 limit was 370 nanocuries per gram. And that limit has
8 been removed.

9 MS. CLARK: Thank you. Mr. Lovejoy
10 referred to a series of letters. I don't want to go
11 back and refer to all of them. But I'd like to call
12 your attention again to NIRS/PC Exhibit 277.

13 (Pause.)

14 WITNESS JOHNSON: All right.

15 MS. CLARK: On the first page he referred
16 you to a sentence in the third paragraph that states,
17 we also stated that near surface disposal was not
18 acceptable for the large quantities of depleted
19 uranium that would be generated at the CEC.

20 Now, is that statement consistent with
21 what you've been testifying all along?

22 WITNESS JOHNSON: Yes, it is. I mean,
23 this statement I read as being narrowly applying to
24 the evaluation that was done for the Claibourne
25 Enrichment Facility which looked at a reference site

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 having unit site characteristics.

2 MS. CLARK: And hasn't the NRC always
3 taken the position that for that generic site near
4 surface disposal of large quantities of DU would not
5 be acceptable?

6 WITNESS JOHNSON: Yes.

7 MS. CLARK: Thank you. And lastly I'd
8 like you to refer to NIRS/PC Exhibit 248.

9 (Pause.)

10 WITNESS JOHNSON: Okay, I have it.

11 MS. CLARK: Okay. This consists of a
12 letter dated October 18th, 2000. But what I'd like
13 you to do is turn to the next document, which is
14 entitled review and comment on DUF6 materials use
15 roadmap.

16 WITNESS JOHNSON: Yes.

17 MS. CLARK: Now, given the title of this
18 document, is it your understanding that this is part
19 of the letter that was written by Eric Leeds?

20 WITNESS JOHNSON: Yes.

21 MS. CLARK: Okay. Thank you. That's it.

22 CHAIR BOLLWERK: All right. Then let's
23 turn to LES then.

24

25

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25

EXAMINATION BY MR. CURTISS OF

DONALD PALMROSE

JAMES PARK

JENNIFER MAYER

CRAIG DEAN

TIMOTHY C. JOHNSON

MR. CURTISS: I'll be real quick here because we've been at it for three hours now. Ms. Mayer, could I ask you, following-up on the questions about the LES cost estimate, were you present during the testimony of Mr. Krich yesterday?

WITNESS MAYER: Yes, I was.

MR. CURTISS: And did he explain the dollar 14 estimate for disposal of DU as U308?

WITNESS MAYER: Yes, he did.

MR. CURTISS: And did you understand that the explanation of that amount was the cost that would be paid per KgU and the grouting decision would be a decision made by the site operator independent of what they paid?

WITNESS MAYER: That is correct.

MR. CURTISS: And so, does the issue of grouting have any impact at all on what LES would have to pay and, I should say, financially assure for purposes of DU disposal?

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 WITNESS MAYER: Could you repeat the
2 question?

3 MR. CURTISS: If it's a decision of the
4 site operator as to whether to grout and the dollar
5 14, as Mr. Krich explained yesterday, is the amount
6 that they'll have to pay, and that decision is made
7 subsequently by the site operator and not charged,
8 isn't that the basis for the estimate that he
9 provided?

10 WITNESS MAYER: That is the basis for the
11 estimate that he provided.

12 MR. CURTISS: Now, I want to go back just
13 briefly to also review the testimony that he gave
14 yesterday on why the ■ dollar per cubic foot or a
15 dollar 14 for KgU is conservative. Did you hear that
16 testimony?

17 WITNESS MAYER: I did.

18 MR. CURTISS: And did you understand,
19 based upon the references to various exhibits,
20 including LES Exhibit 108, which was the DOE webpage
21 with the estimate of seven dollars to 31 dollars and
22 the DOE -- the LES comparison of the DOE cost
23 estimate, the LMI report, which is Exhibit 87, did you
24 understand based upon subsequent information that the
25 ■ dollar estimate is, as Mr. Krich said in the

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 application when that was presented, in fact a
2 conservative estimate?

3 WITNESS MAYER: I did. I also find the
4 estimate conservative based on my own experience in
5 looking at disposal costs.

6 MR. CURTISS: And what is that experience?

7 WITNESS MAYER: I have prepared -- I have
8 reviewed other decommissioning cost estimates. And I
9 have prepared independent estimates of
10 decommissioning.

11 MR. CURTISS: So the estimates and the
12 references that were discussed by Mr. Krich yesterday
13 provide further support for the proposition they did,
14 per cubic foot estimate is conservative?

15 WITNESS MAYER: They do.

16 MR. CURTISS: And it at least has a
17 reasonable basis?

18 WITNESS MAYER: Yes.

19 MR. CURTISS: Okay, thank you. Mr.
20 Johnson, let me see if I can cut through a lot of what
21 we discussed over the last three hours. You, I think,
22 said, if I can recall the discussion early on, that
23 the reference site analysis in the CEC case was a
24 humid site.

25 WITNESS JOHNSON: Yes.

1 MR. CURTISS: In fact, a southeastern
2 site, as I recall. And I don't have all of the
3 parameters.

4 WITNESS JOHNSON: It was intended to be a
5 site that would be located in the Louisiana compact.

6 MR. CURTISS: Fundamentally. And that's
7 because the LES facility CEC was proposed to be
8 located in Louisiana, isn't that correct?

9 WITNESS JOHNSON: Correct.

10 MR. CURTISS: Okay. And just in terms of
11 sort of a layman's view of this, which of course I am,
12 the site characteristics for a dry site would be
13 analyzed differently and likely lead to a different
14 result, isn't that correct?

15 WITNESS JOHNSON: I'm sorry?

16 MR. CURTISS: The analysis of a dry site
17 would likely lead to a different result than the
18 analysis of a humid site.

19 MR. LOVEJOY: Objection. The question is
20 hopelessly speculative.

21 MR. CURTISS: Well, then let me ask the
22 question --

23 WITNESS JOHNSON: I believe the answer to
24 that is it would lead to different results because of
25 the different scenarios.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 MR. CURTISS: Wait, wait, wait.

2 CHAIR BOLLWERK: Wait. Try again.

3 MR. CURTISS: All right. I'm going to ask
4 the question differently because we had a string of
5 exhibits here from the last two and a half hours,
6 including the Bangart letter from January 12th, 1993,
7 the Bernero letter from January 3rd, 1995.

8 I'm surprised we didn't have more in the
9 alphabetical list here as we were working through
10 these. The CEC FEIS of August 1994, the Croff report,
11 the October 18th, 2000 Leeds letter, a whole string of
12 exhibits which were cited for the -- June 2000 Croff
13 report -- for the proposition that you can't dispose
14 of DU in a dry site.

15 Isn't it a fact, Mr. Johnson, that the
16 analysis upon which those conclusions were based was
17 in fact the original CEC evaluation of the humid site?

18 WITNESS JOHNSON: I'm not sure that that
19 is correct.

20 MR. CURTISS: Okay. In the case of a dry
21 site, such as Envirocare, compared to a humid site
22 evaluation, are there likely going to be variables
23 that would be different in terms of the key inputs to
24 the model?

25 MR. LOVEJOY: Objection.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 WITNESS JOHNSON: Well, there would be
2 variables --

3 CHAIR BOLLWERK: Hold on a second. When
4 he makes an objection, you have to stop. Okay. Go
5 ahead.

6 MR. LOVEJOY: I'm sorry, of course if
7 you're analyzing in a different place things will be
8 different. If the question is, is that so, and he can
9 say yes, fine.

10 But it's just hopelessly open-ended to ask
11 an expert won't things be different if you have a
12 different place. It just asks for speculation.

13 CHAIR BOLLWERK: Well, I guess if the
14 first answer is yes, then the follow-up question can
15 be, in what ways would that be -- I mean --

16 MR. LOVEJOY: All right. I'm sorry. I
17 withdraw the objection. Let's proceed.

18 CHAIR BOLLWERK: All right.

19 MR. CURTISS: We'll pursue this with NIRS
20 witnesses. I don't have any further questions.

21 CHAIR BOLLWERK: All right. Do you have
22 any additional questions, Mr. Lovejoy?
23
24
25

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25

EXAMINATION BY MR. LOVEJOY OF

DONALD PALMROSE

JENNIFER MAYER

TIMOTHY JOHNSON

JAMES PARK

CRAIG DEAN

MR. LOVEJOY: Ms. Mayer, if you're going to go forward on the assumption that Envirocare is going to pay for the grouting, wouldn't you want to go check with them and make sure that they're willing to pay that?

WITNESS MAYER: I don't know that Envirocare is going to go forward with the grouting. My impression is that the cost that they have quoted or the costs that are being considered represent the cost they would pay to take the material.

Whether they incur any cost after that is entirely their business operations and not within the realm of this as I understand it.

MR. LOVEJOY: So, as to grouting, you're assuming that they'd be happy to pay for that?

WITNESS MAYER: I'm non-traditional even sure they're going to grout the material. But, if they charge a cost to take the material, they will incur many costs to process, the cost to put it in the

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 ground, the cost to dig the thing, the cost to have
2 the cell in the first place.

3 I'm assuming that the cost, if they choose
4 to grout the material, would fall within those sort of
5 business costs and not be in the realm of the
6 decommissioning cost estimate.

7 MR. LOVEJOY: So, you are assuming that if
8 grouting is necessary they will pay for it?

9 WITNESS MAYER: That is correct.

10 MR. LOVEJOY: That's all I have.

11 CHAIR BOLLWERK: Any other questions from
12 Staff or LES?

13 (No verbal response.)

14 CHAIR BOLLWERK: Thank you all for your
15 service to the Board and your testimony.

16 JUDGE ABRAMSON: Stick around.

17 CHAIR BOLLWERK: I guess that's probably
18 good advice to everyone. It's now about 11:20.
19 Should we take a quick break? No? Let's get Dr.
20 Makhijani on the Board.

21 (Pause.)

22 CHAIR BOLLWERK: You had a statement to
23 make. And we'll take that in a second. Wait until
24 everybody gets settled here.

25 (Pause.)

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 CHAIR BOLLWERK: Let's -- can I talk with
2 the lawyers here and it won't interfere with anything
3 you're doing here.

4 (No verbal response.)

5 CHAIR BOLLWERK: Let's do a compute
6 things. You had a statement you wanted to make?

7 MR. CURTISS: Yes. Depending upon the
8 brevity of Dr. Makhijani's answers, I can complete my
9 cross examination of him within three hours.

10 CHAIR BOLLWERK: Within three hours?

11 MR. CURTISS: And I'd like to do it in an
12 uninterrupted way. It may not take that long. But
13 I'd like to have the opportunity, having spent the
14 last three hours and 15 minutes, to have a detailed
15 discussion with Dr. Makhijani about the modeling he
16 has done.

17 CHAIR BOLLWERK: Okay.

18 MR. CURTISS: And I am prepared to
19 proceed. But I'd like to do that in some sort of
20 uninterrupted way.

21 CHAIR BOLLWERK: Okay.

22 JUDGE ABRAMSON: Let me ask Mr. Lovejoy,
23 are you intending to start with new testimony from Dr.
24 Makhijani related to --

25 MR. LOVEJOY: Anything.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 JUDGE ABRAMSON: Anything?

2 MR. LOVEJOY: There is going to be some
3 testimony, yes.

4 JUDGE ABRAMSON: How long do you think
5 that will take?

6 MR. LOVEJOY: It really depends on Dr.
7 Makhijani. But it could, you know, ballpark 20
8 minutes.

9 JUDGE ABRAMSON: All right. Let's at
10 least get that part on the record before we deal with
11 --

12 CHAIR BOLLWERK: All right. And then,
13 does the Staff have an estimate of how long their
14 cross examination will be?

15 MS. CLARK: Well, in light of the three
16 hour estimate from LES, I expect it won't be very
17 much.

18 CHAIR BOLLWERK: All right. Then, just
19 for our purposes, we would be looking then potentially
20 -- do you anticipate any surrebuttal after that?

21 MR. CURTISS: We did ask for the
22 opportunity for our panel to be called for surrebuttal
23 a couple days ago. And it depends upon the outcome of
24 this.

25 But, I'm trying to make this as efficient

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 as possible.

2 CHAIR BOLLWERK: I understand.

3 MR. CURTISS: We have to assume most of
4 the morning in a discussion that I think the record
5 needs to be clarified on. And this is the opportunity
6 to do that.

7 It may not take three hours. But I want
8 to know if that time frame is available for that
9 uninterrupted examination.

10 CHAIR BOLLWERK: So the parties would tend
11 to -- what I'm hearing, I see that you all perhaps
12 think that by in the neighborhood of three to four
13 o'clock we may be ready to move to the last item, does
14 that seem reasonable?

15 MR. CURTISS: Yes.

16 CHAIR BOLLWERK: All right. So, if we
17 were to put a message on that said then we anticipate
18 at four o'clock or later starting the last panel, that
19 would be appropriate?

20 (Whereupon, the above-entitled matter
21 went off the record at 11:10 a.m. and
22 went back on the record at 11:12 a.m.)

23 CHAIR BOLLWERK: Back on the record.
24 Before we start with Dr. Makhijani, is there anything
25 else the parties have procedurally?

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 (No verbal response.)

2 CHAIR BOLLWERK: All right. Welcome back,
3 Dr. Makhijani. You remain under oath as having been
4 sworn in previously.

5 Whereupon,

6 ARKUN MAKHIJANI
7 was called as a witness by Counsel for the Intervenor
8 and, having been previously duly sworn, assumed the
9 witness stand, was examined and testified as follows:

10 CHAIR BOLLWERK: And I believe we need to
11 get your testimony in this morning.

12 And you all had yesterday been kind enough
13 to give us copies of the most recent revision of his
14 rebuttal testimony. I think everyone here has that.
15 And as long as we're all right with the court
16 reporter, I think we're in good shape.

17 MR. LOVEJOY: VERY good. I hope we are.
18 Dr. Makhijani, do you have before you two copies of
19 direct testimony and two copies of revised rebuttal
20 testimony on your behalf?

21 WITNESS MAKHIJANI: I've given one to the
22 court reporter already.

23 MR. LOVEJOY: You've turned them in, okay.

24 CHAIR BOLLWERK: Are you all set? Do you
25 have what you need?

1 MR. LOVEJOY: Yes.

2 CHAIR BOLLWERK: Good, thank you.

3 MR. LOVEJOY: Do you in any event have any
4 copies of your revised direct and revised rebuttal
5 testimony?

6 WITNESS MAKHIJANI: I have one.

7 MR. LOVEJOY: Okay. Looking at your
8 direct testimony, could you just identify the date in
9 the upper-right corner?

10 WITNESS MAKHIJANI: My direct testimony is
11 dated October 18th, 2005.

12 MR. LOVEJOY: Okay. Is that testimony,
13 testimony that you're prepared under oath before this
14 Board in this proceeding?

15 WITNESS MAKHIJANI: Yes, I am. I'm not
16 going to repeat the caveats.

17 MR. LOVEJOY: Okay. We offer that direct
18 testimony for admission into the record.

19 CHAIR BOLLWERK: All right. Any
20 objections?

21 (No verbal response.)

22 CHAIR BOLLWERK: There being none, then
23 the revised direct testimony of Dr. Makhijani
24 concerning LES' disposal strategy and cost estimate
25 dated October 18th, 2005 is adopted into the record as

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 if read.

2 (Whereupon, the revised prefiled direct
3 testimony of Dr. Arkun Makhijani was bound into the
4 record as if having been read.)**

5

6

7

8

9

10

11

12

13

14

15

16

17

18

19

20

21

22

23

24

25

**UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION**

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of

Docket No. 70-3103

Louisiana Energy Services, L.P.

ASLBP No. 04-826-01-ML

National Enrichment Facility

**REVISED DIRECT TESTIMONY OF DR. ARJUN MAKHIJANI
IN SUPPORT OF NIRS/PC CONTENTIONS EC-3/TC-1, EC-5/TC-2, AND EC-6/TC-3
CONCERNING LES'S DISPOSAL STRATEGY AND COST ESTIMATE**

Q1. Please state your name, affiliation, and qualifications.

A1. My name is Dr. Arjun Makhijani. Among my credentials is a doctorate in Engineering from the Electrical Engineering Department of the University of California at Berkeley (1972, specialization: the application of plasma physics to controlled nuclear fusion). I am President of the Institute for Energy and Environmental Research (IEER), an organization, which, among its activities, assesses environmental damage from the operation of nuclear fuel facilities, and estimates

the compliance of those facilities with environmental regulations, mainly relating to radioactive materials and wastes and to radioactivity exposures. In addition, I am, in my personal capacity as part of a non-IEER team, currently one of the principal personnel who have been chosen by the U.S. government to carry out an audit of the radiation dose reconstruction program that is being done for nuclear weapons complex workers who have applied for compensation under the Energy Employees Occupational Illness Compensation Program Act.

I have authored and co-authored numerous studies, articles, and books examining nuclear-related issues, including emissions from nuclear weapons plants, nuclear fuel cycle related issues, nuclear weapons production and testing, and nuclear waste. Among other things, I was the principal author of the first ever independent source term reconstruction from a nuclear weapons plant (the Feed Materials Production Center), done in 1989.

Chapters that I have co-authored include "Dismantling the Bomb," and "Nuclear Waste Management and Environmental Remediation," in *Atomic Audit: The Costs and Consequences of U.S. Nuclear Weapons Since 1940*, Stephen I. Schwartz, editor, Brookings Institution Press, Washington, D.C., 1998. I am also a co-author of "The Production of Nuclear Weapons and Environmental Hazards," a chapter appearing in *Nuclear Wastelands: A Global Guide to Nuclear Weapons Production and its Health and Environmental Effects*, MIT Press, Cambridge, Massachusetts, 1995. I am principal editor of this book.

I have served on the Radiation Advisory Committee of the Science Advisory Board of the United States Environmental Protection Agency (EPA), and on the EPA's advisory subcommittee on Radiation Cleanup Standards of the National Advisory Committee on Environmental Policy and

Technology. From 1997 to 2002, I was part of an IEER team that monitored three independent audits of the compliance of the Los Alamos National Laboratory in New Mexico with radiation regulations under the Clean Air Act, specified in 40 CFR 61, Subpart H. The audits and the IEER monitoring of the audits were the result of a federal consent decree issued after the court found Los Alamos National Laboratory to be in violation of 40 CFR 61, Subpart H.

My current resume is attached to this testimony.

Q2. What is the purpose of your testimony today?

A2. I am testifying in support of three contentions, which were advanced in this proceeding by Nuclear Information and Resource Service and Public Citizen. The first contention, EC-3/TC-1 -- Depleted Uranium Hexafluoride Storage and Disposal, states as follows:

CONTENTION: Petitioners contend that Louisiana Energy Service, L.P., (LES) does not have a sound, reliable, or plausible strategy for private sector disposal of the large amounts of radioactive and hazardous Depleted Uranium Hexafluoride ("DUF6") waste that the operation of the plant would produce in that the statement that "discussions have recently been held with Cogema concerning a private conversion facility" (ER 4.13-8) is without substance.

The second contention, EC-5/TC-2 -- Decommissioning Costs, states as follows:

CONTENTION: Louisiana Energy Services, L.P., (LES) has presented estimates of the costs of decommissioning and funding plan as required by 42 U.S.C. 2243 and 10 C.F.R. 30.35, 40.36, and 70.25 to be included in a license application. See Safety Analysis Report 10.0 through 10.3; ER 4.13.1. Petitioners contest the sufficiency of such presentations as based on the lack of any relevant estimate of the cost of converting and disposing of depleted uranium, given it does not rely upon the three examples -- the 1993 CEC estimate, the LLNL report, and the UDS contract --cited in its application.

LES has presented additional estimates for the costs of deconversion, transportation, and disposal of depleted uranium for purposes of the decommissioning and funding plan required by 42 USC 2243 and 10 CFR 30.35, 40.36, and 70.25. See LES Response to RAI

dated January 7, 2005. Such presentations are insufficient because they contain no factual bases or documented support for the amounts of the following particular current LES estimates, i.e., \$2.69/kgU for conversion, \$1.14/kgU for disposal, \$0.85/kgU for transportation, and a total of \$5.85/kgU including contingency, and cannot be the basis for financial assurance.

The third contention, EC-6/TC-3 -- Costs of Management and Disposal of Depleted UF₆, states as follows:

CONTENTION: Petitioners contend that the Louisiana Energy Services, L.P., (LES) application seriously underestimates the costs and the feasibility of managing and disposing of the Depleted Uranium Hexafluoride ("DUF6") produced in the planned enrichment facility in that:

(E) A problem arises with respect to disposal of CaF₂. It is not known whether the CaF₂ will be contaminated with uranium. Such contamination would prevent the resale of the CaF₂ and would require that such material be disposed of as low-level waste.

(G) LES's "preferred plausible strategy" for the disposition of depleted UF₆ is the possible sale to a "private sector conversion facility" followed by disposal of deconverted U₃O₈ in a "western U.S. exhausted underground uranium mine." (ER 4.13-8). Such a conversion strategy cannot be accepted as plausible given that no such conversion facility exists nor is it likely to be built to suit LES's timing and throughput requirements.

(I) The "engineered trench" method of waste disposal proposed by LES is not likely to be acceptable (ER 4.13-11, -19) if DUF₆ is not considered low level waste.

Q3. What materials have you reviewed in preparation for your testimony?

A3. Part of my preparation was working with and assigning tasks to Dr. Brice Smith, a senior scientist at IEER, and our librarian Lois Chalmers. I reviewed various parts of the LES license application, including the Environmental Report and the Safety Analysis Report, submitted by LES to the Commission in support of its application, that relate to the depleted uranium to be generated by the facility, the management of that material, and its deconversion and disposal. I also reviewed various documents prepared by LES and persons working for LES that shed light on LES's plans

for disposition of depleted uranium. I have also reviewed documents on uranium disposal options and uranium health effects including those from scientific journals as well as publications from national and international bodies such as the International Commission on Radiological Protection, the National Research Council of the National Academy of Sciences, the OECD Nuclear Energy Agency, the Royal Society, the International Atomic Energy Agency, and the World Health Organization.

In addition, I have reviewed the Draft and Final Environmental Impact Statement for the proposed National Enrichment Facility prepared by the Nuclear Regulatory Commission (NUREG-1790) (NIRS/PC Ex. 152) (NRC Staff Ex. 36) as well as the Final Environmental Impact Statement for the proposed Claiborne Enrichment Facility (NUREG-1484) (NIRS/PC Ex. 58). I have revisited the history of 10 CFR 61.55 as well as other parts of 10 CFR 61. I have reviewed several related Department of Energy documents, such as the Environmental Impact Statements for the proposed Portsmouth and Paducah conversion plants (DOE/EIS-0359 and DOE/EIS-0360) (LES Ex. 16, 17) and the 1999 DOE Programmatic Environmental Impact Statement for Alternative Strategies for the Long-Term Management and Use of Depleted Uranium Hexafluoride (DOE/EIS-0269) (LES Ex. 18). I have also reviewed some of the supporting documents for those studies such as the 1997 Lawrence Livermore National Laboratory Engineering and Cost Analyses. (NIRS/PC Ex. 55, 56).

I have studied these and related areas for many years, and so cannot make a full list of all the materials I have reviewed that may shed light on the questions before the Board. For a further listing of documents reviewed as part of my work in this case in collaboration with Dr. Smith, I refer you to the reference lists in the following reports:

Makhijani and Smith, Costs and Risks of Management and Disposal of Depleted Uranium from the National Enrichment Facility Proposed to be Built in Lea County, New Mexico by

LES, November 24, 2004. (NIRS/PC Ex. 190) (See particularly 3-19 concerning uranium health risks, 19-29 concerning regulatory aspects and generic analyses of near-surface disposal, 30-34 concerning deconversion and byproducts thereof, and 35-51 concerning factors affecting costs and cost estimates).

Makhijani and Smith, *Update to Costs and Risks of Management and Disposal of Depleted Uranium from the National Enrichment Facility Proposed to be Built in Lea County New Mexico* by LES by Arjun Makhijani, PhD. and Brice Smith, Ph.D. based on information obtained since November 2004, July 5, 2005. (NIRS/PC Ex. 224) (See particularly 1 (summary), 2-6 concerning the need to analyze specific disposal options, 7-8 concerning the difficulties of the Envirocare site, 8-22 concerning the difficulties of the WCS site, 22-24 concerning the probable need for geologic disposal).

Both of these reports have been filed in this proceeding on the indicated dates and are incorporated by reference here. These works form the primary technical basis for my conclusions as presented in this testimony. I asked Dr. Brice Smith to draft my testimony for me based on the above materials, my deposition testimony, and an outline we developed together. I reviewed, edited, and approved the text of this testimony while on travel.

Q4. What is your understanding of the requirements for a plausible strategy as it relates to the disposition of the depleted uranium hexafluoride that would be generated by the proposed National Enrichment Facility?

A4. In the Claiborne Enrichment Center case the Atomic Safety and Licensing Board ruled that

Thus, in assessing the plausible tails disposal strategy adopted by the Applicant as part of its decommissioning funding plan, we first must determine whether the funding plan contains a reasonable or credible plan to dispose of the DUF₆ tails generated at the CEC and then determine whether the Applicant's cost estimates for the components of the plan are reasonable.¹

¹ ASLB CEC 1997 (NIRS/PC Ex. 205) p. 4 of 18.

In the current context, a reasonable and credible plan for the disposition of the depleted uranium hexafluoride that would be produced by the proposed NEF facility would have to address the deconversion of the DUF6 to a more stable chemical form, the safe disposal of the deconversion by-products (i.e. the neutralization of the hydrofluoric acid and the disposal of the resulting calcium fluoride), the processing of the DU into a suitable waste form, and the ultimate disposal of the depleted uranium in a manner that will meet all current regulatory requirements including the annual dose limits in 10 CFR 61 and the EPA maximum concentration limits for drinking water.

With respect to the disposal of depleted uranium, the proposed LES facility will generate as much as 133,000 metric tons of DU, and to date the disposal of such large quantities of depleted uranium has not occurred anywhere in the world.

An additional element that needs to be considered in the context of defining a plausible strategy is cost. While the Board has ruled that “the cost of implementing a particular strategy has no bearing upon whether any particular strategy is technically plausible,” it has also acknowledged that LES itself noted that “the issues of ‘plausible strategy’ for waste disposal/dispositioning and decommissioning costs are closely related” and that “the reasonableness of the estimated costs of either the DOE plausible strategy or any potential private disposal strategy will be at issue in this proceeding.”²

For an additional discussion on the nature and requirements of a plausible strategy I refer you to the Makhijani and Smith 2004 Report (NIRS/PC Ex. 190), specifically pages 44 to 47.

² ASLB June 30 2005 (NIRS/PC Ex. 206) p. 13-14.

Q5. Moving to the proposal before the Commission, what do you understand LES proposes to do with the DUF6 from the NEF?

A5. The LES FEIS contains the following description of the two options proposed for the management of the DUF6 that would be generated by the proposed NEF:

Two options are proposed for disposition of DUF6. The first option would be to ship the material to a private conversion facility prior to disposal (Option 1). An alternative available under the provisions of the United States Enrichment Corporation (USEC) Privatization Act of 1996 would be to ship the material to a DOE conversion facility, either at Portsmouth, Ohio, or at Paducah, Kentucky, for temporary storage and eventual processing by the DOE conversion facility prior to disposal by DOE (Option 2).³

In addition, LES has publicly stated that

For many reasons, including the large volume of byproduct already in storage in the US, *the DOE deconversion facilities are not LES's path of choice for byproduct deconversion.* LES has continually supported the development of a commercial, private deconversion facility. In fact, the company will seek to develop long-term supply contracts with potential deconversion operators in order to assist in their financing and licensing efforts to build such a facility.⁴

LES and the NRC Staff have also stated that it is their position that the depleted uranium from the deconversion facility would be considered Class A low-level radioactive waste under 10 CFR 61.55 and that the preferred option is the deconversion of the DUF₆ to DU₃O₈ followed by its disposal in a shallow land disposal facility. While no shallow-land burial site has been specifically identified by LES as the final destination for the DU₃O₈ that would be generated, the NRC FEIS considers only the Hanford and Envirocare sites as potential options. The option of disposal at the proposed Waste Control Specialists facility in Andrews County, Texas, which is currently seeking a license was explicitly removed from consideration by the NRC as follows:

³ NEF FEIS 2005 (NIRS/PC Ex. 191) p. 2-28.

⁴ LES NEF UF6 info sheet (NIRS/PC Ex. 134) p. 3 (emphasis added).

Due to the need for separate regulatory actions prior to disposal at WCS [Waste Control Specialists], it is assumed that the depleted U3O8 generated from the adjacent or offsite private conversion process would be disposed at another disposal site licensed to accept this material.⁵

The FEIS focuses heavily on the choice of Envirocare and, in fact, draws no conclusions whatsoever about the environmental impacts of disposal at Hanford. The option of disposing of the depleted uranium in an abandoned mine previously put forth by LES in this case was withdrawn as a basis upon which they would rely for their plausible strategy.

Finally, LES has stated that it will consider only the neutralization of the hydrofluoric acid generated during deconversion to form calcium fluoride (CaF₂). They have also proposed that the CaF₂ would be disposed of in the Lea County landfill as industrial waste.⁶

Q6. What is your understanding of the past positions taken by the NRC, NRC Staff, DOE, and others regarding need for additional environmental analysis before a disposal option for depleted uranium could be selected?

A6. In response to the issues raised by our November 2004 report and other supporting information in connection with the intervention by Nuclear Information and Resource Service (NIRS) and Public Citizen in this case, the Commission issued a January 18, 2005, decision addressing, in part, the question of depleted uranium's classification as a waste. In particular, the Commission ruled that

Depleted uranium clearly is not spent fuel, transuranic waste, or 11e.(2) byproduct material. Nor does it meet the high-level waste definition, which includes specific

⁵ NEF FEIS 2005 (NIRS/PC Ex. 191) p. 2-33.

⁶ Krich 2005 (NIRS/PC Ex. 187) Attachment 1.

kinds of wastes such as irradiated fuel and the liquid and solid wastes resulting from the processing of irradiated fuel.⁷

and that therefore

Although the Commission itself may not have explicitly declared previously, as a matter of law, that depleted uranium is a form of low-level radioactive waste, it has long been understood within the NRC to fall within the low-level radioactive waste umbrella.⁸

Thus, the Commission's decision on depleted uranium's classification as low-level waste did not hinge upon the hazards DU presented, but instead upon a legal argument about its relation to the other existing classes of waste (i.e. high-level waste, transuranic waste, and 11e.(2) byproduct material). In this respect the Commission noted that even

In the event depleted uranium at some particular radionuclide concentration level and volume were to require disposal by methods more stringent than near-surface disposal, it would still be low-level waste.⁹

The Commission went on to explicitly endorse our position that the legal classification of DU as low-level waste does not settle the question as to the suitability of proposed disposal options. In particular, the Commission concluded that

A more difficult question – and one we need not answer today -- concerns whether the LES material, in the volumes and concentration proposed, will meet the Part 61 requirements for near-surface disposal. The Commission agrees with the intervenors that a definitive conclusion on this and other disposal method questions cannot be reached at this time, and may require further environmental or safety analysis. Our decision should not be read to intimate any Commission view on this issue, which relates both to the plausibility of LES's proposed private disposal options, and to financial assurance -- issues which remain before the Board.¹⁰

The position taken by the Commission in its January 2005 ruling that the legal classification of depleted uranium as low-level waste is not sufficient to demonstrate the suitability of disposal

⁷ NRC 2005 (NIRS/PC Ex. 195) p. 25.

⁸ NRC 2005 (NIRS/PC Ex. 195) p. 26.

⁹ NRC 2005 (NIRS/PC Ex. 195) p. 25.

¹⁰ NRC 2005 (NIRS/PC Ex. 195) p. 26.

options is consistent with the position that has been expressed by representatives of the NRC and the DOE going back as many as 14 years. This need for additional case-by-case analysis is due in large part to the fact that uranium, while included in the proposed rule, was explicitly removed from the final version of 10 CFR 61. In 1982, when the final rule and supporting Environmental Impact Statement were issued, it was determined that

Analysis of the data base for the Part 61 EIS indicates that the types of uranium-bearing wastes typically disposed of by NRC licensees do not present a sufficient hazard to warrant limitation on the concentration of this naturally occurring material.¹¹

At that time, only the Department of Energy was in possession of a large quantity of depleted uranium hexafluoride tails in the United States. Since uranium was removed from consideration based on this fact, the results of applying the 10 CFR 61 performance assessment methodology to uranium were not presented by the NRC at that time.

In 1991, as part of its preparation for a review of the expected license application for the construction of a new enrichment facility by LES, the NRC's Executive Director for Operations explicitly took up the issues of waste classification and disposal. At that time it was concluded that "the tails are considered source material" but that they could legally "be disposed of as LLW waste under the requirements of 10 CFR Part 61."¹² However, it was explicitly noted that

Review of the Environmental Impact Statement supporting 10 CFR Part 61 shows that although NRC considered the disposal of uranium and UF₆ conversion facility source terms in the analysis supporting Part 61, NRC did not consider disposal of large quantities of depleted uranium from an enrichment facility in the waste streams analyzed because there was no commercial source at that time. Therefore, analysis of the disposal of depleted uranium tails from an enrichment facility at a Part 61 LLW disposal facility should be conducted similar to the pathway analyses conducted in support of Part 61.¹³

¹¹ 10 CFR 61 FEIS 1982 (NIRS/PC Ex. 169) p. 5-38.

¹² NRC 1991 (NIRS/PC Ex. 193) p. 5.

¹³ NRC 1991 (NIRS/PC Ex. 193) p. 4.

The Director went on to conclude that, in support of a decision on disposal options, a "detailed pathway analysis of depleted uranium should be conducted following the provisions of 10 CFR 61.58" which states that

The Commission may, upon request or on its own initiative, authorize other provisions for the classification and characteristics of waste, on a specific basis, if, after evaluation, of the specific characteristics of the waste, disposal site, and method of disposal, it finds reasonable assurance of compliance with the performance objectives in Subpart C of this part [Performance Objectives].¹⁴

As part of the subsequent review of the initial LES license application to build the Claiborne Enrichment Center (CEC) in Louisiana, the Division of Low-Level Waste Management and Decommissioning (LLWM) at Sandia National Laboratories provided technical assistance to the NRC by preparing such a report on the suitability of shallow-land disposal facilities for the disposal of depleted uranium. In the 1992 report *Performance Assessment of the Proposed Disposal of Depleted Uranium as Class A Low-Level Waste*, the authors concluded that

According to the concentration limits and provisions of 10 CFR 61.55, the depleted uranium [from the proposed enrichment facility] would be considered Class A waste. Thus, these wastes might be acceptable for disposal in a Part 61 facility. Given the large inventory and form of the depleted uranium wastes, and the fact that this type of waste was not included in the Environmental Impact statement (EIS) analyses supporting 10 CFR 61, further analysis is necessary to demonstrate whether the disposal of this material in a 10 CFR 61 disposal facility will be acceptable in terms of public health and safety.¹⁵

This need for additional analysis was also the position taken by the NRC staff in their 1994 review of the environmental impacts of the proposed Claiborne Enrichment Center. The NRC staff described the scope of their analysis presented in the final Environmental Impact Statement as follows:

The tails disposal impact analysis approach includes selection of representative disposal sites, development of undisturbed performance, exposure scenarios, and selection of consequence estimation models.... Exposure scenarios selected for

¹⁴ NRC 1991 (NIRS/PC Ex. 193) p. 5.

¹⁵ Kozak et al. 1992 (NIRS/PC Ex. 128) p. 1.

evaluation of near-surface disposal included drinking of well water and consumption of crops irrigated with water drawn from the well.¹⁶

In addition to considerations surrounding the CEC facility outlined above, in June 2004 the Department of Energy issued the final Environmental Impact Statements for the management of the approximately 740,000 metric tons of depleted uranium currently stored at the gaseous diffusion plants at Oak Ridge, Tennessee; Paducah, Kentucky; and Portsmouth, Ohio. In the two final EIS's, the DOE listed disposal at the Envirocare site in Utah as the primary option for the proposed disposition of the DUF₆ deconversion product and disposal at the Nevada Test Site as the secondary option. However, in a footnote to this text the DOE explicitly made it clear that the

DOE plans to decide the specific disposal location(s) for the depleted U₃O₈ conversion product after additional appropriate NEPA review. Accordingly, DOE will continue to evaluate its disposal options and will consider any further information or comments relevant to that decision. DOE will give a minimum 45-day notice before making the specific disposal decision and will provide any supplemental NEPA analysis for public review and comment.¹⁷

Thus, it is incorrect to claim that the DOE has selected a disposal option as the NRC staff has claimed in the present case.¹⁸ In fact, the DOE has instead reiterated the long-expressed position that disposal in a low-level waste facility would be desired, but that additional analysis would need to be done before the suitability of any particular option could be determined.

Finally, in the present case, the NRC staff initially took a similar, but somewhat more nuanced position. In its 2004 draft EIS for the proposed National Enrichment Facility, the authors noted that

The environmental impacts at the shallow disposal sites considered for disposition of low-level radioactive wastes would have been assessed at the time of the initial license approvals of these facilities. Final disposal of large quantities of depleted uranium at a licensed facility could require additional environmental impact

¹⁶ CEC FEIS 1994 (NIRS/PC Ex. 58) p. A-7.

¹⁷ Paducah FEIS 2004 (LES Ex. 17) p. 2-11 and Portsmouth FEIS 2004 (LES Ex. 16) p. 2-12.

¹⁸ NEF DEIS 2004 (NIRS/PC Ex. 152) p. 2-32 and NEF FEIS 2005 (NRC Staff Ex. 36) p. 2-33.

evaluations depending on the location of the disposal facility and quantity of depleted uranium to be deposited.¹⁹

While weaker than the previous positions which had concluded that additional analysis will necessarily be required, the NRC staff retained the conclusion that additional analysis could be necessary to ensure that the proposed options for the bulk disposal of tens of thousands of metric tons of depleted uranium would meet all necessary performance objectives and dose limits.

Q7. What is the basis for your conclusion that no strategy for disposal of depleted uranium can be considered to be plausible without the presentation of a site specific analysis demonstrating compliance with the dose limits of 10 CFR 61 and other applicable environmental regulations?

A7. In order to be in compliance with the law, any disposal option must be able to demonstrate that it is capable of meeting the applicable dose limits in 10 CFR 61 as well as the EPA National Primary Drinking Water maximum contaminant level in 40 CFR 141. The calculations of future doses from the disposal of uranium are strongly dependent upon the geology and hydrogeology of the site, the soil chemistry, the site meteorology, the assumed exposure scenarios, and many other site specific factors. The significance of site specific assessment was clearly described by the International Commission on Radiological Protection in its guidance on disposal of long-lived radioactive wastes:

Site specific assessments are essential in order to evaluate the radiological consequences of waste disposal. They are also necessary to understand, describe, quantify, and optimise the role of the different barriers of the disposal system and its subsystems. Assessments consider a number of scenarios where a scenario is defined as one possible combination of specified processes affecting the disposal system that could lead to radiological consequences. Typically, an assessment consists of the following elements, which are usually dealt with in an iterative manner: system understanding, scenario analysis, development of conceptual

¹⁹ NEF DEIS 2004 (NIRS/PC Ex. 152) p. 4-58.

and detailed system models, consequence analysis, uncertainty and sensitivity analysis, and interpretation of the calculated results. An integrated assessment will evaluate the expected system evolution as well as less likely system evolutions including those caused by disruptive events of natural origin or as a result of human intrusion.²⁰

Even in presenting its own generic screening calculations in the Programmatic Environmental Impact Statement for dispositioning of depleted uranium, the Department of Energy noted at great length the significance of site specific parameters:

The estimated impacts associated with the disposal options are subject to a great deal of uncertainty, especially for the post-closure period. The degree of uncertainty in the disposal impacts is greater than that for the other categories of options in the PEIS, because disposal impacts consider an extremely long period of time and depend on predicting the behavior of the waste material as it interacts with soil and water in a complex and changing environment. Consequently, the estimated disposal impacts are very dependent on the assumptions made for the assessment, including such key factors as soil characteristics, water infiltration rates, depth to underlying groundwater table, chemistry of different uranium compounds, and locations of future human receptors. These factors could vary widely depending on site-specific conditions.²¹

As a further example, the 1992 analysis conducted at Sandia National Laboratory to support the Claiborne Enrichment Center case noted that

Uranium solubilities can vary widely, even under fairly well established ground-water chemical conditions. As an example, a recent performance assessment was performed of an arid site for which substantial site-specific ground-water characterization was available; in this performance assessment the uranium solubility ranged over five orders of magnitude. It is clear that on a generic basis little can be done to specify a solubility range with much confidence.²²

Finally, a 1994 analysis of DU disposal options conducted for the Department of Energy at the Idaho National Engineering Laboratory noted that the partition coefficient for uranium has been found to vary by four orders of magnitude "indicating a very large dependence on local soil conditions."²³ These examples highlight the need expressed by the ICRP for detailed site-specific evaluations when considering the disposal of depleted uranium.

²⁰ ICRP 81 (NIRS/PC Ex. 122) p. 7.

²¹ DOE PEIS 1999 (LES Ex. 18) p. I-3 to I-4.

²² Kozak et al. 1992 (NIRS/PC Ex. 128) p. 49.

²³ Hertzler et al. 1994 (NIRS/PC Ex. 117) p.12.

Given the long half lives of the radioisotopes in depleted uranium and the high specific activity of pure DU oxides, no disposal strategy can be considered to be scientifically credible without being specific to a well characterized site. As concluded by John Bredehoeft, a member of the National Academy of Engineering and one of the most eminent hydrogeologists in the United States

Both of these site-specific examples [Yucca Mountain and the Waste Isolation Pilot Plant] demonstrate the level of scientific and engineering effort necessary to license a nuclear waste facility. One cannot simply draw upon generic calculations to justify that nuclear wastes can be disposed of safely. Prudent design would dictate that one must propose a specific site and method of sequestering long-lived nuclear wastes. Only after a specific site and design are proposed can one assess its safety.²⁴

Q8. What is basis for testimony regarding the acceptability of shallow-land burial in this proceeding?

A8. In its August 4, 2005 ruling, the Board has stated that “the particular suitability of either the WCS or Envirocare facilities as disposal options is outside the scope of this proceeding” but that “as we have previously indicated, whether deep disposal at greater expense would be necessary is a legitimate subject for inquiry.”²⁵ This ruling was referring to previous statements by the Board such as the following from their June 30, 2005 ruling:

In that vein, the parties should be mindful that, although the Board has found that the cost of implementing a particular strategy has no bearing upon whether any particular strategy is technically plausible, see November Late-Filing Ruling at 13, as LES notes in its response, the issues of “plausible strategy” for waste disposal/dispositioning and decommissioning costs are closely related. Therefore, the reasonableness of the estimated costs of either the DOE plausible strategy or any potential private disposal strategy will be at issue in this proceeding.²⁶

²⁴ As quoted in Makhijani and Smith 2004 (NIRS/PC Ex. 190) p. 27-28.

²⁵ ASLB Aug 4 2005 (NIRS/PC Ex. 204) p. 20.

²⁶ ASLB June 30 2005 (NIRS/PC Ex. 206) p. 13-14.

Thus, as the Commission has indicated, see CLI-05-05, 61 NRC at 35, NIRS/PC attempts to posit a challenge to the LES cost estimates relating to near-surface disposal, see First Motion to Amend EC-5/TC-2, at 21; Second Motion to Amend EC-5/TC-2, at 7-8, would be litigable to the extent they seek to establish that the depleted uranium from the NEF, albeit low-level waste, would be “at some particular radionuclide concentration level and volume” so as “to require disposal by methods more stringent than near-surface disposal,” i.e., by land disposal methods in accordance with 10 C.F.R. Part 61 other than near surface disposal.²⁷

Thus, the Board has consistently and clearly stated that the question of the performance of shallow-land burial sites is relevant as to whether a reliance on their cost is reasonable or whether deeper disposal will be required at greater expense.

Q9. What is your conclusion on the reasonableness of LES’s reliance on cost information from either the Envirocare or WCS sites?

A9. In their June 30, 2005 ruling, the Board stated that

To be sure, the choice regarding a “plausible strategy,” and the concomitant need to provide a reasonable explanation of the costs of that choice as they relate to its financial qualifications/decommissioning funding responsibilities, rests with LES in the first instance.²⁸

In addition, the NRC stated in its guidelines for determining decommissioning costs that

The purpose of the review of the cost estimate is to ensure that the licensee or responsible party has developed a cost estimate for decommissioning the facility based on documented and reasonable assumptions and that the estimated cost is sufficient to allow an independent third party to assume responsibility for decommissioning the facility if the licensee or responsible party is unable to complete the decommissioning.²⁹

The current LES cost estimates rely on the lowest price quoted to them in a Memorandum of Agreement (MOA) between LES and WCS. This MOA states the parties’ intention to consider

²⁷ ASLB June 30 2005 (NIRS/PC Ex. 206) p. 13-14.

²⁸ ASLB June 30 2005 (NIRS/PC Ex. 206) p. 14 (emphasis added).

²⁹ NUREG 1757, Vol. 3 (NIRS/PC Ex. 249) p. 4-9 (emphasis added).

discussions that could lead to a contract for WCS to accept [REDACTED] of depleted uranium from a private deconversion facility amounting to a total of [REDACTED] metric tons of DU_3O_8 or [REDACTED] tons of DU. This quantity is less than [REDACTED] percent of the 133,000 metric tons of DU that the proposed NEF facility would be expected to generate over its operational lifetime.³⁰ [REDACTED]

[REDACTED] Currently, however, WCS has no license to dispose of radioactive waste and, therefore, these discussion are contingent upon the WCS assumption that it will receive a license from the Texas Commission on Environmental Quality.

In the final EIS for the NEF, the NRC staff notes the following actions that would be necessary before it would be possible to dispose of the depleted uranium from the NEF facility at the proposed Waste Control Specialists site in Andrews County, Texas:

Before the depleted uranium generated by the proposed NEF could be disposed at the proposed WCS Compact Facility, a series of legal procedures and approval processes would have to be successfully addressed. These procedures and processes include:

1. Approval by the State of Texas of WCS's application, including authorization by the State for the WCS Compact Facility to accept for disposal depleted uranium oxides of the type and quantities expected to be generated as a result of the proposed NEF's operations;
2. Approval by the Rocky Mountain Compact (in which the proposed NEF would be located) for the export of the depleted uranium oxides from the Compact; and
3. Approval by the Texas Compact for the import and disposal of the depleted uranium oxides generated as a result of the proposed NEF's operations.³¹

They go on to specifically recognize that "[a] separate licensing process could be required to obtain approval from the State of Texas" for the disposal of DU even if the general low-level waste application is eventually granted.³² In light of these considerations, the NRC staff concluded that

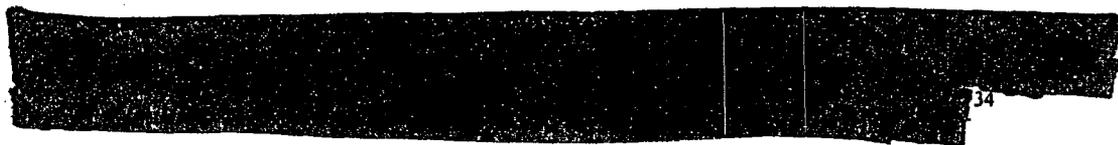
³⁰ MOA 2005 (LES Ex. 105) p. 2 to 3.

³¹ NEF FEIS 2005 (NIRS/PC Ex. 191) p. 2-32 to 2-33.

³² NEF FEIS 2005 (NIRS/PC Ex. 191) p. I-83 (in the electronic version of the FEIS this quote appears on page I-82).

Due to the need for separate regulatory actions prior to disposal at WCS, it is assumed that the depleted U_3O_8 generated from the adjacent or offsite private conversion process would be disposed at another disposal site licensed to accept this material.³³

WCS is not in a position to set its prices for disposal. Those prices would have to be set by the Texas Compact Commission. Thus, a vague cost estimate from WCS that can be changed at any time, that contains no basis for how it might be changed, when it might be changed, or whether there are any upper limits to the cost cannot be considered to be reasonable or credible estimate in this case. In light of this conclusion it is interesting to note that the January 2005 memorandum of agreement explicitly states that



This type of agreement should not form the basis for estimating the cost of a plausible disposal strategy, and should not be accepted by the NRC. Relying on this memorandum of agreement for a cost estimate before WCS has been granted a license is more wishful thinking than a plausible strategy.

LES also notes in support of its cost estimate a single page letter from the Executive Vice President of Envirocare that states that the cost stated in the LES license application were "a conservative estimate of what it would currently cost at standard depleted U_3O_8 density to dispose of such material at Envirocare's Utah facility."³⁵ At the time the Envirocare letter was written, the disposal costs reported by LES in its license application were between \$1.47 and \$2.17 per kilogram of uranium compared to the current LES estimate of \$1.14 per kilogram of uranium.³⁶ As with the

³³ NEF FEIS 2005 (NIRS/PC Ex. 191) p. 2-33

³⁴ MOA 2005 (LES Ex. 105) p. 4 (emphasis added).

³⁵ Krich 2005 (NIRS/PC Ex. 187) Attachment 2.

³⁶ LES SAR 2004 (NIRS/PC Ex. 222) Table 10.3-1.

case of WCS, a vague unsupported statement with no supporting discussion of the analysis underlying the conclusion cannot be considered sufficient to document the assumptions made, much less determine if they are reasonable. In addition, the letter from Envirocare also noted that their review was not an offer to dispose of the material at this cost and that the DU would still have to meet "Envirocare's licenses, permits, and operational requirements."³⁷

Q10. What is your conclusion regarding the likely requirements for the safe disposal of the depleted uranium from the proposed NEF facility given that shallow land burial is very unlikely to be able to satisfy the existing dose limits?

A10. I have concluded that, for the purpose of making reasonable cost estimates, it is best to assume that the depleted uranium from the proposed NEF facility will require disposal in a deep geologic repository comparable to the Waste Isolation Pilot Plant (WIPP) now operating in New Mexico.³⁸

Q11. What is the basis of your conclusion that depleted uranium will likely require disposal in a deep geologic repository?

A11. The specific activity of pure natural uranium metal is about 670 nanocuries per gram. The specific activity of DU can vary, but it is always greater than 340 and less than 670 nanocuries per gram. For the purposes of this report, we will take the specific activity of DU to be 400 nanocuries

³⁷ Krich 2005 (NIRS/PC Ex. 187) Attachment 2.

³⁸ For further discussion, including our generic screening analyses, see Makhijani and Smith 2004 (NIRS/PC Ex. 190) p. 21-29.

per gram (metal). This is consistent with the assumption set forth in the 1997 Lawrence Livermore Engineering Analysis for the long-term management of the Department of Energy's depleted uranium stockpile and corresponds to an isotopic composition of: 99.75% U-238, 0.25% U-235, and 0.001% U-234.³⁹ This assumption yields a specific activity for depleted uranium oxide (DU₃O₈) of about 340 nanocuries per gram and a specific activity of 350 nanocuries per gram for depleted uranium dioxide (DUO₂). The metabolic behavior of DU in the human body and its mobility in the environment is essentially the same as that of natural uranium. The toxicological properties of depleted uranium are also essentially the same as natural uranium, while its radioactivity is roughly 40 percent less. Thus, the only significant difference between DU and natural uranium is its lower specific activity.

In terms of its radiological properties, depleted uranium would be most comparable to transuranic (TRU) waste which is similar to the classification of Greater than Class C (GTCC) waste under 10 CFR 55(a).⁴⁰ Shallow land disposal for these wastes (TRU or GTCC) is generally not appropriate and they are considered to require deep geologic disposal. The table below summarizes the relevant radiological properties of the three isotopes composing DU compared to a number of the most important transuranic radionuclides present in TRU wastes.⁴¹

Isotope	Main decay mode	Alpha particle energy, MeV	Half-life, years	Comments
Uranium-238	Alpha	4.1	4.46 billion	
Uranium-235	Alpha	4.4	700 million	weak gamma emitter

³⁹ LLNL 1997 EA (NIRS/PC Ex. 55) p. 2-8.

⁴⁰ 10 CFR 61 final rule 1982 (NIRS/PC Ex.85), p.57473-74 and EPA 2001 (NIRS/PC Ex.109).

⁴¹ For simplicity in this report we will refer interchangeably to TRU and GTCC waste. The important element of their classification with respect to this discussion is the limit of 100 nCi/gm of long lived alpha-emitting transuranic elements.

Uranium-234	Alpha	4.8	245,000	
Neptunium-237	Alpha	4.8	2.14 million	
Plutonium-238	Alpha	5.5	87.7	
Plutonium-239	Alpha	5.1	24,110	
Plutonium-240	Alpha	5.1	6,537	
Americium-241	Alpha	5.5	432	strong gamma emitter

Note: All energies rounded to two significant figures. The alpha emitting radionuclides emit alpha particles with more than one characteristic energy, with each energy level being produced with a known probability. The alpha particle energy shown is an approximate average of these particles energies, weighted by the emission probability.

From the above table it is clear that, in terms of its radiological properties, DU is directly comparable to these important radionuclides composing TRU waste. Adding a further consideration, we note that the depleted uranium being considered for ultimate disposal by LES is a pure material, whereas TRU wastes are generally composed of inhomogeneous materials containing trace amounts of transuranic radionuclides, most notably Pu-238, Pu-239, and Pu-240, as well as Am-241 and Np-237.

The specific activity of depleted uranium will continue to grow slowly over time until secular equilibrium is reached after more than a million years. In addition to an increase in the amount of U-234 present in the DU, two of the other important daughter products of U-238 that need to be considered are thorium-230 and radium-226. Th-230, with a half-life of 77,000 years, is an alpha emitter with an average energy of 4.7 MeV. Ra-226 has a half-life of just 1,600 years, and is also an alpha emitting radionuclide with an average energy of 4.8 MeV. These two daughter products are also weak beta and gamma emitters. The inclusion of additional long-lived alpha emitting radionuclides to our considerations of depleted uranium adds further justification to the need for

treating DU as analogous to TRU waste. In fact, the risks in terms of mortality per becquerel of intake of DU (including its decay products)⁴² are together about four times more dangerous than that of plutonium-239, as can be seen from the table below.

Radionuclide	Mortality per Bq for Tap Water Intake	Mortality per Bq for Dietary Intake	Ratio of Mortality per Bq versus Pu Tap Water	Ratio of Mortality per Bq versus Pu Dietary	Mortality Ratio adj for sp act per gm Tap water	Mortality Ratio adj for sp act per gm Dietary
Uranium-238	1.13E-09	1.51E-09	0.40	0.42	1.34	1.41
Uranium-234	1.24E-09	1.66E-09	0.44	0.46	1.48	1.55
Thorium-230	1.67E-09	2.16E-09	0.59	0.60	1.99	2.05
Radium-226	7.17E-09	9.56E-09	2.52	2.63	8.53	8.93
total mortality ratio at secular equilibrium			3.93	4.11	13.34	13.94
Plutonium-239	2.85E-09	3.63E-09				

Note: The source for the drinking water and dietary mortality ratios is EPA Federal Guidance Report 13.⁴³ The two right most columns show the ratio of the mortality coefficients for uranium and its daughter products versus plutonium-239 after adjusting by 340/100 to account for the greater specific activity of bulk DU₃O₈ relative to that of the transuranic elements at the threshold of TRU waste.

When adjusted for the greater specific activity of DU₃O₈ relative to the 100 nanocuries per gram threshold of TRU waste, any one of these four components of depleted uranium exceeds the risk of plutonium-239. Together, DU and its decay products are about an order of magnitude more risky (in terms of cancer mortality per unit of mass consumed) than TRU waste with 100 nanocuries per

⁴² Th-234 and Pa-234m are omitted from the present discussion because they contribute relatively little to drinking water and other ingestion doses compared to the radionuclides under discussion here.

⁴³ EPA FGR 13 (NIRS/PC Ex. 111) p. 102-103.

gram of plutonium-239. Further, uranium and its decay products (with the possible exception of thorium-230) have, in general, comparable or greater environmental mobility than plutonium.⁴⁴

Hence, from a regulatory point of view as well as from a scientific point of view the risks that would arise from DU disposal cannot be considered as less than those from TRU waste disposal.

While DU has been declared to be low-level waste by the Commission and low-level waste is typically regulated for a limited time and not to the time of peak dose, the very long half-lives of the uranium isotopes make it a special concern. Both the draft and final EIS in the current case include a dose estimate for disposal in a mine that was calculated “[i]n the year of maximum exposure” as we have done for the case of shallow land disposal.⁴⁵ The issues raised by the very long half-lives of the uranium isotopes in relation to the analysis of shallow land disposal were summarized by the authors of the Sandia analysis as follows:

The acceptability of near-surface disposal for large quantities of depleted uranium depends upon the regulatory time frame applied to the analysis. Risks associated with the disposal grow for about 2 million years. Truncation of the analysis prior to that time will not capture the potential peak doses, but extrapolation of current conditions to 2 million years is of dubious merit for a near-surface facility. The potential exists for more adverse conditions than present to exist at the site over that long time frame.⁴⁶

These considerations further strengthen the conclusion that depleted uranium will likely require disposal in a deep geologic repository. The radiological similarity between depleted uranium and TRU waste or the likely need for the disposal of depleted uranium in a mined repository of some kind has been recognized by the International Atomic Energy Agency, the OECD’s Nuclear Energy Agency, the National Research Council of the U.S. National Academy of Sciences, and the staff of

⁴⁴ Yu et al. 1993 (NIRS/PC Ex. 201) p. 110-111.

⁴⁵ NEF DEIS 2004 (NIRS/PC Ex. 152) p. 4-59 and NEF FEIS 2005 (NRC Staff Ex. 36) p. 4-63.

⁴⁶ Kozak et al. 1992 (NIRS/PC Ex. 128) p. 49.

the Nuclear Regulatory Commission (in the Claiborne Enrichment Center case).⁴⁷ In the last example, the Atomic Safety and Licensing Board itself noted that

Because the projected drinking water and agricultural doses from a modeled near-surface burial site consisting of an earth-mounded bunker subject to the environmental characteristics of the humid southeastern United States exceeded the 10 C.F.R. Part 61 limits, the Staff concluded that a deep disposal site is most likely to be selected for tails disposal.⁴⁸

The remaining question is what type of mined repository would be acceptable. As already noted, the similarity of DU to TRU waste has been recognized by the National Research Council, both in regard to their radiological characteristics as well in regard to the likely difficulties that will be associated with their disposal:

If disposal [of depleted uranium oxide] is necessary, it is not likely to be simple. The alpha activity of DU is 200 to 300 nanocuries per gram. Geological disposal is required for transuranic waste with alpha activity above 100 nanocuries per gram. If uranium were a transuranic element, it would require disposal in the Waste Isolation Pilot Plant (WIPP) based on its radioactivity. The chemical toxicity of this very large amount of material would certainly become a problem as well. One option suggested by the U.S. Nuclear Regulatory Commission (USNRC) is disposal in a mined cavity or former uranium mine. Challenges for this option would include understanding the fundamental differences between uranium ore (see Sidebar 6.1) and the bulk uranium oxide powder.⁴⁹

In addition, Dr. John Bredehoeft, a member of the National Academy of Engineering who participated in the study of both Yucca Mountain and the Waste Isolation Pilot Plant, concluded that

The type of site required for disposal of depleted uranium from NEF is roughly comparable to the WIPP site in terms of the level of isolation required. All three isotopes contained in depleted uranium have very long half-lives, with the half-life of the principal one, U-238 extending to the billions of years. The specific activity of depleted uranium exceeds 300 nanocuries per gram of alpha-emitting radionuclides, and radium 226 and thorium 230 would build up over time to exceed 100 nanocuries per gram. The transuranic waste disposed of at WIPP has a concentration of at least 100 nanocuries per gram of alpha-emitters. The WIPP project involves deep disposal in a sealed mine in bedded salt more than 2000 feet below the surface. The plan for WIPP was examined in a detailed

⁴⁷ CEC FEIS 1994 (NIRS/PC Ex. 58) p. A-9, IAEA/NEA 2001 (NIRS/PC Ex. 186) p. 23, NAS/NRC 2003 (NIRS/PC Ex. 151) p. 64, IAEA 2003 (NIRS/PC Ex. 185) p. 29.

⁴⁸ ASLB CEC 1997 (NIRS/PC Ex. 205) p. 6 of 18.

⁴⁹ NAS/NRC 2003 (NIRS/PC Ex. 151) p. 64.

performance assessment, which was reiterated several times. It required well over 20 years of analysis by a large team of scientists and engineers to achieve a level of understanding such that a consensus was reached that the WIPP facility is safe and could receive waste.

Only after a specific site and design are proposed can one assess its safety. It would be prudent to assume that, before a site could be qualified to receive depleted uranium waste, a similar amount of time, effort, expense, and scrutiny to that which went to qualify WIPP would be required.⁵⁰

Thus, based on my own analysis, and consistent with the conclusions and recommendations of other experts and international advisory bodies, I have concluded that the depleted uranium from the proposed NEF facility will require disposal in a deep geologic repository comparable to the Waste Isolation Pilot Plant (WIPP) now operating in New Mexico.

Q12. What is your conclusion regarding the likely cost for safely disposing of the depleted uranium from the proposed NEF facility in a deep geologic repository?

A12. As I have testified with respect to the deconversion costs, when available, the best option is to make use of real-world experience with operating facilities. In the context of disposing the depleted uranium from the proposed LES facility, no such facility exists because no country has ever disposed of the large quantities of depleted uranium now under consideration. Given the similarity of the radiological properties between DU and TRU waste noted above, it is reasonable as a next best option to use the U.S. experience with disposing of TRU waste in WIPP to guide the cost of disposing of the deleted uranium from the proposed NEF.

⁵⁰ as quoted in [Makhijani and Smith 2004 (NIRS/PC Ex. 190) p. 27-28]

Based on the experience at WIPP we estimated in the November 2004 report that the disposal costs would range from between \$5.40 and \$8.00 per kilogram of uranium. This can be compared to the \$1.14 per kilogram that LES has proposed as its cost for disposal. It is important to note that our highest cost estimate is not intended to be a worst case analysis, but, in fact, represents our conclusions regarding a realistic scenario that would be prudent to considered given the uncertainties involved in planning for the handling and eventual disposal of large quantities of depleted uranium over the next three decades.

References:

10 CFR 61 DEIS 1981 (NIRS/PC Ex. 167)	U.S. Nuclear Regulatory Commission, "Draft Environmental Impact Assessment on 10 CFR 61 'Licensing Requirements for Land Disposal of Radioactive Waste'", Main Report, September 1981 (NUREG-0782, Vol. 2)
10 CFR 61 DEIS 1981b (NIRS/PC Ex. 168)	U.S. Nuclear Regulatory Commission, "Draft Environmental Impact Assessment on 10 CFR 61 'Licensing Requirements for Land Disposal of Radioactive Waste'", Appendices G-Q, September 1981 (NUREG-0782, Vol. 4)
10 CFR 61 FEIS 1982 (NIRS/PC Ex. 169)	U.S. Nuclear Regulatory Commission, "Final Environmental Impact Assessment on 10 CFR 61 'Licensing Requirements for Land Disposal of Radioactive Waste'", Summary and Main Report, November 1982 (NUREG-0945, Vol. 1)
10 CFR 61 final rule 1982 (NIRS/PC Ex. 85)	U.S. Nuclear Regulatory Commission. "10 CFR parts 2, 19, 20, 21, 30, 40, 51, 61, 70, 73 and 170: licensing requirements for land disposal of radioactive waste. Final Rule." <i>Federal register</i> , v.47, no. 248 (Dec. 27, 1982). pp. 57446-57477.
40 CFR 141 2004 (NIRS/PC Ex. 202)	U.S. Code of Federal Regulations, "Title 40 – Protection of Environment: Chapter I – Environmental Protection Agency; Part 141 – National primary drinking water regulations", July 1, 2004, online at http://www.access.gpo.gov/nara/cfr/waisidx_04/40cfr141_04.html .
40 CFR 61 2004 (NIRS/PC Ex. 87)	U.S. Code of Federal Regulations, "Title 40 – Protection of Environment: Chapter I – Environmental Protection Agency; Part 61 – National emission standards for hazardous air pollutants", July 1, 2004, online at http://www.access.gpo.gov/nara/cfr/waisidx_04/40cfr61_04.html .
ACP DEIS 2005 (NIRS/PC Ex. 203)	U.S. Nuclear Regulatory Commission, Office of Waste Management and Environmental Protection, Office of Nuclear Material Safety and Safeguards, <i>Environmental Impact Statement for the Proposed American Centrifuge Plant in Piketon, Ohio</i> , Draft Report for Comment, August 2005 (NUREG-1834)
ASLB Aug 4 2005 (NIRS/PC Ex. 204).	U.S. Nuclear Regulatory Commission, Atomic Safety and Licensing Board, In the Matter of Louisiana Energy Services, L.P. (National Enrichment Facility), "Memorandum and Order: (Ruling on Motion to Admit Late-Filed Amended and Supplemental Contentions)", Docket No. 70-3103-ML, ASLBP No. 04-826-01-ML, August 4, 2005.
ASLB CEC 1997 (NIRS/PC Ex. 205)	U.S. Nuclear Regulatory Commission, Atomic Safety and Licensing Board, In the Matter of Louisiana Energy Services, L.P.(Claiborne Enrichment Center), LBP-97-3, Docket No. 70-3070-ML, ASLBP No. 91-641-02-ML (Special Nuclear Material License), 45 N.R.C. 99, 1997 WL 345666 (N.R.C.), March 7, 1997.
ASLB June 30 2005 (NIRS/PC Ex. 206)	U.S. Nuclear Regulatory Commission, Atomic Safety and Licensing Board, In the Matter of Louisiana Energy Services, L.P.(National Enrichment Facility), "Memorandum and Order: (Ruling on NIRS/PC Late-Filed Contention Amendments)", Docket No. 70-3103-ML, ASLBP No. 04-826-01-ML, June 30, 2005.
Baird et al. 1990 (NIRS/PC Ex. 170)	R.D. Baird, M.K. Bollenbacher, E.S. Murphy, R. Shuman, and P.B. Klein, "Evaluation of the Potential Public Health Impacts Associated with Radioactive Waste Disposal at a Site Near Clive, Utah", Rogers and Associates Engineering Corporation, June 1990 (RAE-9004/2-1)

Baird et al. 1990b (NIRS/PC Ex. 171)	R.D. Baird, G.B. Merrell, D.E. Bernhardt, and V.C. Rogers, "Additional Radionuclide Concentration Limits for the NORM Disposal Site at Clive, Utah", Rogers and Associates Engineering Corporation, August 1990 (RAE-9000/16-1)
Barron 2005 (NIRS/PC Ex. 207)	Jeff Barron, "Plant construction falls behind", <i>Portsmouth Daily Times</i> , July 15, 2005.
Bauman 2005 (NIRS/PC Ex. 172)	Joe Bauman, "Senate OKs Class B, C waste ban", <i>Deseret Morning News (Salt Lake City)</i> , February 3, 2005.
Bauman 2005b (NIRS/PC Ex. 173)	Joe Bauman, "House votes to ban importing of B, C wastes", <i>Deseret Morning News (Salt Lake City)</i> , February 10, 2005
Blevins 2005 (LES Ex. 104)	Memo to Scott Flanders from Matthew Blevins, "Telephone Summary Regarding Depleted Uranium Disposal", April 6, 2005. [Internal NRC memo regarding a February 24, 2005 teleconference]
Carr 2005 (NIRS/PC Ex. 174)	Letter from James R. Carr, Professor of Geological Sciences and Engineering at the University of Nevada, Reno, to Arjun Makhijani, Regarding the Potential for Erosion at the Proposed WCS Site, May 16, 2005.
CEC FEIS 1994 (NIRS/PC Ex. 58)	U.S. Nuclear Regulatory Commission, "Final Environmental Impact Statement for the Construction and Operation of Claiborne Enrichment Center, Homer, Louisiana", Volume 1, August 1994 (NUREG-1484)
Closing the Circle (NIRS/PC Ex. 208)	U.S. Department of Energy, <i>Closing the Circle on the Splitting of the Atom: The Environmental Legacy of Nuclear Weapons Production in the United States and What the Department of Energy is Doing About It</i> , DOE/EM-0266, Washington, D.C.: DOE Office of Environmental Management, Office of Strategic Planning and Analysis, January 1996. Closing the Circle on the Splitting of the Atom online at http://legacystory.apps.em.doe.gov/text/close/close2.htm .
Dallas Morning News 2005 (NIRS/PC Ex. 175)	Wire Reports, "Probation threatened for nuclear agency", <i>Dallas Morning News</i> , April 30, 2005.
Deposition Chater et al. 2004/10/04 (NIRS/PC Ex. 100)	<i>Deposition of Chris Chater, Bernard Duperret, Rodney H. Fisk, Rod Krich, Robert Pratt, Paul G. Schneider, Michael H. Schwartz, Julian J Steyn</i> . Monday, October 4, 2004. In the matter of Louisiana Energy Services (National Enrichment Facility) v. Nuclear Information and Resource Service and Public Citizen. U.S. Nuclear Regulatory Commission, Docket No. 70-3103-ML; ASLBP No. 03-816-01-ML. Transcript by Neal R. Gross. At head of title: Before the Commission. Deposition took place in offices of Winston & Strawn, Washington, DC.
DOE 1995 (NIRS/PC Ex. 176)	U.S. Department of Energy, "Integrated Data Base Report – 1994: U.S. Spent Nuclear Fuel and Radioactive Waste Inventories, Projections, and Characteristics", September 1995 (DOE/RW-0006, Rev. 11)
DOE 1997 (NIRS/PC Ex. 177)	U.S. Department of Energy, "Integrated Data Base Report – 1996: U.S. Spent Nuclear Fuel and Radioactive Waste Inventories, Projections, and Characteristics", December 1997 (DOE/RW-0006, Rev. 13)
DOE 1998 (NIRS/PC Ex. 102)	U.S. Department of Energy. Office of Environmental Management. <i>Department of Energy Response to 1997 IEER Environmental Management report</i> . [Washington, DC]: EM, March 18, 1998.

DOE 1998b (NIRS/PC Ex. 209)	U.S. Department of Energy, <i>The Current and Planned Low-Level Waste Disposal Capacity Report</i> , Revision 1, September 18, , 1998.
DOE 2000 (NIRS/PC Ex. 103)	U.S. Department of Energy. Office of Environmental Management. <i>Buried Transuranic-Contaminated Waste Information for U.S. Department of Energy Facilities</i> , Washington, DC: DOE EM, June 2000.
DOE 2001 (NIRS/PC Ex. 178)	U.S. Department of Energy, "Summary Data on the Radioactive Waste, Spent Nuclear Fuel, and Contaminated Media Managed by the U.S. Department of Energy", April 2001.
DOE Paducah ROD 2004 (NIRS/PC Ex. 105)	U.S. Department of Energy. "Record of decision for construction and operation of a depleted uranium hexafluoride conversion facility at the Paducah, KY, site." <i>Federal Register</i> , v. 69, no. 143 (July 27, 2004). pp. 44654-44658. On the Web at http://web.ead.anl.gov/uranium/pdf/PadRODRegister.pdf .
DOE PEIS 1999 (LES Ex. 18)	U.S. Department of Energy, "Final Programmatic Environmental Impact Statement For Alternative Strategies For The Long-Term Management And Use Of Depleted Uranium Hexafluoride", April 1999 (DOE/EIS-0269)
DOE Portsmouth ROD 2004 (NIRS/PC Ex. 106)	U.S. Department of Energy. "Record of decision for construction and operation of a depleted uranium hexafluoride conversion facility at the Portsmouth, OH, Site." <i>Federal Register</i> , v. 69, no. 143 (July 27, 2004). pp. 44649-44654. On the Web at http://web.ead.anl.gov/uranium/pdf/PortRODRegister.pdf .
Envirocare 2005 (NIRS/PC Ex. 179)	Envirocare of Utah, LLC, "State of Utah Radioactive Material License UT 2300249: Amendment 22", adopted June 13, 2005, online at http://www.envllc.com/pages/lp/index.php (as viewed on July 1, 2005)
Envirocare 2005b (NIRS/PC Ex. 180)	Envirocare of Utah, LLC. Press Release, "Envirocare Purchased By Investor Group: New Owners Call for Ban of B & C Waste in the State of Utah", February 1, 2005
EPA 1999 (NIRS/PC Ex. 181)	U.S. Environmental Protection Agency, "Understanding Variation in Partition Coefficient, K_d , Values, Volume II: Review of Geochemistry and Available K_d Values for Cadmium, Cesium, Chromium, Lead, Plutonium, Radon, Strontium, Thorium, Tritium (^3H), and Uranium", August 1999 (EPA 402-R-99-004B)
EPA FGR 13 (NIRS/PC Ex. 111)	Keith F. Eckerman, Richard W. Leggett, Christopher B. Nelson, Jerome S. Puskin, Allan C.B. Richardson. <i>Cancer Risk Coefficients for Environmental Exposure to Radionuclides: Radionuclide-Specific Lifetime Radiogenic Cancer Risk Coefficients for the U.S. Population, Based on Age-Dependent Intake, Dosimetry, and Risk Models.</i> Federal Guidance Report No. 13. EPA 402-R-99-001. Oak Ridge, TN: Oak Ridge National Laboratory; Washington, DC: Office of Radiation and Indoor Air, United States Environmental Protection Agency, September 1999.
EPA FGR 13 CD Supplement 2002 (NIRS/PC Ex. 112)	EPA (2002). U.S. Environmental Protection Agency, <i>Federal Guidance Report 13 Cancer Risk Coefficients for Environmental Exposure to Radionuclides: CD Supplement</i> , EPA 402-C-99-001, Rev. 1 (Oak Ridge National Laboratory, Oak Ridge, TN; U.S. Environmental Protection Agency, Washington, DC).
Etter 1996 (NIRS/PC Ex. 182)	Memo to Susan White, Staff Attorney, From Stephen D. Etter, Staff Geologist for the Texas Natural Resource Conservation Commission, "Suitability of the Waste Control Specialists, Inc. Site, Andrews Country, Texas, for Disposal of Radioactive Wastes, Draft", April 1996.

Fioravanti & and Makhijani 1997 (NIRS/PC Ex. 115)	Marc Fioravanti and Arjun Makhijani. <i>Containing the Cold War Mess: Restructuring the Environmental Management of the U.S. Nuclear Weapons Complex</i> . Takoma Park, Maryland: Institute for Energy and Environmental Research, October 1997. On the Web at http://www.ieer.org/reports/cleanup .
Fioravanti & and Makhijani 1998 (NIRS/PC Ex.116)	Marc Fioravanti and Arjun Makhijani. <i>Supplement to Containing the Cold War Mess</i> <i>IEER's Response to the Department of Energy's Review</i> . Takoma Park, Maryland: Institute for Energy and Environmental Research, March, 1998. On the Web at http://www.ieer.org/reports/cleanup/cln-supp.html .
Fisk 2004 (LES Ex. 98)	Rod Fisk to Rod Krich, "Costs", December 2, 2004. E-mail.
Fisk 2005 (LES ex. 99)	Rod Fisk to Rod Krich, "Transportation of Depleted UF6 and U3O8", March 23, 2005. E-mail.
GAO 2004 (NIRS/PC Ex. 183)	U.S. General Accounting Office, "Low-Level Radioactive Waste: Disposal Availability Adequate in the Short Term, but Oversight Needed to Identify Any Future Shortfalls", Report to the Chairman, Committee on Energy and Natural Resources, U.S. Senate, June 2004 (GAO-04-604)
GAO/RCED-92-183 (NIRS/PC Ex. 211)	U.S. General Accounting Office, "Nuclear Waste: Defense Waste Processing Facility – Cost, Schedule, and Technical Issues", Report to the Chairman, Environment, Energy, and Natural Resources Subcommittee, Committee on Government Operations, House of Representatives, June 1992 (GAO/RCED-92-183)
GAO/RCED-93-87 (NIRS/PC Ex. 212)	U.S. General Accounting Office, "Federal Research: Super Collider is Over Budget and Behind Schedule", Report to the Congressional Requesters, February 1999 1993 (GAO/RCED-93-87)
GAO/RCED-97-63 (NIRS/PC Ex. 213)	U.S. General Accounting Office, "Department of Energy: Management and Oversight of Cleanup Activities at Fernald", Report to the Congressional Requesters, March 1997 (GAO/RCED-97-63)
GAO/T-RCED-93-58 (NIRS/PC Ex. 214)	U.S. General Accounting Office, "Nuclear Waste: Yucca Mountain Project Management and Funding Issues", Statement of Jim Wells, Testimony before the Subcommittee on Energy and Power, Committee on Energy and Commerce and the Subcommittee on Energy and Mineral Resources, Committee on Natural Resources, House of Representatives, July 1, 1993 (GAO/T-RCED-93-58)
GAO/T-RCED-99-21 (NIRS/PC Ex. 215)	U.S. General Accounting Office, "Nuclear Waste: Schedule, Cost, and Management Issues at DOE's Hanford Tank Waste Project", Statement of Ms. Gary L. Jones, Testimony before the Subcommittee on Oversight and Investigations, Committee on Commerce, House of Representatives, October 8, 1998 (GAO/T-RCED-99-21)
GAO-02-191 (NIRS/PC Ex. 216)	U.S. General Accounting Office, "Nuclear Waste: Technical, Schedule, and Cost Uncertainties of the Yucca Mountain Repository Project", Report to the Congressional Requesters, December 2001 (GAO-02-191)
GAO-03-593 (NIRS/PC Ex. 217)	U.S. General Accounting Office, "Nuclear Waste: Challenges to Achieving Potential Savings in DOE's High-Level Waste Cleanup Program", Report to the Chairman, Subcommittee on Oversight and Investigations, Committee on Energy and Commerce, House of Representatives , June 2003 (GAO-03-593)

Henetz 2005 (NIRS/PC Ex. 184)	Patty Henetz, "Huntsman signs waste-ban measure; Class B and C: The material can be thousands of times hotter than what Envirocare of Utah deals in", <i>Salt Lake City Tribune</i> , February 26, 2005.
Hertzler et al. 1994 (NIRS/PC Ex. 117)	T.J. Hertzler, D.D. Nishimoto, and M.D. Otis. <i>Depleted uranium disposal options evaluation</i> . EGG-MS-11297. Idaho Falls, ID: Waste Management Technology Division, Science Applications International Corporation for EG&G Idaho, Inc. and the U.S. Department of Energy, Office of Environmental Restoration and Waste Management, May 1994.
Holt 2005 (NIRS/PC Ex. 219)	Mark Holt, "Civilian nuclear waste disposal", CRS Issue Brief for Congress, Order code IP92059, Congressional Research Service, Updated June 9, 2005.
Huntoon 2000 (NIRS/PC Ex.118)	Letter from Carolyn L. Huntoon, Assistant Secretary for Environmental Management, U.S. Department of Energy, to Arjun Makhijani, July 18, 2000.
IAEA 2003 (NIRS/PC Ex. 185)	International Atomic Energy Agency, "Scientific and Technical Basis for the Geologic Disposal of Radioactive Wastes", Technical Reports Series No. 413, February 2003 (STI/DOC/010/413)
IAEA/NEA 2001 (NIRS/PC Ex.186)	A Joint Report by the OECD Nuclear Energy Agency and the International Atomic Energy Agency, "Management of Depleted Uranium", 2001
ICRP 81 (NIRS/PC Ex. 122)	International Commission on Radiological Protection. <i>Radiation protection recommendations as applied to the disposal of long-lived solid radioactive waste</i> . Annals of the ICRP, v. 28, no. 4. ICRP publication 81. Kidlington, Oxford; Tarrytown, NY: Pergamon, 1998.
Johnson 2005 (NRC Staff Ex. 39)	Timothy C. Johnson to James W. Clifford, "April 19, 2005, In-Office Review Summary: Louisiana Energy Services Decommissioning Funding", April 29, 2005. Internal NRC memo.
Kozak et al. 1992 (NIRS/PC Ex. 128)	Matthew W. Kozak, Thomas A. Feeney, Christi D. Leigh, Harlan W. Stockman. <i>Performance assessment of the proposed disposal of depleted uranium as Class A Low-level Wastewaste</i> . FIN A1764 Final Letter Report submitted December 16, 1992 to F.W. Ross (Low-Level Waste Management Branch, Office of Nuclear Material Safety and Safeguards, Nuclear Regulatory Commission). Albuquerque, NM: Sandia National Laboratories, 1992.
Krich 2005 (NIRS/PC Ex. 187)	Letter to Director, Office of Nuclear Material Safety and Safeguards, U.S. Nuclear Regulatory Commission, From R.M. Krich, LES, "Clarifying Information Related to Depleted UF ₆ Disposition Costs and Request for License Condition", March 29, 2005 (NEF#05-016)
Krich 2005b (NIRS/PC Ex. 188)	Letter to Director, Office of Nuclear Material Safety and Safeguards, U.S. Nuclear Regulatory Commission, From R.M. Krich, LES, "Clarifying Information Related to Depleted UF ₆ Disposition Costs and Application for Withholding Information from Public Disclosure", April 8, 2005 (NEF#05-017)
LES 2005/08/11 (NIRS/PC Ex. 221)	U.S. Nuclear Regulatory Commission, before the Atomic Safety and Licensing Board, In the Matter of Louisiana Energy Services, L.P. (National Enrichment Facility), "Applicant's Objections and Responses to Nuclear Information and Resource Service's and Public Citizen's Second Supplemental Interrogatories and Document Request", Docket No. 70-3103-ML, ASLBP No. 04-826-01-ML, August 11, 2005.

LES Business Study 2004 (LES Ex. 91)	<i>Business study: tails deconversion and cylinder washing plants at Urenco (Capenhurst) Limited.</i> 26 th August 2004. Protected Materials. Bates no. LES-PRO-00631 etc.
LES NEF UF6 info sheet (NIRS/PC Ex. 134)	Louisiana Energy Services. <i>Uranium hexafluoride deconversion and disposal in the United States.</i> National Enrichment Facility Information Sheet, Version 2. 1-19-04. On the Web at http://www.nefnm.com/documents/infosheets/uranium.pdf .
LES SAR 2004 (NIRS/PC Ex. 222)	Louisiana Energy Services, "National Enrichment Facility License Application Safety Analysis Report", Revision 2, July 2004, On the Web at http://www.nrc.gov/materials/fuel-cycle-fac/ml042190038.pdf .
LLNL 1997 CA (NIRS/PC Ex. 56)	Hatem Elayat, Julie Zoller, Lisa Szytel. <i>Cost analysis report for the long-term management of depleted uranium hexafluoride.</i> UCRL-AR-127650. Livermore, CA: Lawrence Livermore National Laboratory, May 1997. Summary (26 p) on the Web at http://www.osti.gov/energycitations/product.biblio.jsp?osti_id=575544&queryId=3&start=0 .
LLNL 1997 EA (NIRS/PC Ex. 55)	J.W. Dubrin, J.N. Zoller, L. Rahm-Crites, et al. <i>Depleted Uranium Hexafluoride Program: Engineering analysis report for the long-term management of depleted uranium hexafluoride.</i> UCRL-AR-124080, Rev 2. Livermore, CA: Lawrence Livermore National Laboratory, May 1997. (Volumes I & II). On the Web at http://www.llnl.gov/tid/lof/documents/toc/231539.html .
LLNL Wilt 1997 (NIRS/PC Ex. 135)	Gloria Wilt. "Dealing with a Dangerous Surplus from the Cold War." Lawrence Livermore National Laboratory UCRL-52000-97-4. <i>Science & technology review</i> (April 1997) pp. 4-13. On the Web at http://www.llnl.gov/str/pdfs/04_97.pdf .
LMI 2004 (LES Ex. 86)	Eve M. Meek, David R. Gallay, Douglas A. Gray, and Gerald W. Westerbeck, "An Analysis of DOE's Cost to Dispose of DUF6", LMI Government Consulting, December 2004 (Report DE523T1)
Makhijani & Boyd 2001 (NIRS/PC Ex. 137)	Arjun Makhijani and Michele Boyd. <i>Poison in the Vadose Zone: An examination of the threats to the Snake River Plain aquifer from the Idaho National Engineering and Environmental Laboratory.</i> Takoma Park, Maryland: Institute for Energy and Environmental Research, October 2001. On the Web at http://www.ieer.org/reports/poison/pvz.pdf .
Makhijani & Boyd 2004 (NIRS/PC Ex. 136)	Arjun Makhijani and Michele Boyd. <i>Nuclear Dumps by the Riverside: Threats to the Savannah River from Radioactive Contamination at the Savannah River Site (SRS).</i> Takoma Park, Maryland: Institute for Energy and Environmental Research, March 11, 2004. On the Web at http://www.ieer.org/reports/srs/index.html .
Makhijani and Gopal 2001 (NIRS/PC Ex. 189)	Arjun Makhijani and Sriram Gopal, "Setting Cleanup Standards to Protect Future Generations: The Scientific Basis of the Subsistence Farmer Scenario and Its Application to the Estimation of Radionuclide Soil Action Levels (RSALs) for Rocky Flats", December 2001.
Makhijani and Smith 2004 (NIRS/PC Ex. 190)	Arjun Makhijani and Brice Smith, "Costs and Risks of Management and Disposal of Depleted Uranium from the National Enrichment Facility Proposed to be Built in Lea County New Mexico by LES", November 24, 2004.

Makhijani October 2000 (NIRS/PC Ex. 138)	Arjun Makhijani. Letter from IEER to Carolyn Huntoon, Assistant Secretary for Environmental Management, United States Department of Energy October 13, 2000 On the Web http://www.ieer.org/comments/waste/tru2hunt.html .
MOA 2005 (LES Ex. 105)	E. James Ferland, President and CEO Louisiana Energy Services, L.P. and George E. Dials, President and COO Waste Control Specialists LLC, "Memorandum of Agreement between Louisiana Energy Services, L.P. and Waste Control Specialists LLC", January 14, 2005.
NAS/NRC 1996 (NIRS/PC Ex. 150)	National Research Council. Committee on Decontamination and Decommissioning of Uranium Enrichment Facilities. <i>Affordable Cleanup? Opportunities for cost reduction in the decontamination and decommissioning of the nation's uranium enrichment facilities.</i> Washington, DC: National Academies Press, 1996.
NAS/NRC 2003 (NIRS/PC Ex. 151)	National Research Council. Board on Radioactive Waste Management. Committee on Improving the Scientific Basis for Managing Nuclear Materials and Spent Nuclear Fuel through the Environmental Management Science Program. <i>Improving the Scientific Basis for Managing DOE's Excess Nuclear Materials and Spent Nuclear Fuel.</i> Washington, DC: National Academies Press, 2003.
NAS/NRC 2005 (NIRS/PC Ex. 225)	Richard R. Monson (Chair) et al., "Health Risks from Exposure to Low Levels of Ionizing Radiation: BEIR VII – Phase 2", Committee to Assess Health Risks from Exposure to Low Levels of Ionizing Radiation, Board on Radiation Effects Research, National Academies Press, Washington, DC (2005)
NEF DEIS 2004 (NIRS/PC Ex. 152)	U.S. Nuclear Regulatory Commission, "Environmental Impact Statement for the Proposed National Enrichment Facility in Lea County, New Mexico: Draft Report for Comment", September 2004 (NUREG-1790)
NEF FEIS 2005 (NIRS/PC Ex. 191)	U.S. Nuclear Regulatory Commission, "Environmental Impact Statement for the Proposed National Enrichment Facility in Lea County, New Mexico: Final Report", Chapters 1 through 10 and Appendices A through G, June 2005 (NUREG-1790, Vol. 1)
NRC 1991 (NIRS/PC Ex. 193)	James M. Taylor, "Disposition of Depleted Uranium Tails from Enrichment Plants", Enclosure: Factors Involved in the Disposition of Depleted Uranium Hexafluoride DUF ₆ Tails, January 25, 1991 (SECY-91-019)
NRC 2002 (NIRS/PC Ex. 88)	U.S. Nuclear Regulatory Commission, "Nuclear Regulatory Legislation: 107th Congress; 1st Session", June 2002 (NUREG-0980 Vol. 1, No. 6)
NRC 2005 (NIRS/PC Ex. 195)	U.S. Nuclear Regulatory Commission in the matter of Louisiana Energy Services, L.P. (National Enrichment Facility), "Memorandum and Order", CLI-05-05, Docket No. 70-3103-ML, January 18, 2005
NRC CEC EIS Final 1994 (NIRS/PC Ex. 58)	U.S. Nuclear Regulatory Commission. Office of Nuclear Material Safety and Safeguards. <i>Final Environmental Impact Statement for the Construction and Operation of Claiborne Enrichment Center, Homer, Louisiana.</i> NUREG-1484. Washington, DC, September 2004.

NUREG 1757, Vol.3 (NIRS/PC Ex. 249)	U.S. Nuclear Regulatory Commission, Office of Nuclear Material Safety and Safeguards, Division of Waste Management, <i>Consolidated NMSS Decommissioning Guidance: Financial Assurance, Recordkeeping, and Timeliness, Final Report</i> , Prepared by T.L. Fredrichs, E.R. Pogue, M.C. Maier, and R. N. Young, August 2005 (NUREG-1757 Vol.3)
Paducah FEIS 2004 (LES Ex. 17)	U.S. Department of Energy, "Final Environmental Impact Statement for Construction and Operation of a Depleted Uranium Hexafluoride Conversion Facility at the Paducah, Kentucky, Site", Volume 1: Main Text and Appendixes A-H, June 2004 (DOE/EIS-0359)
Portsmouth FEIS 2004 (LES Ex. 16)	U.S. Department of Energy, "Final Environmental Impact Statement for Construction and Operation of a Depleted Uranium Hexafluoride Conversion Facility at the Portsmouth, Ohio, Site", Volume 1: Main Text and Appendixes A-H, June 2004 (DOE/EIS-0360)
Rod Krich Deposition August 26, 2005 (NIRS/PC Ex. 226)	<i>Deposition of Rod Krich</i> . Friday, August 26, 2005. In the matter of Louisiana Energy Services (National Enrichment Facility) v. Nuclear Information and Resource Service and Public Citizen. U.S. Nuclear Regulatory Commission, Docket No. 70-3103-ML; ASLBP No. 04-826-01-ML. Deposition took place in offices of Winston & Strawn, Washington, DC.
Rowberg 2001 (NIRS/PC Ex.227)	Richard Rowberg, "The National Ignition Facility: Management, Technical, and Other Issues", CRS report for Congress, Order code RL30540, Congressional Research Service, Updated November 8, 2001.
Saunders and Young 1983 (NIRS/PC Ex. 196)	Ian Saunders and Anthony Young, "Rates of Surface Processes on Slopes, Slope Retreat, and Denudation", <i>Earth Surface Processes and Landforms</i> , Vol. 8, 473-501 (1983)
Schenk and Jackson 2002 (NIRS/PC Ex. 197)	H. Jochen Schenk and Robert B. Jackson, "Rooting depths, lateral root spreads and below-ground/above-ground allometries of plants in water-limited ecosystems", <i>Journal of Ecology</i> , Vol. 90, 480-494 (2002)
Smith 2004 (NIRS/PC Ex.160)	Brice Smith. <i>What the DOE Knows it Doesn't Know about Grout: Serious Doubts Remain About the Durability of Concrete Proposed to Immobilize High-Level Nuclear Waste in the Tank Farms at the Savannah River Site and other DOE Sites</i> . Institute for Energy and Environmental Research, Takoma Park, Maryland updated October 18, 2004. On the web at http://www.ieer.org/reports/srs/grout.pdf .
TCEQ 2003 (NIRS/PC Ex. 228)	Texas Commission on Environmental Quality, "Lineup of Legislation, The TCEQ's playbook grows with new responsibilities, laws to implement", <i>Natural Outlook</i> , Summer 2003, online at http://www.tceq.state.tx.us/AC/comm_exec/forms_pubs/pubs/pd/020/03-03/legislation.html (Last Modified 8/4/05)
Texas Agreement 1963 (NIRS/PC Ex. 198)	Glenn T. Seaborg, Chairman of the Atomic Energy Commission, and Price Daniel, Governor of Texas, "Agreement Between the United States Atomic Energy Commission and the State of Texas for Discontinuance of Certain Commission Regulatory Authority and Responsibility Within the State Pursuant to Section 274 of the Atomic Energy Act of 1954, as Amended", 1963.

WCS 2004 (NIRS/PC Ex. 199)	Waste Control Specialists, LLC., "Application for License to Authorize Near-Surface Land Disposal of Low-Level Radioactive Waste", originally filed on August 4, 2004 and ruled Administratively Complete by the Texas Commission on Environmental Quality on February 18, 2005, available online at http://64.224.191.188/wcs/ .
Wheatley 2005 (NIRS/PC Ex. 200)	Letter from Wade M. Wheatley to Glenn Shankle, "License Application for a Proposed Low-Level Radioactive Waste Disposal Facility: Evaluation of Merit", Texas Commission on Environmental Quality, April 26, 2005.
Yu et al. 1993 (NIRS/PC Ex. 201)	C. Yu, C. Loureiro, J.-J. Cheng, L.G. Jones, Y.Y. Wang, Y.P. Chia, and E. Faillace. <i>Data collection handbook to support modeling impacts of radioactive material in soil</i> . Argonne, IL: Environmental Assessment and Information Sciences Division, Argonne National Laboratory, April 1993. On the Web at http://web.ead.anl.gov/resrad/documents/data_collection.pdf .

Curriculum Vita of
Arjun Makhijani

Address and Phone:

Institute for Energy and Environmental Research
6935 Laurel Ave., Suite 201
Takoma Park, MD 20912
Phone: 301-270-5500
e-mail: arjun@ieer.org
Website www.ieer.org

Education:

Ph.D. University of California, Berkeley, 1972, from the Department of Electrical Engineering. Area of specialization: plasma physics as applied to controlled nuclear fusion. Dissertation topic: multiple mirror confinement of plasmas.
M.S. (Electrical Engineering) Washington State University, Pullman, Washington, 1967. Thesis topic: electromagnetic wave propagation in the ionosphere.
Bachelor of Engineering (Electrical), University of Bombay, Bombay, India, 1965.

Current Employment:

1987-present: President and Senior Engineer, Institute for Energy and Environmental Research, Takoma Park, Maryland. (part-time in 1987).
February 3, 2004-present, Associate, SC&A, Inc., one of the principal investigators in the audit of the reconstruction of worker radiation doses under the Energy Employees Occupational Illness Compensation Program Act under contract to the Centers for Disease Control and Prevention, U.S. Department of Health and Human Services.

Other Long-term Employment

1984-88: Associate Professor, Capitol College, Laurel, Maryland (part-time in 1988).
1983-84: Assistant Professor, Capitol College, Laurel, Maryland.
1977-79: Visiting Professor, National Institute of Bank Management, Bombay, India. Principal responsibility: evaluation of the Institute's extensive pilot rural development program.
1975-87: Independent consultant (see page 2 for details)
1972-74: Project Specialist, Ford Foundation Energy Policy Project. Responsibilities included research and writing on the technical and economic aspects of energy conservation and supply in the U.S.; analysis of Third World rural energy problems; preparation of requests for proposals; evaluation of proposals; and the management of grants made by the Project to other institutions.
1969-70: Assistant Electrical Engineer, Kaiser Engineers, Oakland California. Responsibilities included the design and checking of the electrical aspects of mineral industries such as cement plants, and plants for processing mineral ores such as lead and uranium ores. Pioneered the use of the desk-top computer at Kaiser Engineers for performing electrical design calculations.

Professional Societies:

Institute of Electrical and Electronics Engineers and its Power Engineering Society
American Physical Society
Health Physics Society
American Association for the Advancement of Science

Awards:

The John Bartlow Martin Award for Public Interest Magazine Journalism of the Medill School of Journalism, Northwestern University, 1989, with Robert Alvarez.

Consulting Experience, 1975-1987

Consultant on a wide variety of issues relating to technical and economic analyses of alternative energy sources; electric utility rates and investment planning; energy conservation; analysis of energy use in agriculture; US energy policy; energy policy for the Third World; evaluations of portions of the nuclear fuel cycle.

Partial list of institutions to which I was a consultant in the 1975-87 period:

Tennessee Valley Authority
Lower Colorado River Authority
Federation of Rocky Mountain States
Environmental Policy Institute
Lawrence Berkeley Laboratory
Food and Agriculture Organization of the United Nations
International Labour Office of the United Nations
United Nations Environment Programme
United Nations Center on Transnational Corporations
The Ford Foundation
Economic and Social Commission for Asia and the Pacific
United Nations Development Programme

Languages: English, French, Hindi, Sindhi, and Marathi.

Reports, Books, and Articles (Partial list)

(Newsletter, newspaper articles, excerpts from publications reprinted in books and magazines or adapted therein, and other similar publications are not listed below)

Hower, G.L., and A. Makhijani, "Further Comparison of Spread-F and Backscatter Sounder Measurements," *Journal of Geophysical Research*, 74, p. 3723, 1969.

Makhijani, A., and A.J. Lichtenberg, *An Assessment of Energy and Materials Utilization in the U.S.A.*, University of California Electronics Research Laboratory, Berkeley, 1971.

Logan, B. G., A.J. Lichtenberg, M. Lieberman, and A. Makhijani, "Multiple-Mirror Confinement of Plasmas," *Physical Review Letters*, 28, 144, 1972.

Makhijani, A., and A.J. Lichtenberg, "Energy and Well-Being," *Environment*, 14, 10, June 1972.

Makhijani, A., A.J. Lichtenberg, M. Lieberman, and B. Logan, "Plasma Confinement in Multiple Mirror Systems. I. Theory," *Physics of Fluids*, 17, 1291, 1974.

A Time to Choose: America's Energy Future, final report of the Ford Foundation Energy Policy Project, Ballinger, Cambridge, 1974. One of many co-authors.

Makhijani, A., and A. Poole, *Energy and Agriculture in the Third World*, Ballinger, Cambridge, 1975.

Makhijani, A., *Energy Policy for the Rural Third World*, International Institute for Environment and Development, London, 1976.

Kahn, E., M. Davidson, A. Makhijani, P. Caeser, and S. Berman, *Investment Planning in the Energy Sector*, Lawrence Berkeley Laboratory, Berkeley, 1976.

- Makhijani, A., "Solar Energy for the Rural Third World," *Bulletin of the Atomic Scientists*, May 1977.
- Makhijani, A., "Energy Policy for Rural India," *Economic and Political Weekly*, 12, Bombay, 1977.
- Makhijani, A., *Some Questions of Method in the Tennessee Valley Authority Rate Study*, Report to the Tennessee Valley Authority, Chattanooga, 1978.
- Makhijani, A., *The Economics and Sociology of Alternative Energy Sources*, Economic and Social Commission for Asia and the Pacific, 1979.
- Makhijani, A., *Energy Use in the Post-Harvest Component of the Food Systems in Ivory Coast and Nicaragua*, Food and Agriculture Organization of the United Nations, Rome, 1982.
- Makhijani, A., *Oil Prices and the Crises of Debt and Unemployment: Methodological and Structural Aspects*, International Labour Office of the United Nations, Final Draft Report, Geneva, April 1983.
- Makhijani, A., and D. Albright, *The Irradiation of Personnel at Operation Crossroads*, International Radiation Research and Training Institute, Washington, D.C., 1983.
- Makhijani, A., K.M. Tucker, with Appendix by D. White, *Heat, High Water, and Rock Instability at Hanford*, Health and Energy Institute, Washington, D.C., 1985.
- Makhijani, A., and J. Kelly, *Target: Japan - The Decision to Bomb Hiroshima and Nagasaki*, July 1985, a report published as a book in Japanese under the title, *Why Japan?*, Kyoikusha, Tokyo, 1985.
- Makhijani, A., *Experimental Irradiation of Air Force Personnel During Operation Redwing - 1956*, Environmental Policy Institute, Washington, D.C., 1985.
- Makhijani, A., and R.S. Browne, "Restructuring the International Monetary System," *World Policy Journal*, New York, Winter, 1985-86.
- Makhijani, A., R. Alvarez, and B. Blackwelder, *Deadly Crop in the Tank Farm: An Assessment of Management of High-Level Radioactive Wastes in the Savannah River Plant Tank Farm*, Environmental Policy Institute, Washington, D.C., 1986.
- Makhijani, A., "Relative Wages and Productivity in International Competition," *College Industry Conference Proceedings*, American Society for Engineering Education, Washington, D.C., 1987.
- Makhijani, A., *An Assessment of the Energy Recovery Aspect of the Proposed Mass Burn Facility at Preston, Connecticut*, Institute for Energy and Environmental Research, Takoma Park, 1987.
- Makhijani, A., R. Alvarez, and B. Blackwelder, *Evading the Deadly Issues: Corporate Mismanagement of America's Nuclear Weapons Production*, Environmental Policy Institute, Washington, D.C., 1987.
- Makhijani, A., *Release Estimates of Radioactive and Non-Radioactive Materials to the Environment by the Feed Materials Production Center, 1951-85*, Institute for Energy and Environmental Research, Takoma Park, 1988.
- Alvarez, R., and A. Makhijani, "The Hidden Nuclear Legacy," *Technology Review*, 91, 42, 1988.
- Makhijani, A., Annie Makhijani, and A. Bickel, *Saving Our Skins: Technical Potential and Policies for the Elimination of Ozone-Depleting Chlorine Compounds*, Environmental Policy Institute and Institute for Energy and Environmental Research, Takoma Park, 1988.

Makhijani, A., Annie Makhijani, and A. Bickel, *Reducing Ozone-Depleting Chlorine and Bromine Accumulations in the Stratosphere: A Critique of the U.S. Environmental Protection Agency's Analysis and Recommendations*, Institute for Energy and Environmental Research and Environmental Policy Institute/Friends of the Earth, Takoma Park, 1989.

Makhijani, A., and B. Franke, *Addendum to Release Estimates of Radioactive and Non-Radioactive Materials to the Environment by the Feed Materials Production Center, 1951-85*, Institute for Energy and Environmental Research, Takoma Park, 1989.

Makhijani, A., *Global Warming and Ozone Depletion: An Action Program for States*, Institute for Energy and Environmental Research, Takoma Park, 1989.

Makhijani, A., *Managing Municipal Solid Wastes in Montgomery County*, Prepared for the Sugarloaf Citizens Association, Institute for Energy and Environmental Research, Takoma Park, 1990.

Saleska, S., and A. Makhijani, *To Reprocess or Not to Reprocess: The Purex Question - A Preliminary Assessment of Alternatives for the Management of N-Reactor Irradiated Fuel at the U.S. Department of Energy's Hanford Nuclear Weapons Production Facility*, Institute for Energy and Environmental Research, Takoma Park, 1990.

Makhijani, A., "Common Security is Far Off," *Bulletin of the Atomic Scientists*, May 1990.

Makhijani, A., *Draft Power in South Asian Agriculture: Analysis of the Problem and Suggestions for Policy*, prepared for the Office of Technology Assessment, Institute for Energy and Environmental Research, Takoma Park, 1990.

Mehta, P.S., S.J. Mehta, A.S. Mehta, and A. Makhijani, "Bhopal Tragedy's Health Effects: A Review of Methyl Isocyanate Toxicity," *JAMA* 264, 2781, December 1990.

Special Commission of International Physicians for the Prevention of Nuclear War and the Institute for Energy and Environmental Research, *Radioactive Heaven and Earth: The Health and Environmental Effects of Nuclear Weapons Testing In, On, and Above the Earth*, Apex Press, New York, 1991. One of many co-authors.

Makhijani, A., and S. Saleska, *High Level Dollars Low-Level Sense: A Critique of Present Policy for the Management of Long-Lived Radioactive Waste and Discussion of an Alternative Approach*, Apex Press, New York, 1992.

Makhijani, A., *From Global Capitalism to Economic Justice: An Inquiry into the Elimination of Systemic Poverty, Violence and Environmental Destruction in the World Economy*, Apex Press, New York, 1992.

Special Commission of International Physicians for the Prevention of Nuclear War and the Institute for Energy and Environmental Research, *Plutonium: Deadly Gold of the Nuclear Age*, International Physicians Press, Cambridge, MA, 1992. One of several co-authors.

Makhijani, A., "Energy Enters Guilty Plea," *Bulletin of the Atomic Scientists*, March/April 1994.

Makhijani, A., "Open the Files," *Bulletin of the Atomic Scientists*, Jan./Feb. 1995.

Makhijani, A., "'Always' the Target?" *Bulletin of the Atomic Scientists*, May/June 1995.

Makhijani, A., and Annie Makhijani, *Fissile Materials in a Glass, Darkly: Technical and Policy Aspects of the Disposition of Plutonium and Highly Enriched Uranium*, IEER Press, Takoma Park, 1995.

Makhijani, A., and K. Gurney, *Mending the Ozone Hole: Science, Technology, and Policy*, MIT Press, Cambridge, MA, 1995.

Makhijani, A., H. Hu, K. Yih, eds., *Nuclear Wastelands: A Global Guide to Nuclear Weapons Production and the Health and Environmental Effects*, MIT Press, Cambridge, MA, 1995.

- Zerriffi, H., and A. Makhijani, *The Nuclear Safety Smokescreen: Warhead Safety and Reliability and the Science Based Stockpile Stewardship Program*, Institute for Energy and Environmental Research, Takoma Park, May 1996.
- Zerriffi, H., and A. Makhijani, "The Stewardship Smokescreen," *Bulletin of the Atomic Scientists*, September/October 1996.
- Makhijani, A., *Energy Efficiency Investments as a Source of Foreign Exchange*, prepared for the International Energy Agency Conference in Chelyabinsk, Russia, 24-26 September 1996.
- Makhijani, A., "India's Options," *Bulletin of the Atomic Scientists*, March/April 1997.
- Ortmeyer, P. and A. Makhijani, "Worse than We Knew," *Bulletin of the Atomic Scientists*, November/December 1997.
- Fioravanti, M., and A. Makhijani, *Containing the Cold War Mess: Restructuring the Environmental Management of the U.S. Nuclear Weapons Complex*, Institute for Energy and Environmental Research, Takoma Park, October 1997.
- Principal author of three chapters in Schwartz, S., ed., *Atomic Audit: The Costs and Consequences of U.S. Nuclear Weapons Since 1940*, Brookings Institution, Washington, D.C., 1998.
- Franke, B., and A. Makhijani, *Radiation Exposures in the Vicinity of the Uranium Facility in Apollo, Pennsylvania*, Institute for Energy and Environmental Research, Takoma Park, February 2, 1998.
- Fioravanti, M., and A. Makhijani, *Supplement to Containing the Cold War Mess- IEER's Response to the Department of Energy's Review*, Institute for Energy and Environmental Research, Takoma Park, March 1998.
- Makhijani, A., "A Legacy Lost," *Bulletin of the Atomic Scientists*, July/August 1998.
- Makhijani, A., and Hisham Zerriffi, *Dangerous Thermonuclear Quest: The Potential of Explosive Fusion Research for the Development of Pure Fusion Weapons*, Institute for Energy and Environmental Research, Takoma Park, July 1998.
- Makhijani, A., and Scott Saleska, *The Nuclear Power Deception - U.S. Nuclear Mythology from Electricity "Too Cheap to Meter" to "Inherently Safe" Reactors*, Apex Press, New York, 1999.
- Makhijani, A., "Stepping Back from the Nuclear Cliff," *The Progressive*, vol. 63, no. 8, August 1999.
- Makhijani, A., Bernd Franke, and Hisham Zerriffi, *Preliminary Partial Dose Estimates from the Processing of Nuclear Materials at Three Plants during the 1940s and 1950s*, Institute for Energy and Environmental Research, Takoma Park, September 2000. (Prepared under contract to the newspaper *USA Today*.)
- Makhijani, A., and Bernd Franke, *Final Report of the Institute for Energy and Environmental Research on the Second Clean Air Act Audit of Los Alamos National Laboratory by the Independent Technical Audit Team*, Institute for Energy and Environmental Research, Takoma Park, December 13, 2000.
- Makhijani, A., *Plutonium End-Game: Managing Global Stocks of Separated Weapons-Usable Commercial and Surplus Nuclear Weapons Plutonium*, Institute for Energy and Environmental Research, Takoma Park, January 2001.
- Makhijani, A., Hisham Zerriffi, and Annie Makhijani, "Magical Thinking: Another Go at Transmutation," *Bulletin of the Atomic Scientists*, March/April 2001.
- Makhijani, A., *Ecology and Genetics: An Essay on the Nature of Life and the Problem of Genetic Engineering*. New York: Apex Press, 2001.
- Makhijani, A., "Burden of Proof," *Bulletin of the Atomic Scientists*, July/August 2001.
- Makhijani, A., "Reflections on September 11, 2001," in Kamla Bhasin, Smitu Kothari, and Bindia Thapar, eds., *Voices of Sanity: Reaching Out for Peace*, Lokayan, New Delhi, 2001, pp. 59-64.

- Makhijani, A., and Michele Boyd, *Poison in the Vadose Zone: An examination of the threats to the Snake River Plain aquifer from the Idaho National Engineering and Environmental Laboratory* Institute for Energy and Environmental Research, Takoma Park, October 2001.
- Makhijani, A., *Securing the Energy Future of the United States: Securing the Energy Future of the United States: Oil, Nuclear, and Electricity Vulnerabilities and a post-September 11, 2001 Roadmap for Action*, Institute for Energy and Environmental Research, Takoma Park, November 2001.
- Makhijani, A., and Sriram Gopal, *Setting Cleanup Standards to Protect Future Generations: The Scientific Basis of Subsistence Farmer Scenario and Its Application to the Estimation of Radionuclide Soil Action Levels (RSALs) for Rocky Flats*, Institute for Energy and Environmental Research, Takoma Park, December 2001.
- Makhijani, A., "Some Factors in Assessing the Response to September 11, 2001," *Medicine and Global Survival*, International Physicians for the Prevention of Nuclear War, Cambridge, Mass., February 2002.
- Makhijani, Annie, Linda Gunter, and A. Makhijani. *Cogéma: Above the Law?: Concerns about the French Parent Company of a U.S. Corporation Set to Process Plutonium in South Carolina*. A report prepared by Institute for Energy and Environmental Research and Safe Energy Communication Council. Takoma Park, MD, May 7, 2002.
- Deller, N., A., Makhijani, and J. Burroughs, eds., *Rule of Power or Rule of Law? An Assessment of U.S. Policies and Actions Regarding Security-Related Treaties*, Apex Press, New York, 2003.
- Makhijani, A., "Nuclear targeting: The first 60 years," *Bulletin of the Atomic Scientists*, May/June 2003.
- Makhijani, A., "Strontium," *Chemical & Engineering News*, September 8, 2003.
- Makhijani, A., and Nicole Deller, *NATO and Nuclear Disarmament: An Analysis of the Obligations of the NATO Allies of the United States under the Nuclear Non-Proliferation Treaty and the Comprehensive Test Ban Treaty*, Institute for Energy and Environmental Research, Takoma Park, Maryland, October 2003.
- Makhijani, A., *Manifesto for Global Democracy: Two Essays on Imperialism and the Struggle for Freedom*, Apex Press, New York, 2004.
- Makhijani, A., "Atomic Myths, Radioactive Realities: Why nuclear power is a poor way to meet energy needs," *Journal of Land, Resources, & Environmental Law*, v. 24, no. 1, 2004, pp. 61-72. Adapted from an oral presentation given on April 18, 2003, at the Eighth Annual Wallace Stegner Center Symposium titled "Nuclear West: Legacy and Future," held at the University of Utah S.J. Quinney College of Law."
- Makhijani, A., and Michele Boyd, *Nuclear Dumps by the Riverside: Threats to the Savannah River from Radioactive Contamination at the Savannah River Site*, Institute for Energy and Environmental Research, Takoma Park, Maryland, forthcoming, March 2004.
- Makhijani, A., and Brice Smith, *The Role of E.I. du Pont de Nemours and Company (Du Pont) and the General Electric Company in Plutonium Production and the Associated I-131 Emissions from the Hanford Works*, Institute for Energy and Environmental Research, Takoma Park, Maryland, March 30, 2004.
- Makhijani, A., Peter Bickel, Aiyou Chen, and Brice Smith, *Cash Crop on the Wind Farm: A New Mexico Case Study of the Cost, Price, and Value of Wind-Generated Electricity*, Institute for Energy and Environmental Research, Takoma Park, Maryland, April 2004.
- Makhijani, A., Lois Chalmers, and Brice Smith, *Uranium Enrichment: Just Plain Facts to Fuel an Informed Debate on Nuclear Proliferation and Nuclear Power*, Institute for Energy and Environmental Research, Takoma Park, Maryland, October 15, 2004.
- Makhijani, A., and Brice Smith, *Costs and Risks of Management and Disposal of Depleted Uranium from the National Enrichment Facility Proposed to be Built in Lea County New Mexico by LES*, Institute for Energy and Environmental Research, Takoma Park, Maryland, November 24, 2004.

Institute for Energy and Environmental Research, *Lower Bound for Cesium-137 Releases from the Sodium Burn Pit at the Santa Susana Field Laboratory*, IEER, Takoma Park, Maryland, January 13, 2005.
(Authored by A. Makhijani and Brice Smith.)

Institute for Energy and Environmental Research, *Iodine-131 Releases from the July 1959 Accident at the Atomics International Sodium Reactor Experiment*, IEER, Takoma Park, Maryland, January 13, 2005.
(Authored by A. Makhijani and Brice Smith.)

Makhijani, A., and Brice Smith. *Update to Costs and Risks of Management and Disposal of Depleted Uranium from the National Enrichment Facility Proposed to be Built in Lea County New Mexico by LES*. Institute for Energy and Environmental Research, Takoma Park, Maryland, July 5, 2005.

CERTIFICATE OF SERVICE

Pursuant to 10 CFR § 2.305 the undersigned attorney of record certifies that on October 18, 2005, the foregoing Revised Direct Testimony of Dr. Arjun Makhijani in Support of NIRS/PC Contentions EC-3/TC-1, EC-5/TC-2, and EC-6/TC-3 concerning LES's Disposal Strategy and Cost Estimate was served by expedited delivery upon the following:

G. Paul Bollwerk, III
Atomic Safety and Licensing Board Panel
U.S. Nuclear Regulatory Commission
Third Floor, Two White Flint North
11545 Rockville Pike
Rockville, MD 20852-2738
e-mail: gpb@nrc.gov

Dr. Paul B. Abramson
Atomic Safety and Licensing Board Panel
U.S. Nuclear Regulatory Commission
Third Floor, Two White Flint North
11545 Rockville Pike
Rockville, MD 20852-2738
e-mail: pba@nrc.gov

Dr. Charles N. Kelber
Atomic Safety and Licensing Board Panel
U.S. Nuclear Regulatory Commission
Third Floor, Two White Flint North
11545 Rockville Pike
Rockville, MD 20852-2738
e-mail: CKelber@att.net

James Curtiss, Esq.
David A. Repka, Esq.
Martin J. O'Neill, Esq.
Winston & Strawn
1700 K Street, N.W.
Washington, D.C. 20006-3817
e-mail: jcurtiss@winston.com
drepka@winston.com
moneill@winston.com

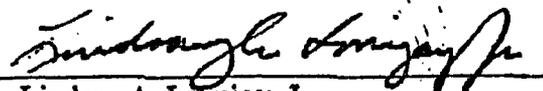
John W. Lawrence, Esq.
National Enrichment Facility
100 Sun Ave., N.E.
Suite 204
Albuquerque, NM 87109 (by Fedex)
e-mail: jlawrence@nefnm.com

Office of the General Counsel
U.S. Nuclear Regulatory Commission
One White Flint North
11555 Rockville Pike
Rockville, MD 20852-2738
Attention: Lisa B. Clark, Esq.
e-mail: OGCMailCenter@nrc.gov

lbc@nrc.gov
abc1@nrc.gov
jth@nrc.gov
dmr1@nrc.gov
dac3@nrc.gov

Office of Commission Appellate Adjudication
Mail Stop O-16C1
U.S. Nuclear Regulatory Commission
One White Flint North
11555 Rockville Pike
Rockville, MD 20852-2738

Secretary
U.S. Nuclear Regulatory Commission
One White Flint North
11555 Rockville Pike
Rockville, MD 20852-2738
Attention: Rulemakings and Adjudications Staff
e-mail: hearingdocket@nrc.gov



Lindsay A. Lovejoy, Jr.
618 Paseo de Peralta, Unit B
Santa Fe, NM 87501
(505) 983-1800
(505) 983-0036 (facsimile)
e-mail: lindsay@lindsaylovejoy.com

1 MR. LOVEJOY: And do you have in front of
2 you a copy of your revised rebuttal testimony?

3 WITNESS MAKHIJANI: Yes.

4 MR. LOVEJOY: And what's the date on that?

5 WITNESS MAKHIJANI: October 25, 2005.

6 MR. LOVEJOY: Very good. Does that
7 contain the testimony you're prepared to give before
8 this board under oath?

9 WITNESS MAKHIJANI: Yes.

10 MR. LOVEJOY: We offer that testimony for
11 admission into the record.

12 CHAIR BOLLWERK: All right. Any
13 objections to that testimony being admitted?

14 (No verbal response.)

15 CHAIR BOLLWERK: No? Then the revised
16 rebuttal testimony of Dr. Makhijani concerning LES'
17 disposal strategy and cost estimate dated October
18 25th, 2005 should be entered into the record and
19 adopted as if read.

20 (Whereupon, the revised prefiled rebuttal
21 testimony of Dr. Arjun Makhijani was bound into the
22 transcript as if having been read.)**

23

24

25

October 25, 2005

**UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION**

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of

Docket No. 70-3103

Louisiana Energy Services, L.P.

ASLBP No. 04-826-01-ML

National Enrichment Facility

**REVISED REBUTTAL TESTIMONY OF DR. ARJUN MAKHIJANI
IN SUPPORT OF NIRS/PC CONTENTIONS EC-3/TC-1, EC-5/TC-2, AND EC-6/TC-3
CONCERNING LES'S DISPOSAL STRATEGY AND COST ESTIMATE**

Q1. Please state your name and what testimony you will be discussing today?

A1. My name is Dr. Arjun Makhijani and I have previously submitted direct testimony in this proceeding. I will be offering rebuttal to the pre-filed direct testimony of Rod M. Krich and Thomas E. Potter presented on behalf of Louisiana Energy Services, L.P. dated September 16, 2005 and the pre-filed direct testimony of Timothy C. Johnson, James Park, Jennifer Mayer, Craig Dean, and Donald E. Palmrose presented on behalf of the NRC Staff dated September 15, 2005. The testimony of Rod Krich, Timothy Johnson, James Park, Jennifer Mayer, Craig Dean, and

Donald Palmrose was offered with respect to issues of depleted uranium disposal as they relate to Nuclear Information and Research Service and Public Citizen Contentions EC-5/TC-2 and EC-6/TC-3.

Q2. With respect to the issue of depleted uranium's classification as a low-level waste and the implications of that classification, what opinions were offered by the opposing experts in their direct testimony that you plan to discuss?

A2. The testimony of interest from Thomas Potter was as follows:

A18. (TEP) As a regulatory matter, DU is appropriately classified as Class A low-level waste under 10 C.F.R. Part 61. Among other things, Subpart D, "Technical Requirements for Land Disposal Facilities," of Part 61 establishes a classification system for evaluating whether radioactive wastes are suitable for near-surface disposal, and for assigning appropriate waste form and stability requirements. This classification system is based on the amount of radioactivity in waste that results from radionuclides listed in 10 C.F.R. Part 61, Tables 1 and 2...

...

Importantly, a radioactive waste that does not contain any radionuclide listed in Tables 1 and 2 is designated as Class A. The NRC has listed no form of uranium in either Table 1 or Table 2. Therefore, under the NRC's classification system, DU308 is a Class A low-level waste.¹

A19. (TEP) I would first note that the regulations state what the regulations state, and the conclusion is clear: DU308 is a Class A low-level waste, and, accordingly, DU308 is eligible for near-surface disposal.²

The testimony of interest from Timothy Johnson, James Park, and Donald Palmrose was as follows:

A.7. (TJ, JP, DP) ... As explained in our FEIS, for regulatory purposes low level radioactive waste is categorized in three classifications: Class A, B, or C based on the concentration of certain long-lived radionuclides which are set forth in Tables 1 and 2 of 10 C.F.R. § 61.55. The regulation further provides, in § 61.55(a)(6), that if radioactive waste does not contain

¹ LES Disposal 2005 p. 9-10 (emphasis in the original).

² LES Disposal 2005 p. 11.

any of the nuclides listed in those Tables, it is Class A. Depleted uranium consists mostly of long-lived isotopes of uranium, with small quantities of thorium-234 and protactinium-234. None of those isotopes is listed in Tables 1 or 2. Accordingly, pursuant to 10 C.F.R. § 61.55(a)(6), depleted uranium is considered Class A low level radioactive waste.³

A.11 (TJ, JP, DP) The Commission has determined that the type of waste generated by the NEF – depleted uranium – is low level waste. Therefore, the premise for the contention – that DUF6 is not considered low-level waste – is not valid. Furthermore, Envirocare – which uses this type of disposal – and the responsible State regulatory authority consider the disposal of depleted uranium at Envirocare under its current license to be acceptable. This is consistent with the Staff's determination that depleted uranium is Class A low level waste. Therefore, disposal at Envirocare, or at the other waste disposal sites discussed above under certain specified conditions, is a credible disposal option for the depleted uranium generated by the NEF.⁴

Q3. What conclusions have you drawn regarding the arguments cited above?

A3. As the Commission stated in its January 2005 ruling on the classification of depleted uranium as low-level waste:

A more difficult question – and one we need not answer today -- concerns whether the LES material, in the volumes and concentration proposed, will meet the Part 61 requirements for near-surface disposal. *The Commission agrees with the intervenors that a definitive conclusion on this and other disposal method questions cannot be reached at this time, and may require further environmental or safety analysis.* Our decision should not be read to intimate any Commission view on this issue, which relates both to the plausibility of LES's proposed private disposal options, and to financial assurance -- issues which remain before the Board.⁵

The Commission's conclusion that a demonstration that depleted uranium "in the volumes and concentration proposed" would be able to satisfy the performance criteria in 10 CFR 61 Subpart C "may require further environmental or safety analysis" is in line with the long-held opinion of the NRC and DOE as I testified to in my pre-filed direct testimony.

³ NRC Staff Disposal 2005 p. 5.

⁴ NRC Staff Disposal 2005 p. 6-7.

⁵ NRC 2005 (NIRS/PC Ex. 195) p. 26 (emphasis added).

Since uranium was not included in the final environmental analysis supporting 10 CFR 61, additional NEPA analysis is required now that a large amount of depleted uranium is being proposed for disposal. As stated by the NRC Executive Director for Operations in 1991

Review of the Environmental Impact Statement supporting 10 CFR Part 61 shows that although NRC considered the disposal of uranium and UF₆ conversion facility source terms in the analysis supporting Part 61, NRC did not consider disposal of large quantities of depleted uranium from an enrichment facility in the waste streams analyzed because there was no commercial source at that time. Therefore, analysis of the disposal of depleted uranium tails from an enrichment facility at a Part 61 LLW disposal facility should be conducted similar to the pathway analyses conducted in support of Part 61.⁶

The Director went on to conclude that, in support of any decision on disposal, a “detailed pathway analysis of depleted uranium... should be conducted following the provisions of 10 CFR 61.58” which states that

The Commission may, upon request or on its own initiative, authorize other provisions for the classification and characteristics of waste, on a specific basis, if, after evaluation, of the specific characteristics of the waste, disposal site, and method of disposal, it finds, reasonable assurance of compliance with the performance objectives in Subpart C of this part [Performance Objectives].⁷

The conclusion that the environmental impacts of disposal must be considered in addition to waste classification was shared by the Atomic Safety and Licensing Board in the Claiborne Enrichment Center case. In a 1995 ruling, the Board in the CEC case clearly explained that waste classification alone does not establish the plausibility of near-surface disposal:

. . . [R]egardless of the classification of the depleted uranium as A, B, C, or GTCC waste and regardless of the type of land disposal involved, the enrichment tails cannot be disposed of pursuant to 10 CFR Part 61 unless the performance standards of Subpart C are met. . . .

The mere classification of the Applicant’s enrichment tails as Class A waste does not guarantee . . . that the waste can be disposed of in a near-surface facility. Rather, all low level radioactive waste must meet the performance objectives of Subpart C in order to be

⁶ NRC 1991 (NIRS/PC Ex. 193) p. 4.

⁷ NRC 1991 (NIRS/PC Ex. 193) p. 5.

disposed of under Part 61. In other words, under Part 61 the classification of waste is not the sole determinant of whether the waste may be disposed of in a near-surface facility The performance objectives of Subpart C, which the Intervenor has not challenged, ensure that the safety objectives of Part 61 are met.⁸

Thus, the Board in that case explained:

. . . [A]ll waste, regardless of its classification, and all types of land disposal must meet the performance objectives of Subpart C before it can be disposed of under Part 61. If the near-surface disposal of enrichment tails, regardless of how the waste is classified, cannot meet the performance objectives of Subpart C, it cannot be disposed of in a near-surface facility.⁹

And again:

The performance objectives of Subpart C are the final determinant on the type of land disposal for the wastes involved, not the waste classification.¹⁰

Thus, the claims by both the NRC Staff and LES witnesses that the classification of depleted uranium as Class A waste under 10 CFR 61 Part 55 rule would alone settle the issue of its suitability for disposal in a shallow land burial facility runs directly counter to the long-held position of the Commission, the DOE, and the ruling of the ASLB in the CEC case. The fact that the only environmental impact analysis of shallow land burial that has been presented in this case by any party shows that shallow land burial is very likely to lead to a gross violation of the dose limits in 10 CFR 61 Subpart C (see Makhijani and Smith 2004 pages 19 to 29 and Makhijani and Smith 2005 pages 7 to 24) strengthens this conclusion. In fact, as noted above, in 1991 the NRC Executive Director for Operations explicitly called for depleted uranium to be classified on a specific basis under 10 CFR 61 Part 58 following a NEPA analysis “conducted similar to the pathway analyses conducted in support of Part 61.”¹¹

⁸ ASLB CEC 1995 (NIRS/PC Ex. 263).

⁹ ASLB CEC 1995 (NIRS/PC Ex. 263).

¹⁰ ASLB CEC 1995 (NIRS/PC Ex. 263).

¹¹ NRC 1991 (NIRS/PC Ex. 193) p. 5.

Q4. With respect to the issues of decay mode, half-life, and specific activity of depleted uranium what opinions were offered by the opposing experts in their direct testimony that you plan to discuss?

A4. The testimony of interest from Rod Krich and Thomas Potter was as follows:

A10. (TEP) ... In so testifying, I will demonstrate that the comparisons of DU to greater-than-Class C ("GTCC") and transuranic ("TRU") waste made by NIRS/PC (based on certain radiological properties of those materials such as decay mode, specific activity, and half-life) are inapposite as a regulatory and technical matter and do not support the conclusion that DU should be disposed of in a in [sic] deep geologic repository.¹²

A20. (TEP) As I stated earlier, in comparing DU waste to TRU waste and concluding that the two waste types are "directly analogous," Dr. Makhijani focuses on three radiological properties: decay mode, specific activity, and half life.... These comparisons, which are truly of the "apples-to-oranges" kind, certainly do not support the conclusion that DU is comparable to TRU waste and requires a comparable disposal facility, such as the WIPP.¹³

A21. (RMK, TEP) The fact that a given isotope is an alpha emitter is, by itself, no indication that the isotope is TRU, or comparable, to TRU material. In fact, many isotopes which are not TRU materials are long-lived alpha emitters that occur in nature.¹⁴

Q24. Does the long half-life of DU indicate that it is comparable to TRU material, as NIRS/PC suggest?

A24. (TEP) No. A long half-life is directly related to a proportionately lower radiation activity concentration (radiation emission rate per unit mass, in units such as curies per gram).... This is an important consideration in limiting TRU wastes to nuclides that are "trans-U", *i.e.*, elements with an atomic number greater than 92.¹⁵

Q5. Do you agree with the above criticisms of the comparisons between the radiological properties of bulk depleted uranium and transuranic waste?

¹² LES Disposal 2005 p. 4.

¹³ LES Disposal 2005 p. 11-12.

¹⁴ LES Disposal 2005 p. 12.

¹⁵ LES Disposal 2005 p. 14.

A5. No. The comparison of depleted uranium to transuranic waste with respect the difficulty that is likely to be encountered in their disposal is not an “apples-to-oranges” comparison. My conclusion in this matter is shared by other prominent scientists and scientific bodies. For example, the National Research Council of the U.S. National Academy of Sciences has concluded that

If disposal [of depleted uranium oxide] is necessary, it is not likely to be simple. The alpha activity of DU is 200 to 300 nanocuries per gram. Geological disposal is required for transuranic waste with alpha activity above 100 nanocuries per gram. If uranium were a transuranic element, it would require disposal in the Waste Isolation Pilot Plant (WIPP) based on its radioactivity. The chemical toxicity of this very large amount of material would certainly become a problem as well. One option suggested by the U.S. Nuclear Regulatory Commission (USNRC) is disposal in a mined cavity or former uranium mine. Challenges for this option would include understanding the fundamental differences between uranium ore (see Sidebar 6.1) and the bulk uranium oxide powder.¹⁶

In addition, IEER sought the opinion of Dr. John Bredehoeft, one of the most eminent hydrogeologists in the United States and a member of the National Academy of Engineering. Significantly, he was also a member of the National Academy of Sciences/National Research Council Committee on the Department of Energy’s Waste Isolation Pilot Plant (WIPP) as well as a member of the NAS/NRC Panel responsible for reviewing groundwater issues at the Yucca Mountain Nuclear Repository. Following his review of relevant portions of the draft EIS for the proposed NEF and the final EIS for the Claiborne Enrichment Center, Dr. Bredehoeft concluded that

The type of site required for disposal of depleted uranium from NEF is roughly comparable to the WIPP site in terms of the level of isolation required. All three isotopes contained in depleted uranium have very long half-lives, with the half-life of the principal one, U-238 extending to the billions of years. The specific activity of depleted uranium exceeds 300 nanocuries per gram of alpha-emitting radionuclides, and radium 226 and thorium 230 would build up over time to exceed 100 nanocuries per gram. The transuranic waste disposed of at WIPP has a concentration of at least 100 nanocuries per gram of alpha-emitters.¹⁷

¹⁶ NAS/NRC 2003 (NIRS/PC Ex. 151) p. 64 (emphasis added).

¹⁷ As quoted in Makhijani and Smith 2004 (NIRS/PC Ex. 190) p. 28 (emphasis added).

Contrary to the implication in the testimony of Rod Krich and Thomas Potter I do not claim that the fact that uranium, radium, and thorium are alpha emitters means that they are transuranic elements. I have compared the physical and radiological and health risk aspects of depleted uranium with transuranic waste or GTCC waste as it is defined in federal regulations and guidance documents.

The importance of the decay mode is that it determines the biological effects of the radiation. The fact that all of these elements are alpha emitters with similar energies means that their radiation will have similar effects on cells inside the body once they are there. Alpha radiation is particularly destructive to biological tissues. The relative biological effectiveness for alpha particles is that they are 20 times more damaging than a gamma ray that deposits the same energy. The radiological comparison of uranium, radium, thorium, and plutonium is discussed at greater length in the answer to question seven below.

Finally, the long half-lives of the three main uranium isotopes does mean that they will have lower specific activities than plutonium-239 or other transuranic elements like americium-241. However, the uranium decay product radium-226, which will build up to over 100 nanocuries per gram in the DU over time, has a much shorter half-life than plutonium-239 and a correspondingly larger specific activity. It is true that 100 nanocuries of uranium-238 will have a larger mass than 100 nanocuries of plutonium-239 which will in turn have a larger mass than 100 nanocuries of radium-226. However, this fact is not germane to the present discussion. While the specific activity of the constituent radionuclides will determine the theoretical upper limit to the waste's activity, the relevant quantity with respect to the impacts from disposal is the average activity of the waste. The regulations in 10 CFR 61 limit the average waste activity of long-lived alpha emitting transuranic

elements to 100 nanocuries per gram and any waste above this level of contamination will require disposal in WIPP. Significantly, both the states of Utah and Washington have also included a 10 nanocuries per gram limit on radium-226 in their Class A low-level waste definitions.¹⁸ The same logic that has already extended the limit for near surface disposal to radium-226, would likely extend this same limit to the three uranium isotopes under consideration as well. The specific activity of bulk DU308 would exceed a 10 nanocurie per gram limit for Class A LLW by more than a factor of 30.

Thus, our comparison of radiological properties of bulk depleted uranium with transuranic waste at the lower activity limit is very much an apples-to-apples comparison and one that is well founded in scientific principles and supported by the scientific community.

Q6. With respect to the issues of environmental mobility, dose conversion factors, and cancer risk factors what opinions were offered by the opposing experts in their direct testimony that you plan to discuss?

A6. The testimony of interest from Rod Krich and Thomas Potter was as follows:

A25. (RMK, TEP) Yes. We would note that in considering the characteristics of radioactive materials for purposes of evaluating its suitability for a particular land disposal method, it is useful to consider the manner in which releases of those materials could impact human health (*i.e.*, what the relevant dose equivalent are). For example, NIRS/PC implicitly assume in their specific activity comparison that all nanocuries in all respects are equivalent. However, from the standpoint of radiation dose -- the ultimate measure of potential radiation harm -- a nanocurie of uranium inhaled or ingested is not necessarily equivalent to a nanocurie of TRU inhaled or ingested. For example, the radiation dose from a nanocurie of plutonium-239, a typical TRU nuclide, dissolved in drinking water is at least 10 times higher than the dose from a nanocurie of uranium dissolved in drinking water. This difference

¹⁸ Utah Rule 2005/07/01 (NIRS/PC Ex. 259) and Washington Code 1998 (NIRS/PC Ex. 260).

results from different chemical behaviors of uranium and plutonium in the body. Different radionuclides also behave differently in the environment because of chemical differences.¹⁹

Q7. Do you agree with the conclusions presented by Rod Krich and Thomas Potter?

A7. No. As I showed in my November 2004 report and my pre-filed direct testimony, the mortality risk per becquerel from depleted uranium at secular equilibrium is roughly four times greater than that of plutonium-239. This is due mainly to the ingrowth of radium-226 over a long time. The table below shows that the comparison of depleted uranium to plutonium-239 grows slightly worse when cancer incidence is considered rather than the risk of fatal cancers.

Element	Age Averaged Cancer Risk per Bq (tap water)	Ratio to Plutonium-239 (tap water)	Age Averaged Cancer Risk per Bq (dietary)	Ratio to Plutonium-239 (dietary)
Ra-226	1.04E-08	2.86	1.39E-08	2.96
Th-230	2.46E-09	0.676	3.22E-09	0.685
U-234	1.91E-09	0.525	2.58E-09	0.549
U-235	1.88E-09	0.516	2.55E-09	0.543
U-238	1.73E-09	0.475	2.34E-09	0.498
DU at secular equilibrium	1.65E-08	4.53	2.20E-08	4.69

While the cancer risk is the value of most interest from a human health perspective, we also note that the claim by Rod Krich and Thomas Potter regarding the dose per unit of radiation is apparently based on the outdated Reference Man models incorporated in Federal Guidance Report 11. Under this old model the dose per becquerel from ingesting depleted uranium at secular equilibrium is about 0.68 times that of plutonium-239. However, the newer dose model published by the

¹⁹ LES Disposal 2005 p. 14-15.

International Commission on Radiological Protection in ICRP 72 and the dose model incorporated in the supplement to Federal Guidance Report 13 both show a very different result. At secular equilibrium, the dose per becquerel for ingested DU predicted by both of these new models (averaged over age for comparison to FGR 11) would be about 2.95 times than of plutonium-239, which is consistent with the cancer risk estimates discussed above. (The risk estimate ratios for DU at secular equilibrium to Pu-239 are even greater as indicated in the Table above.) When the fact that DU3O8 has a specific activity that is more than three times the lower activity limit of plutonium-239 in TRU waste (340 nanocuries per gram versus 100 nanocuries per gram), the comparison of the risks on a per gram of waste basis grows even more stark.

With respect to the environmental mobility of uranium and its decay products, I noted in the November 2004 report that, with the possible exception of thorium, the isotopes in DU would have similar or greater mobility than plutonium. The table below shows the geometric mean partition coefficients for each element and each type of soil as reported in the ResRad Data Collection Manual. Significantly, uranium has the lowest Kd values in the table and, therefore, the highest environmental mobility.

Element	Sand	Loam	Clay	Organic
Radium	500	36,000	9,100	2,400
Thorium	3,200	3,300	5,800	89,000
Uranium	35	15	1,600	410
Plutonium	550	1,200	5,100	1,900

[Source: Yu et al. 1993 p. 110-111]

Thus, neither the risk per becquerel, the risk per gram of waste, nor the mobility of the radionuclides in the environment would argue that depleted uranium can be considered to be less

difficult to dispose of than TRU waste at 100 nanocurie per gram, the lower limit that defines TRU waste. Indeed, the far higher risk coefficient of DU once it reaches secular equilibrium indicates that DU disposal would be comparable to TRU waste of activity far higher than 100 nanocuries per gram.

Q8. With respect to the requirement that isolation on the same order as WIPP would be required for depleted uranium, what opinions were offered by the opposing experts in their direct testimony that you plan to discuss?

A8. The testimony of interest from Rod Krich and Thomas Potter was as follows:

A23. (TEP, RMK) ... The intervenors' conclusion that a TRU waste facility like WIPP is needed for the disposal of DU is based on the observation that the upper range of specific activities for DU overlaps with a small portion of the lowest end (which NIRS/PC neglect to point out) of what is a very wide range of specific activities for TRU waste. As noted above, the specific activity of typical TRU waste is orders of magnitude higher than the upper limit specific activity for DU. With respect to the WIPP facility in particular, this fact is illustrated in LES Exhibit 102. The average activity concentration in materials placed in WIPP through September 2002 is about 530 times the activity concentration of DU, and the average activity concentrations in the radionuclide component of material deposited in WIPP is even much higher. Specifically, the average activity concentration for all radionuclides (total activity divided by total radionuclide weight) is 84,000 times higher than the average activity of DU. If uranium nuclides are excluded from the nuclide mix, this ratio jumps to 770,000.²⁰

Q9. What comments do you have concerning the above testimony of Rod Krich and Thomas Potter?

²⁰ LES Disposal 2005 p. 13.

A9. As I have previously testified, both the National Research Council of the U.S. National Academy of Sciences and Dr. John Bredehoeft explicitly support the same conclusion that we have drawn regarding the need for a WIPP-like repository to isolate the depleted uranium that would be produced by an enrichment facility within existing radiation protection norms. As I have testified to above, the fact that some transuranic elements have a higher specific activity than uranium-238 or uranium-234 is not relevant to the present discussion of disposal impacts. The fact is that 10 CFR 61 explicitly states that all wastes contaminated with long-lived alpha emitting transuranic elements above 100 nanocuries per gram will not be suitable for shallow land burial. That the average activity of the waste that had actually been disposed of at WIPP through September 2002 was more than two orders of magnitude more contaminated than the lower limit, does not change the fact that TRU waste, no matter by how much or how little its activity exceeds 100 nanocuries per gram, will be sent to WIPP. Further, a comparison of DU with the average specific activity of the radionuclides in TRU waste is entirely besides the point. Waste classifications do not refer to average specific activity of radionuclides (or of combinations of radionuclides) but to the specific activity of the entire weight or volume of the waste material. For instance, plutonium-239 and other TRU radionuclides can be disposed of as Class A waste provided the specific activity of these radionuclides in the waste is less than 10 nanocuries per gram. Similarly, radium-226 has a specific activity that is more than 15 times greater than plutonium-239. High concentrations of radium-226 would not be acceptable for shallow land disposal, but, as noted above, both Utah and Washington State allow disposal of waste with up to 10 nanocuries per gram of radium-226 as Class A low-level waste. These distinctions support our conclusion that near surface disposal will not be acceptable for bulk depleted uranium and that it will instead require disposal in a repository to ensure its compliance with the dose limits of 10 CFR 61 Subpart C.

The capital cost estimate for the repository considered in our November 2004 report is only about one-third that of WIPP and the operating costs do not include any contribution from transportation or waste characterization activities. Therefore, our disposal cost of \$5.40 to \$8.00 per kilogram of uranium is a reasonable range for estimating the likely costs that will be encountered in disposing of the DU from the proposed NEF.

Q10. With respect to the support for the LES choice of shallow land burial for depleted uranium, what opinions were offered by the opposing experts in their direct testimony that you plan to discuss?

A10. The testimony of interest from Rod Krich and Thomas Potter was as follows:

Q26. Do have [sic] any reason to believe that a near-surface disposal facility cannot meet the performance objectives and applicable technical standards in 10 C.F.R. Part 61 or compatible Agreement State regulations?

A26. (RMK, TEP) No. We have no reason to doubt the technical feasibility of near-surface disposal of large volumes DU3O8 at a license low-level radioactive disposal facility. By way of example, Envirocare of Utah ("Envirocare") has confirmed for LES that the existing licenses and permits for Envirocare's Clive, Utah facility currently allow Envirocare to dispose of DU3O8 subject to the material meeting Envirocare's licenses, permits, and operational requirements, and that Envirocare has previously received and disposed of Du3O8 using the shallow land burial method in accordance with its regulatory authorization in a cell with a cap (*i.e.*, a Class A disposal cell)....

...

It also warrants mention that the DOE, based on its own generic analyses of DU disposal in Appendix I of its 1999 Programmatic Environmental Impact Statement for the management of DUF6, has concluded that near-surface disposal of DU3O8 in a dry environment is acceptable from a radiological health standpoint. Indeed, in its 2004 site-specific EISs for the Portsmouth and Paducah deconversion facilities, DOE has identified Envirocare as its primary or "Proposed Disposition" site.²¹

The testimony of interest from Timothy Johnson, James Park, and Donald Palmrose was as follows:

²¹ LES Disposal 2005 p. 15-16.

Q.6. Will the radioactive waste generated by the NEF necessarily be disposed of in this manner [the "engineered trench" method]?

A.6. (TJ, JP, DP) No, there is no requirement that a particular type of disposal method be used. However, this type of disposal method is used by one of the disposal facilities identified in the FEIS as a potential disposal site – Envirocare, which is located in Clive, Utah.²²

Q11. Given that the LES witnesses Rod Krich and Thomas Potter as well as the NRC witnesses Timothy Johnson, James Park, and Donald Palmrose have all explicitly raised the issue of disposal at Envirocare and thus the suitability of that site, what opinions have you drawn regarding the ability of Envirocare to safely dispose of the depleted uranium from the proposed NEF?

A11. I have concluded that it is very unlikely that Envirocare would be suitable for the disposal of the 133,000 metric tons of depleted uranium that would be generated by the proposed NEF and should not be relied upon as such for determining the cost of disposal.

The classification of depleted uranium under 10 CFR 61.55 has not been officially resolved by the Commission's January 2005 ruling. Our analysis shows that, based on its radiological and transport properties, and analysis of shallow land disposal shows that such disposal would not satisfy the radiation protection in 10 CFR 61 Subpart C, whatever its classification under 10 CFR 61.55. limits. The limit of 10 nanocurie per gram for radium-226 in the current Utah State regulations governing Class A waste supports this conclusion as well.

The likely unacceptability of the Envirocare site for disposal is further strengthened by considering the results of the original performance assessments from 1990 used to support the initial license for

²² NRC Staff Disposal 2005 p. 4.

the site. These reports, referenced in the February 2005 conversation between the NRC and Utah DRC staff, placed limits on the concentration of depleted uranium in the waste that would be allowed for disposal. Applying these types of limits today would likely disallow the bulk disposal of DU_3O_8 . Under the “intruder-agriculture” scenario they considered, the concentration limits for depleted uranium that would yield an annual dose of 100 millirem were 65.5 nanocuries per gram for doses calculated 30 years after waste placement and 25.1 nanocuries per gram if the doses were calculated 1,000 years after placement. These early performance assessments also considered an “intruder-construction” scenario with a dose limit of 500 millirem per year. If this scenario considered a 100 millirem per year dose limit as was done for the intruder-agriculture scenario, the concentration limit for depleted uranium evaluated at 1,000 years would have been 275.4 nanocuries per gram. The use of a 25 millirem per year dose limit would, of course, further lower all of these disposal limits. Finally, a concentration limit based on limiting worker doses to 5,000 millirem per year was found to be 110 nanocuries per gram by these performance assessments.²³ The activity of the bulk DU_3O_8 from the proposed NEF facility would exceed each of these concentration limits.

As noted, the license amendment 22 has a possession limit of “250 pounds, 56.8 millicuries or 110,000 picocuries of Depleted Uranium.” The lower limit is clearly not in line with the other two restrictions. Instead, if it had been 110,000 picocuries per gram it would be far more internally consistent.²⁴ In addition, the 110,000 picocuries per gram possession limit would also then be equal to the limit specified in early Envirocare performance assessments to maintain worker doses below

²³ Blevins 2005 (LES Ex. 104) p. 2, Baird et al. 1990 (NIRS/PC Ex. 170) p. 5-12, and Baird et al. 1990b (NIRS/PC Ex. 171) p. 25.

²⁴ LLNL 1997 EA (NIRS/PC Ex. 55) p. 6.13-1-17.

5 rem per year. As noted before, the grouted waste from the proposed LES facility would exceed this concentration limit. Using the density for grouted waste cited by LES, a 55 gallon drum would have an average specific activity of approximately 270,000 picocuries per gram. Even for the grouted waste considered by the LLNL analysis which has a lower uranium density, the average specific activity would still be approximately 170,000 picocuries per gram.

Q12. Do you agree with the characterization by Rod Krich and Thomas Potter that the DOE PEIS has concluded "that near-surface disposal of DU308 in a dry environment is acceptable from a radiological health standpoint" and that the two "site-specific EISs for the Portsmouth and Paducah deconversion facilities, DOE has identified Envirocare as its primary or "Proposed Disposition" site" and that these "facts" support the LES choice of near surface disposal?

A12. No. The PEIS actually made the following conclusion regarding the potential suitability of near surface disposal at a generic site:

Potential Adverse Impacts. For all disposal options, potentially large impacts to human health and groundwater quality could occur within 1,000 years after failure of a facility in a wet setting, whereas essentially no impacts would occur for a dry setting in the same time frame. Potential impacts would result primarily from the contamination of groundwater. The maximum dose to an individual assumed to live at the edge of the disposal site and use the contaminated water was estimated to be about 110 mrem/yr, which would exceed the 25-mrem/yr limit specified in 10 Code of Federal Regulations [CFR] Part 61 and DOE Order 5820.2A. (For comparison, the average dose to an individual from background radiation is about 360 mrem/yr.) Possible exposures (on the order of 10 rem/yr) could occur for shallow earthen structures and vaults if the cover material were to erode and expose the uranium material; however, this would not occur until several thousand years later, and the exposure could be eliminated by adding new cover material to the top of the waste area.²⁵

Thus, the conclusion that Rod Krich and Thomas Potter point to is explicitly limited by the DOE to impacts that occur within the first 1,000 years after the failure of the facility. Significantly, the

²⁵ DOE PEIS 1999 (LES Ex. 18) p. I-19 (emphasis added).

DOE goes on to conclude that, due to the impacts of erosion, doses of the order of 10 rem per year are possible in either a dry or wet setting and that only by continuously adding new cover could the doses be mitigated. This conclusion is consistent with that of our generic screening analysis presented in the November 2004 report and our site specific analysis presented in the July 2005 report. Both of these analyses were carried out for dry settings. The generic screening analysis considered erosion rates of 0.05 to 0.1 centimeters per year and found that the doses from the external pathway alone could amount to as much as 30 to 75 rem per year. The site specific analysis considered erosion rates of 0.01 to 0.1 centimeters per year and found doses from the external pathway to be as much as 44 to 120 rem per year. These results are generally consistent with the external dose estimates for a wet site carried out by Sandia National Laboratories to support the CEC license application. At 10,000 years, the authors of the Sandia study found that the external dose would be 13.5 rem per year, with Ra-226 contributing more than three-fourths of that dose.²⁶ Thus, the DOE PEIS analysis does not support the LES conclusion regarding the suitability of near surface disposal if timescales beyond 1,000 years are considered (as was done by the NRC Staff for the mine disposal option in the present case). In fact, the DOE analysis in the PEIS far more strongly supports our conclusion that near surface disposal of large quantities of depleted uranium is likely to lead to violations of the applicable dose limits by very large factors (two to three orders of magnitude or even more in some circumstances) once the impacts of erosion are considered.

The fact that the DOE has not yet selected Envirocare, or any other near surface disposal facility, is made quite explicit in the text in the two site-specific EISs for the Paducah and Portsmouth facilities. Despite the generic analysis presented in the PEIS, the two EISs explicitly note that:

²⁶ Kozak et al. 1992 (NIRS/PC Ex. 128) p. 13.

DOE plans to decide the specific disposal location(s) for the depleted U_3O_8 conversion product after additional appropriate NEPA review. Accordingly, DOE will continue to evaluate its disposal options and will consider any further information or comments relevant to that decision. DOE will give a minimum 45-day notice before making the specific disposal decision and will provide any supplemental NEPA analysis for public review and comment.²⁷

Hence the conclusion of Rod Krich and Thomas Potter that shallow land disposal at Envirocare or elsewhere would be radiologically acceptable is unwarranted.

Q13. With respect to the issue of whether near-surface disposal is being planned for the depleted uranium that would be generated by the proposed NEF, what opinions were offered by the opposing experts in their direct testimony that you plan to discuss?

A13. The testimony of interest from Rod Krich was as follows:

Q14. Is LES's cost estimate for the commercial disposal of DU based on the premise that DU from the NEF would be disposed of in a near-surface disposal facility?

A14. (RMK) Yes. LES intends to deconvert the DUF6 generated as a byproduct of NEF enrichment operations to the more chemically stable DU3O8 form, and to send the DU3O8 to an NRC or Agreement State-licensed LLRW waste disposal facility for near-surface disposal as "Class A" low-level waste.²⁸

The testimony of interest from Timothy Johnson, James Park, and Donald Palmrose was as follows:

Q.6. Will the radioactive waste generated by the NEF necessarily be disposed of in this manner [the "engineered trench" method]?

A.6. (TJ, JP, DP) No, there is no requirement that a particular type of disposal method be used. However, this type of disposal method is used by one of the disposal facilities identified in the FEIS as a potential disposal site – Envirocare, which is located in Clive, Utah.²⁹

²⁷ Paducah FEIS 2004 (LES Ex. 17) p. 2-11 and Portsmouth FEIS 2004 (LES Ex. 16) p. 2-12.

²⁸ LES Disposal 2005 p. 8.

²⁹ NRC Staff Disposal 2005 p. 4.

A.10. (TJ, JP, DP) LES would be able to dispose of waste from the NEF at: (1) the Hanford site, which accepts waste from the States in the Rocky Mountain compact (which includes New Mexico) provided the waste meets the Waste Acceptance Criteria for the facility; (2) the Nevada Test Site if ownership of the waste was first transferred to the DOE; or (3) the WCS site provided that WCS obtains a license to accept this material (currently, WCS is licensed to accept RCRA hazardous waste for disposal) and certain procedures and processes are successfully addressed.³⁰

Q14. What conclusions have you drawn regarding the disposal options that have been considered by the NRC Staff and LES and?

A14. First, LES is clearly basing its cost estimates and plausible strategy on shallow-land burial of depleted uranium while the NRC Staff, surprisingly, views this as only one option available. This is an important apparent point of disagreement in what the applicant and the NRC Staff believe is the proposed action in the present case.

In the FEIS, the only option besides disposal at Envirocare for which any conclusions regarding environmental impacts were presented was the disposal of DU in an abandoned mine. This option has been excluded from consideration by LES and, therefore, the only legal basis upon which to grant a license would be for disposal at Envirocare. However, as I have consistently noted, there was no actual environmental impact analysis presented in the environmental impact statement regarding disposal at the Envirocare site, and the conclusion presented in the FEIS was based solely on the NRC Staff opinion that DU is Class A waste under 10 CFR 61.55. Even if it was so classified, this is an insufficient basis for a decision on disposal since DU disposal at Envirocare would not likely meet the radiation dose limits in 10 CFR 61 Subpart C.

³⁰ NRC Staff Disposal 2005 p. 6

Second, the Hanford site is not likely to be a viable option for disposal of depleted uranium from a private deconversion facility. In the settlement agreement with the State of New Mexico, LES agreed that it would "never construct or operate a deconversion facility in New Mexico."³¹ Given that the NEF FEIS states that the private deconversion facility under consideration is to be located with 6.4 kilometers of the NEF, this would leave only Texas as an option.³² Since Texas is outside both the Northwest or Rocky Mountain Compacts, the DU308 produced at such a deconversion facility would not likely be accepted at Hanford.

Finally, both the draft and final EIS for the proposed NEF explicitly removed WCS from consideration as a viable option due to regulatory concerns and, therefore, no license can be granted based on the option of disposing of the DU at the proposed WCS facility in Andrews County, Texas.³³

Q15. In light of the testimony from LES and NRC witnesses regarding the cost of low-level waste disposal at shallow land burial facilities, what conclusions have you drawn regarding the reasonableness of these costs?

A15. As detailed in our November 2004 and July 2005 reports and in my pre-filed direct and rebuttal testimony, the disposal of depleted uranium is not likely to be acceptable at any shallow

³¹ ASLB Aug 12 2005 (NIRS/PC Ex. 262) p. 4.

³² NEF FEIS 2005 (NIRS/PC Ex. 191) p. 2-30.

³³ NEF DEIS 2004 (NIRS/PC Ex. 152) p. 2-32 to 2-33 and NEF FEIS 2005 (NIRS/PC Ex. 191) p. 2-33.

land burial site in either a wet or dry environment.³⁴ Given that the depleted uranium will require geologic disposal in a repository in order to meet the dose limits in 10 CFR 61 Subpart C, the most reasonable and credible cost estimates will be those based on historical experience at WIPP and not those based on the wholly inappropriate premise of shallow-land burial.

Q16. In light of what you have testified to, what is your conclusion for the overall cost of deconversion, transportation, and disposal for the DUF6 that would be produced by the proposed NEF facility?

A16. I have concluded that, if DU is treated in a manner that respects the risks it poses, the likely cost of dispositioning the depleted uranium hexafluoride from the proposed NEF facility would fall between \$18 per kilogram of uranium and \$24 per kilogram of uranium after taking into account the Board-imposed subtractions from the estimates in our November 2004 and July 2005 report.

In the table below, which is restricted to cost elements allowed by the October 4, 2005 directive of the Board, the "IEER WIPP Disposal Scenario 1" includes a low-end cost estimate for DU disposal based on experience at WIPP and an estimated calcium fluoride dispositioning cost based on the Lawrence Livermore National Laboratory analysis while the "IEER WIPP Disposal Scenario 2" includes a medium WIPP cost estimate and an estimated calcium fluoride cost based on a report from the National Research Council of the U.S. National Academy of Sciences.

³⁴ This conclusion is also consistent with the fact that the International Atomic Energy Agency has characterized depleted uranium as one of the "[l]ong-lived wastes destined for geologic disposal" in its 2003 Technical Report Series No. 413 [IAEA 2003 (NIRS/PC Ex. 185) p. 29].

Cost element*	IEER WIPP Disposal Scenario 1	IEER WIPP Disposal Scenario 2
Deconversion to U ₃ O ₈ , Transportation, and Storage	\$7.10	\$7.10
Disposal	\$5.40	\$8.00
CaF ₂ (Neutralization and Disposition)	\$2.00	\$4.00
Contingency - NRC- minimum required (25 percent)	\$3.63	\$4.78
Total Cost per kg U	\$18.13	\$23.88

* This table is based on Table 9 of the November 2004 report and includes only those cost elements allowed by the October 4, 2005 directive of the Board.³⁵



Our costs are significantly larger than the \$5.85 per kilogram of uranium currently proposed by LES (\$4.68 per kilogram of uranium plus a 25 percent contingency factor).

Q17. Does this conclude your testimony for today?

A17. Yes.

³⁵ Makhijani and Smith 2004 (NIRS/PC Ex. 190) p. 51.

References:

10 CFR 61 DEIS 1981 (NIRS/PC Ex. 167)	U.S. Nuclear Regulatory Commission, "Draft Environmental Impact Assessment on 10 CFR 61 'Licensing Requirements for Land Disposal of Radioactive Waste'", Main Report, September 1981 (NUREG-0782, Vol. 2)
10 CFR 61 DEIS 1981b (NIRS/PC Ex. 168)	U.S. Nuclear Regulatory Commission, "Draft Environmental Impact Assessment on 10 CFR 61 'Licensing Requirements for Land Disposal of Radioactive Waste'", Appendices G-Q, September 1981 (NUREG-0782, Vol. 4)
10 CFR 61 FEIS 1982 (NIRS/PC Ex. 169)	U.S. Nuclear Regulatory Commission, "Final Environmental Impact Assessment on 10 CFR 61 'Licensing Requirements for Land Disposal of Radioactive Waste'", Summary and Main Report, November 1982 (NUREG-0945, Vol. 1)
10 CFR 61 final rule 1982 (NIRS/PC Ex. 85)	U.S. Nuclear Regulatory Commission. "10 CFR parts 2, 19, 20, 21, 30, 40, 51, 61, 70, 73 and 170: licensing requirements for land disposal of radioactive waste. Final Rule." <i>Federal register</i> , v.47, no. 248 (Dec. 27, 1982). pp. 57446-57477.
40 CFR 141 2004 (NIRS/PC Ex. 202)	U.S. Code of Federal Regulations, "Title 40 – Protection of Environment: Chapter I – Environmental Protection Agency; Part 141 – National primary drinking water regulations", July 1, 2004, online at http://www.access.gpo.gov/nara/cfr/waisidx_04/40cfr141_04.html .
40 CFR 61 2004 (NIRS/PC Ex. 87)	U.S. Code of Federal Regulations, "Title 40 – Protection of Environment: Chapter I – Environmental Protection Agency; Part 61 – National emission standards for hazardous air pollutants", July 1, 2004, online at http://www.access.gpo.gov/nara/cfr/waisidx_04/40cfr61_04.html .
ACP DEIS 2005 (NIRS/PC Ex. 203)	U.S. Nuclear Regulatory Commission, Office of Waste Management and Environmental Protection, Office of Nuclear Material Safety and Safeguards, <i>Environmental Impact Statement for the Proposed American Centrifuge Plant in Piketon, Ohio</i> , Draft Report for Comment, August 2005 (NUREG-1834)
ASLB Aug 12 2005 (NIRS/PC Ex. 262)	U.S. Nuclear Regulatory Commission, Atomic Safety and Licensing Board, In the Matter of Louisiana Energy Services, L.P. (National Enrichment Facility), "Memorandum and Order: (Approving Settlement Agreement and Accepting Withdrawal of Parties)", Docket No. 70-3103-ML, ASLBP No. 04-826-01-ML, August 12, 2005.
ASLB Aug 4 2005 (NIRS/PC Ex. 204)	U.S. Nuclear Regulatory Commission, Atomic Safety and Licensing Board, In the Matter of Louisiana Energy Services, L.P. (National Enrichment Facility), "Memorandum and Order: (Ruling on Motion to Admit Late-Filed Amended and Supplemental Contentions)", Docket No. 70-3103-ML, ASLBP No. 04-826-01-ML, August 4, 2005.
ASLB CEC 1995 (NIRS/PC Ex. 263)	U.S. Nuclear Regulatory Commission, Atomic Safety and Licensing Board, In the Matter of Louisiana Energy Services, L.P.(Claiborne Enrichment Center), ASLBP No. 91-641-02-ML, 1995 WL 110611 (March 2, 1995)
ASLB CEC 1997 (NIRS/PC Ex. 205)	U.S. Nuclear Regulatory Commission, Atomic Safety and Licensing Board, In the Matter of Louisiana Energy Services, L.P.(Claiborne Enrichment Center), LBP-97-3, Docket No. 70-3070-ML, ASLBP No. 91-641-02-ML (Special Nuclear Material License), 45 N.R.C. 99, 1997 WL 345666 (N.R.C.), March 7, 1997.

ASLB June 30 2005 (NIRS/PC Ex. 206)	U.S. Nuclear Regulatory Commission, Atomic Safety and Licensing Board, In the Matter of Louisiana Energy Services, L.P. (National Enrichment Facility), "Memorandum and Order: (Ruling on NIRS/PC Late-Filed Contention Amendments)", Docket No. 70-3103-ML, ASLBP No. 04-826-01-ML, June 30, 2005.
Baird et al. 1990 (NIRS/PC Ex.170)	R.D. Baird, M.K. Bollenbacher, E.S. Murphy, R. Shuman, and P.B. Klein, "Evaluation of the Potential Public Health Impacts Associated with Radioactive Waste Disposal at a Site Near Clive, Utah", Rogers and Associates Engineering Corporation, June 1990 (RAE-9004/2-1)
Baird et al. 1990b (NIRS/PC Ex. 171)	R.D. Baird, G.B. Merrell, D.E. Bernhardt, and V.C. Rogers, "Additional Radionuclide Concentration Limits for the NORM Disposal Site at Clive, Utah", Rogers and Associates Engineering Corporation, August 1990 (RAE-9000/16-1)
Barron 2005 (NIRS/PC Ex. 207)	Jeff Barron, "Plant construction falls behind", <i>Portsmouth Daily Times</i> , July 15, 2005.
Bauman 2005 (NIRS/PC Ex. 172)	Joe Bauman, "Senate OKs Class B, C waste ban", <i>Deseret Morning News (Salt Lake City)</i> , February 3, 2005.
Bauman 2005b (NIRS/PC Ex. 173)	Joe Bauman, "House votes to ban importing of B, C wastes", <i>Deseret Morning News (Salt Lake City)</i> , February 10, 2005
Blevins 2005 (LES Ex. 104)	Memo to Scott Flanders from Matthew Blevins, "Telephone Summary Regarding Depleted Uranium Disposal", April 6, 2005. [Internal NRC memo regarding a February 24, 2005 teleconference]
Carr 2005 (NIRS/PC Ex. 174)	Letter from James R. Carr, Professor of Geological Sciences and Engineering at the University of Nevada, Reno, to Arjun Makhijani, Regarding the Potential for Erosion at the Proposed WCS Site, May 16, 2005.
CEC FEIS 1994 (NIRS/PC Ex. 58)	U.S. Nuclear Regulatory Commission, "Final Environmental Impact Statement for the Construction and Operation of Claiborne Enrichment Center, Homer, Louisiana", Volume 1, August 1994 (NUREG-1484)
Closing the Circle (NIRS/PC Ex. 208)	U.S. Department of Energy, <i>Closing the Circle on the Splitting of the Atom: The Environmental Legacy of Nuclear Weapons Production in the United States and What the Department of Energy is Doing About It</i> , DOE/EM-0266, Washington, D.C.: DOE Office of Environmental Management, Office of Strategic Planning and Analysis, January 1996. Closing the Circle on the Splitting of the Atom online at http://legacystory.apps.em.doe.gov/text/close/close2.htm .
Dallas Morning News 2005 (NIRS/PC Ex. 175)	Wire Reports, "Probation threatened for nuclear agency", <i>Dallas Morning News</i> , April 30, 2005.
Deposition Chater et al. 2004/10/04 (NIRS/PC Ex. 100)	<i>Deposition of Chris Chater, Bernard Duperret, Rodney H. Fisk, Rod Krich, Robert Pratt, Paul G. Schneider, Michael H. Schwartz, Julian J Steyn.</i> Monday, October 4, 2004. In the matter of Louisiana Energy Services (National Enrichment Facility) v. Nuclear Information and Resource Service and Public Citizen. U.S. Nuclear Regulatory Commission, Docket No. 70-3103-ML; ASLBP No. 03-816-01-ML. Transcript by Neal R. Gross. At head of title: Before the Commission. Deposition took place in offices of Winston & Strawn, Washington, DC.

Deposition Compton et al. 2005/09/02 (NIRS/PC Ex. 229)	Deposition of Leslie Compton, Bernard DuPerret, Paul Harding, Rod M. Krich, and Paul Schneider. Friday September 2, 2005. In the matter of Louisiana Energy Services (National Enrichment Facility) v. Nuclear Information and Resource Service and Public Citizen. U.S. Nuclear Regulatory Commission, Docket No. 70-3103-ML; ASLBP No. 03-816-01-ML. Transcript by Neal R. Gross. Deposition took place in offices of Winston & Strawn, Washington, DC.
DOE 1995 (NIRS/PC Ex. 176)	U.S. Department of Energy, "Integrated Data Base Report – 1994: U.S. Spent Nuclear Fuel and Radioactive Waste Inventories, Projections, and Characteristics", September 1995 (DOE/RW-0006, Rev. 11)
DOE 1997 (NIRS/PC Ex. 177)	U.S. Department of Energy, "Integrated Data Base Report – 1996: U.S. Spent Nuclear Fuel and Radioactive Waste Inventories, Projections, and Characteristics", December 1997 (DOE/RW-0006, Rev. 13)
DOE 1998 (NIRS/PC Ex. 102)	U.S. Department of Energy. Office of Environmental Management. <i>Department of Energy Response to 1997 IEER Environmental Management report.</i> [Washington, DC]: EM, March 18, 1998.
DOE 1998b (NIRS/PC Ex. 209)	U.S. Department of Energy, <i>The Current and Planned Low-Level Waste Disposal Capacity Report</i> , Revision 1, September 18, 1998.
DOE 2000 (NIRS/PC Ex. 103)	U.S. Department of Energy. Office of Environmental Management. <i>Buried Transuranic-Contaminated Waste Information for U.S. Department of Energy Facilities</i> , Washington, DC: DOE EM, June 2000.
DOE 2001 (NIRS/PC Ex. 178)	U.S. Department of Energy, "Summary Data on the Radioactive Waste, Spent Nuclear Fuel, and Contaminated Media Managed by the U.S. Department of Energy", April 2001.
DOE Paducah ROD 2004 (NIRS/PC Ex. 105)	U.S. Department of Energy. "Record of decision for construction and operation of a depleted uranium hexafluoride conversion facility at the Paducah, KY, site." <i>Federal Register</i> , v. 69, no. 143 (July 27, 2004). pp. 44654-44658. On the Web at http://web.ead.anl.gov/uranium/pdf/PadRODRegister.pdf .
DOE PEIS 1999 (LES Ex. 18)	U.S. Department of Energy, "Final Programmatic Environmental Impact Statement For Alternative Strategies For The Long-Term Management And Use Of Depleted Uranium Hexafluoride", April 1999 (DOE/EIS-0269)
DOE Portsmouth ROD 2004 (NIRS/PC Ex. 106)	U.S. Department of Energy. "Record of decision for construction and operation of a depleted uranium hexafluoride conversion facility at the Portsmouth, OH, Site." <i>Federal Register</i> , v. 69, no. 143 (July 27, 2004). pp. 44649-44654. On the Web at http://web.ead.anl.gov/uranium/pdf/PortRODRegister.pdf .
Envirocare 2005 (NIRS/PC Ex.179)	Envirocare of Utah, LLC, "State of Utah Radioactive Material License UT 2300249: Amendment 22", adopted June 13, 2005, online at http://www.envllc.com/pages/lp/index.php (as viewed on July 1, 2005)
Envirocare 2005b (NIRS/PC Ex. 180)	Envirocare of Utah, LLC. Press Release, "Envirocare Purchased By Investor Group: New Owners Call for Ban of B & C Waste in the State of Utah", February 1, 2005
EPA 1999 (NIRS/PC Ex. 181)	U.S. Environmental Protection Agency, "Understanding Variation in Partition Coefficient, K_d , Values, Volume II: Review of Geochemistry and Available K_d Values for Cadmium, Cesium, Chromium, Lead, Plutonium, Radon, Strontium, Thorium, Tritium (^3H), and Uranium", August 1999 (EPA 402-R-99-004B)

EPA FGR 13 (NIRS/PC Ex. 111)	Keith F. Eckerman, Richard W. Leggett, Christopher B. Nelson, Jerome S. Puskin, Allan C.B. Richardson. <i>Cancer Risk Coefficients for Environmental Exposure to Radionuclides: Radionuclide-Specific Lifetime Radiogenic Cancer Risk Coefficients for the U.S. Population, Based on Age-Dependent Intake, Dosimetry, and Risk Models.</i> Federal Guidance Report No. 13. EPA 402-R-99-001. Oak Ridge, TN: Oak Ridge National Laboratory; Washington, DC: Office of Radiation and Indoor Air, United States Environmental Protection Agency, September 1999.
EPA FGR 13 CD Supplement 2002 (NIRS/PC Ex. 112)	EPA (2002). U.S. Environmental Protection Agency, <i>Federal Guidance Report 13 Cancer Risk Coefficients for Environmental Exposure to Radionuclides: CD Supplement</i> , EPA 402-C-99-001, Rev. 1 (Oak Ridge National Laboratory, Oak Ridge, TN; U.S. Environmental Protection Agency, Washington, DC).
Etter 1996 (NIRS/PC Ex. 182)	Memo to Susan White, Staff Attorney, From Stephen D. Etter, Staff Geologist for the Texas Natural Resource Conservation Commission, "Suitability of the Waste Control Specialists, Inc. Site, Andrews Country, Texas, for Disposal of Radioactive Wastes, Draft", April 1996.
Fioravanti & Makhijani 1997 (NIRS/PC Ex. 115)	Marc Fioravanti and Arjun Makhijani. <i>Containing the Cold War Mess: Restructuring the Environmental Management of the U.S. Nuclear Weapons Complex</i> . Takoma Park, Maryland: Institute for Energy and Environmental Research, October 1997. On the Web at http://www.ieer.org/reports/cleanup .
Fioravanti & Makhijani 1998 (NIRS/PC Ex. 116)	Marc Fioravanti and Arjun Makhijani. <i>Supplement to Containing the Cold War Mess IEER's Response to the Department of Energy's Review</i> . Takoma Park, Maryland: Institute for Energy and Environmental Research, March, 1998. On the Web at http://www.ieer.org/reports/cleanup/cln-supp.html .
Fisk 2004 (LES Ex. 98)	Rod Fisk to Rod Krich, "Costs", December 2, 2004. E-mail.
Fisk 2005 (LES Ex. 99)	Rod Fisk to Rod Krich, "Transportation of Depleted UF6 and U3O8", March 23, 2005. E-mail.
GAO 2004 (NIRS/PC Ex. 183)	U.S. General Accounting Office, "Low-Level Radioactive Waste: Disposal Availability Adequate in the Short Term, but Oversight Needed to Identify Any Future Shortfalls", Report to the Chairman, Committee on Energy and Natural Resources, U.S. Senate, June 2004 (GAO-04-604)
GAO/RCED-92-183 (NIRS/PC Ex. 211)	U.S. General Accounting Office, "Nuclear Waste: Defense Waste Processing Facility – Cost, Schedule, and Technical Issues", Report to the Chairman, Environment, Energy, and Natural Resources Subcommittee, Committee on Government Operations, House of Representatives, June 1992 (GAO/RCED-92-183)
GAO/RCED-93-87 (NIRS/PC Ex. 212)	U.S. General Accounting Office, "Federal Research: Super Collider is Over Budget and Behind Schedule", Report to the Congressional Requesters, February 1999 1993 (GAO/RCED-93-87)
GAO/RCED-97-63 (NIRS/PC Ex. 213)	U.S. General Accounting Office, "Department of Energy: Management and Oversight of Cleanup Activities at Fernald", Report to the Congressional Requesters, March 1997 (GAO/RCED-97-63)

GAO/T-RCED-93-58 (NIRS/PC Ex. 214)	U.S. General Accounting Office, "Nuclear Waste: Yucca Mountain Project Management and Funding Issues", Statement of Jim Wells, Testimony before the Subcommittee on Energy and Power, Committee on Energy and Commerce and the Subcommittee on Energy and Mineral Resources, Committee on Natural Resources, House of Representatives, July 1, 1993 (GAO/T-RCED-93-58)
GAO/T-RCED-99-21 (NIRS/PC Ex. 215)	U.S. General Accounting Office, "Nuclear Waste: Schedule, Cost, and Management Issues at DOE's Hanford Tank Waste Project", Statement of Ms. Gary L. Jones, Testimony before the Subcommittee on Oversight and Investigations, Committee on Commerce, House of Representatives, October 8, 1998 (GAO/T-RCED-99-21)
GAO-02-191 (NIRS/PC Ex. 216)	U.S. General Accounting Office, "Nuclear Waste: Technical, Schedule, and Cost Uncertainties of the Yucca Mountain Repository Project", Report to the Congressional Requesters, December 2001 (GAO-02-191)
GAO-03-593 (NIRS/PC Ex. 217)	U.S. General Accounting Office, "Nuclear Waste: Challenges to Achieving Potential Savings in DOE's High-Level Waste Cleanup Program", Report to the Chairman, Subcommittee on Oversight and Investigations, Committee on Energy and Commerce, House of Representatives, June 2003 (GAO-03-593)
Henetz 2005 (NIRS/PC Ex. 184)	Patty Henetz, "Huntsman signs waste-ban measure; Class B and C: The material can be thousands of times hotter than what Envirocare of Utah deals in", <i>Salt Lake City Tribune</i> , February 26, 2005.
Hertzler et al. 1994 (NIRS/PC Ex. 117)	T.J. Hertzler, D.D. Nishimoto, and M.D. Otis. <i>Depleted uranium disposal options evaluation</i> . EGG-MS-11297. Idaho Falls, ID: Waste Management Technology Division, Science Applications International Corporation for EG&G Idaho, Inc. and the U.S. Department of Energy, Office of Environmental Restoration and Waste Management, May 1994.
Holt 2005 (NIRS/PC Ex. 219)	Mark Holt, "Civilian nuclear waste disposal", CRS Issue Brief for Congress, Order code IP92059, Congressional Research Service, Updated June 9, 2005.
Huntoon 2000 (NIRS/PC Ex. 118)	Letter from Carolyn L. Huntoon, Assistant Secretary for Environmental Management, U.S. Department of Energy, to Arjun Makhijani, July 18, 2000.
IAEA 2003 (NIRS/PC Ex. 185)	International Atomic Energy Agency, "Scientific and Technical Basis for the Geologic Disposal of Radioactive Wastes", Technical Reports Series No. 413, February 2003 (STI/DOC/010/413)
IAEA/NEA 2001 (NIRS/PC Ex. 186)	A Joint Report by the OECD Nuclear Energy Agency and the International Atomic Energy Agency, "Management of Depleted Uranium", 2001
ICRP 81 (NIRS/PC Ex. 122)	International Commission on Radiological Protection. <i>Radiation protection recommendations as applied to the disposal of long-lived solid radioactive waste</i> . Annals of the ICRP, v. 28, no. 4. ICRP publication 81. Kidlington, Oxford; Tarrytown, NY: Pergamon, 1998.
Johnson 2005 (NRC Staff Ex. 39)	Timothy C. Johnson to James W. Clifford, "April 19, 2005, In-Office Review Summary: Louisiana Energy Services Decommissioning Funding", April 29, 2005. Internal NRC memo.

Kozak et al. 1992 (NIRS/PC Ex. 128)	Matthew W. Kozak, Thomas A. Feeney, Christi D. Leigh, Harlan W. Stockman. <i>Performance assessment of the proposed disposal of depleted uranium as Class A Low-level Wastewater</i> . FIN A1764 Final Letter Report submitted December 16, 1992 to F.W. Ross (Low-Level Waste Management Branch, Office of Nuclear Material Safety and Safeguards, Nuclear Regulatory Commission). Albuquerque, NM: Sandia National Laboratories, 1992.
Krich 2005 (NIRS/PC Ex. 187)	Letter to Director, Office of Nuclear Material Safety and Safeguards, U.S. Nuclear Regulatory Commission, From R.M. Krich, LES, "Clarifying Information Related to Depleted UF ₆ Disposition Costs and Request for License Condition", March 29, 2005 (NEF#05-016)
Krich 2005b (NIRS/PC Ex. 188)	Letter to Director, Office of Nuclear Material Safety and Safeguards, U.S. Nuclear Regulatory Commission, From R.M. Krich, LES, "Clarifying Information Related to Depleted UF ₆ Disposition Costs and Application for Withholding Information from Public Disclosure", April 8, 2005 (NEF#05-017)
Leeds 2000 (NIRS/PC Ex. 248)	Letter from Eric Leeds (Chief, Special Projects Branch, Division of Fuel Cycle Safety and Safeguards, Office of Nuclear Materials Safety and Safeguards) to Depleted Uranium Hexafluoride Management (U.S. DOE), October 18, 2000
LES 2005/08/11 (NIRS/PC Ex. 221)	U.S. Nuclear Regulatory Commission, before the Atomic Safety and Licensing Board, In the Matter of Louisiana Energy Services, L.P. (National Enrichment Facility), "Applicant's Objections and Responses to Nuclear Information and Resource Service's and Public Citizen's Second Supplemental Interrogatories and Document Request", Docket No. 70-3103-ML, ASLBP No. 04-826-01-ML, August 11, 2005.
LES Business Study 2004 (LES Ex. 91)	<i>Business study: tails deconversion and cylinder washing plants at Urenco (Capenhurst) Limited</i> . 26 th August 2004. Protected Materials. Bates no. LES-PRO-00631 etc.
LES NEF UF6 info sheet (NIRS/PC Ex. 134)	Louisiana Energy Services. <i>Uranium hexafluoride deconversion and disposal in the United States</i> . National Enrichment Facility Information Sheet, Version 2. 1-19-04. On the Web at http://www.nefnm.com/documents/infosheets/uranium.pdf .
LES SAR 2004 (NIRS/PC Ex. 222)	Louisiana Energy Services, "National Enrichment Facility License Application Safety Analysis Report", Revision 2, July 2004, On the Web at http://www.nrc.gov/materials/fuel-cycle-fac/ml042190038.pdf .
LLNL 1997 CA (NIRS/PC Ex. 56)	Hatem Elayat, Julie Zoller, Lisa Szytel. <i>Cost analysis report for the long-term management of depleted uranium hexafluoride</i> . UCRL-AR-127650. Livermore, CA: Lawrence Livermore National Laboratory, May 1997. Summary (26 p) on the Web at http://www.osti.gov/energycitations/product.biblio.jsp?osti_id=575544&queryId=3&start=0 .
LLNL 1997 EA (NIRS/PC Ex. 55)	J.W. Dubrin, J.N. Zoller, L. Rahm-Crites, et al. <i>Depleted Uranium Hexafluoride Program: Engineering analysis report for the long-term management of depleted uranium hexafluoride</i> . UCRL-AR-124080, Rev 2. Livermore, CA: Lawrence Livermore National Laboratory, May 1997. (Volumes I & II). On the Web at http://www.llnl.gov/tid/lof/documents/toc/231539.html .

LLNL Wilt 1997 (NIRS/PC Ex. 135)	Gloria Wilt. "Dealing with a Dangerous Surplus from the Cold War." Lawrence Livermore National Laboratory UCRL-52000-97-4. <i>Science & technology review</i> (April 1997) pp. 4-13. On the Web at http://www.llnl.gov/str/pdfs/04_97.pdf .
LMI 2004 (LES Ex. 86)	Eve M. Meek, David R. Gallay, Douglas A. Gray, and Gerald W. Westerbeck, "An Analysis of DOE's Cost to Dispose of DUF6", LMI Government Consulting, December 2004 (Report DE523T1)
Makhijani & Boyd 2001 (NIRS/PC Ex. 137)	Arjun Makhijani and Michele Boyd. <i>Poison in the Vadose Zone: An examination of the threats to the Snake River Plain aquifer from the Idaho National Engineering and Environmental Laboratory</i> . Takoma Park, Maryland: Institute for Energy and Environmental Research, October 2001. On the Web at http://www.ieer.org/reports/poison/pvz.pdf .
Makhijani & Boyd 2004 (NIRS/PC Ex. 136)	Arjun Makhijani and Michele Boyd. <i>Nuclear Dumps by the Riverside: Threats to the Savannah River from Radioactive Contamination at the Savannah River Site (SRS)</i> . Takoma Park, Maryland: Institute for Energy and Environmental Research, March 11, 2004. On the Web at http://www.ieer.org/reports/srs/index.html .
Makhijani and Gopal 2001 (NIRS/PC Ex. 189)	Arjun Makhijani and Sriram Gopal, "Setting Cleanup Standards to Protect Future Generations: The Scientific Basis of the Subsistence Farmer Scenario and Its Application to the Estimation of Radionuclide Soil Action Levels (RSALs) for Rocky Flats", December 2001.
Makhijani and Smith 2004 (NIRS/PC Ex. 190)	Arjun Makhijani and Brice Smith, "Costs and Risks of Management and Disposal of Depleted Uranium from the National Enrichment Facility Proposed to be Built in Lea County New Mexico by LES", November 24, 2004.
Makhijani October 2000 (NIRS/PC Ex. 138)	Arjun Makhijani. Letter from IEER to Carolyn Huntoon, Assistant Secretary for Environmental Management, United States Department of Energy October 13, 2000 On the Web http://www.ieer.org/comments/waste/tru2hunt.html .
MOA 2005 (LES Ex. 105)	E. James Ferland, President and CEO Louisiana Energy Services, L.P. and George E. Dials, President and COO Waste Control Specialists LLC, "Memorandum of Agreement between Louisiana Energy Services, L.P. and Waste Control Specialists LLC", January 14, 2005.
NAS/NRC 1996 (NIRS/PC Ex. 150)	National Research Council. Committee on Decontamination and Decommissioning of Uranium Enrichment Facilities. <i>Affordable Cleanup? Opportunities for cost reduction in the decontamination and decommissioning of the nation's uranium enrichment facilities</i> . Washington, DC: National Academies Press, 1996.
NAS/NRC 2003 (NIRS/PC Ex. 151)	National Research Council. Board on Radioactive Waste Management. Committee on Improving the Scientific Basis for Managing Nuclear Materials and Spent Nuclear Fuel through the Environmental Management Science Program. <i>Improving the Scientific Basis for Managing DOE's Excess Nuclear Materials and Spent Nuclear Fuel</i> . Washington, DC: National Academies Press, 2003.
NAS/NRC 2005 (NIRS/PC Ex. 225)	Richard R. Monson (Chair) et al., "Health Risks from Exposure to Low Levels of Ionizing Radiation: BEIR VII - Phase 2", Committee to Assess Health Risks from Exposure to Low Levels of Ionizing Radiation, Board on Radiation Effects Research, National Academies Press, Washington, DC (2005)

NEF DEIS 2004 (NIRS/PC Ex. 152)	U.S. Nuclear Regulatory Commission, "Environmental Impact Statement for the Proposed National Enrichment Facility in Lea County, New Mexico: Draft Report for Comment", September 2004 (NUREG-1790)
NEF FEIS 2005 (NIRS/PC Ex. 191)	U.S. Nuclear Regulatory Commission, "Environmental Impact Statement for the Proposed National Enrichment Facility in Lea County, New Mexico: Final Report", Chapters 1 through 10 and Appendices A through G, June 2005 (NUREG-1790, Vol. 1)
NRC 1991 (NIRS/PC Ex. 193)	James M. Taylor, "Disposition of Depleted Uranium Tails from Enrichment Plants", Enclosure: Factors Involved in the Disposition of Depleted Uranium Hexafluoride DUF ₆ Tails, January 25, 1991 (SECY-91-019)
NRC 2002 (NIRS/PC Ex. 88)	U.S. Nuclear Regulatory Commission, "Nuclear Regulatory Legislation: 107th Congress; 1st Session", June 2002 (NUREG-0980 Vol. 1, No. 6)
NRC 2005 (NIRS/PC Ex. 195)	U.S. Nuclear Regulatory Commission in the matter of Louisiana Energy Services, L.P. (National Enrichment Facility), "Memorandum and Order", CLI-05-05, Docket No. 70-3103-ML, January 18, 2005
NRC 2005b (NIRS/PC Ex. 264)	U.S. Nuclear Regulatory Commission, "Information Digest 2005-2006 Edition", NUREG-1350 Vol. 17, July 2005
NRC CEC EIS Final 1994 (NIRS/PC Ex. 58)	U.S. Nuclear Regulatory Commission. Office of Nuclear Material Safety and Safeguards. <i>Final Environmental Impact Statement for the Construction and Operation of Claiborne Enrichment Center, Homer, Louisiana.</i> NUREG-1484. Washington, DC, September 2004.
NUREG 1757, Vol.3 (NIRS/PC Ex. 249)	U.S. Nuclear Regulatory Commission, Office of Nuclear Material Safety and Safeguards, Division of Waste Management, <i>Consolidated NMSS Decommissioning Guidance: Financial Assurance, Recordkeeping, and Timeliness, Final Report</i> , Prepared by T.L. Fredrichs, E.R. Pogue, M.C. Maier, and R. N. Young, August 2005 (NUREG-1757 Vol.3)
Paducah FEIS 2004 (LES Ex. 17)	U.S. Department of Energy, "Final Environmental Impact Statement for Construction and Operation of a Depleted Uranium Hexafluoride Conversion Facility at the Paducah, Kentucky, Site", Volume 1: Main Text and Appendixes A-H, June 2004 (DOE/EIS-0359)
Portsmouth FEIS 2004 (LES Ex. 16)	U.S. Department of Energy, "Final Environmental Impact Statement for Construction and Operation of a Depleted Uranium Hexafluoride Conversion Facility at the Portsmouth, Ohio, Site", Volume 1: Main Text and Appendixes A-H, June 2004 (DOE/EIS-0360)
Rod Krich Deposition August 26, 2005 (NIRS/PC Ex. 226)	<i>Deposition of Rod Krich.</i> Friday, August 26, 2005. In the matter of Louisiana Energy Services (National Enrichment Facility) v. Nuclear Information and Resource Service and Public Citizen. U.S. Nuclear Regulatory Commission, Docket No. 70-3103-ML; ASLBP No. 04-826-01-ML. Deposition took place in offices of Winston & Strawn, Washington, DC.
Rowberg 2001 (NIRS/PC Ex. 227)	Richard Rowberg, "The National Ignition Facility: Management, Technical, and Other Issues", CRS report for Congress, Order code RL30540, Congressional Research Service, Updated November 8, 2001.
Saunders and Young 1983 (NIRS/PC Ex. 196)	Ian Saunders and Anthony Young, "Rates of Surface Processes on Slopes, Slope Retreat, and Denudation", <i>Earth Surface Processes and Landforms</i> , Vol. 8, 473-501 (1983)

Schenk and Jackson 2002 (NIRS/PC Ex. 197)	H. Jochen Schenk and Robert B. Jackson, "Rooting depths, lateral root spreads and below-ground/above-ground allometries of plants in water-limited ecosystems", <i>Journal of Ecology</i> , Vol. 90, 480-494 (2002)
Smith 2004 (NIRS/PC Ex. 160)	Brice Smith. <i>What the DOE Knows it Doesn't Know about Grout: Serious Doubts Remain About the Durability of Concrete Proposed to Immobilize High-Level Nuclear Waste in the Tank Farms at the Savannah River Site and other DOE Sites</i> . Institute for Energy and Environmental Research, Takoma Park, Maryland updated October 18, 2004. On the web at http://www.ieer.org/reports/srs/grout.pdf .
TCEQ 2003 (NIRS/PC Ex. 228)	Texas Commission on Environmental Quality, "Lineup of Legislation, The TCEQ's playbook grows with new responsibilities, laws to implement", <i>Natural Outlook</i> , Summer 2003, online at http://www.tceq.state.tx.us/AC/comm_exec/forms_pubs/pubs/pd/020/03-03/legislation.html (Last Modified 8/4/05)
Texas Agreement 1963 (NIRS/PC Ex. 198)	Glenn T. Seaborg, Chairman of the Atomic Energy Commission, and Price Daniel, Governor of Texas, "Agreement Between the United States Atomic Energy Commission and the State of Texas for Discontinuance of Certain Commission Regulatory Authority and Responsibility Within the State Pursuant to Section 274 of the Atomic Energy Act of 1954, as Amended", 1963.
Utah Rule 2005/07/01 (NIRS/PC Ex. 259)	Utah. Division of Administrative Rules. Rule R313-15. Standards for protection against radiation, As in effect on July 1, 2005.
Washington Code 1998 (NIRS/PC Ex. 260)	Washington. Washington Administrative Code. Title 246. Health, Department of, Chapter 246-249 WAC, Radioactive waste -- Use of the commercial disposal site, Last Update: 4/22/98.
WCS 2004 (NIRS/PC Ex. 199)	Waste Control Specialists, LLC., "Application for License to Authorize Near-Surface Land Disposal of Low-Level Radioactive Waste", originally filed on August 4, 2004 and ruled Administratively Complete by the Texas Commission on Environmental Quality on February 18, 2005, available online at http://64.224.191.188/wcs/ .
Wheatley 2005 (NIRS/PC Ex. 200)	Letter from Wade M. Wheatley to Glenn Shankle, "License Application for a Proposed Low-Level Radioactive Waste Disposal Facility: Evaluation of Merit", Texas Commission on Environmental Quality, April 26, 2005.
Yu et al. 1993 (NIRS/PC Ex. 201)	C. Yu, C. Loureiro, J.-J. Cheng, L.G. Jones, Y.Y. Wang, Y.P. Chia, and E. Faillace. <i>Data collection handbook to support modeling impacts of radioactive material in soil</i> . Argonne, IL: Environmental Assessment and Information Sciences Division, Argonne National Laboratory, April 1993. On the Web at http://web.ead.anl.gov/resrad/documents/data_collection.pdf .

CERTIFICATE OF SERVICE

Pursuant to 10 CFR § 2.305 the undersigned attorney of record certifies that on October 21, 2005, the foregoing Revised Rebuttal Testimony of Dr. Arjun Makhijani in Support of NIRS/PC Contentions EC-3/TC-1, EC-5/TC-2, and EC-6/TC-3 concerning LES's Disposal Strategy and Cost Estimate was served by expedited delivery upon the following:

G. Paul Bollwerk, III
Atomic Safety and Licensing Board Panel
U.S. Nuclear Regulatory Commission
Third Floor, Two White Flint North
11545 Rockville Pike
Rockville, MD 20852-2738
e-mail: gpb@nrc.gov

Dr. Paul B. Abramson
Atomic Safety and Licensing Board Panel
U.S. Nuclear Regulatory Commission
Third Floor, Two White Flint North
11545 Rockville Pike
Rockville, MD 20852-2738
e-mail: pba@nrc.gov

Dr. Charles N. Kelber
Atomic Safety and Licensing Board Panel
U.S. Nuclear Regulatory Commission
Third Floor, Two White Flint North
11545 Rockville Pike
Rockville, MD 20852-2738
e-mail: CKelber@att.net

James Curtiss, Esq.
David A. Repka, Esq.
Martin J. O'Neill, Esq.
Winston & Strawn
1700 K Street, N.W.
Washington, D.C. 20006-3817
e-mail: jcurtiss@winston.com
drepka@winston.com
moneill@winston.com

John W. Lawrence, Esq.
National Enrichment Facility
100 Sun Ave., N.E.
Suite 204
Albuquerque, NM 87109 (by Fedex)
e-mail: jlawrence@nefnm.com

Office of the General Counsel
U.S. Nuclear Regulatory Commission
One White Flint North
11555 Rockville Pike
Rockville, MD 20852-2738
Attention: Lisa B. Clark, Esq.
e-mail: OGCMailCenter@nrc.gov
lbc@nrc.gov
abc1@nrc.gov
jth@nrc.gov
dmr1@nrc.gov
dac3@nrc.gov

Office of Commission Appellate Adjudication
Mail Stop O-16C1
U.S. Nuclear Regulatory Commission
One White Flint North
11555 Rockville Pike
Rockville, MD 20852-2738

Secretary
U.S. Nuclear Regulatory Commission
One White Flint North
11555 Rockville Pike
Rockville, MD 20852-2738
Attention: Rulemakings and Adjudications Staff
e-mail: hearingdocket@nrc.gov

Lindsay A. Lovejoy, Jr.
618 Paseo de Peralta, Unit B
Santa Fe, NM 87501
(505) 983-1800
(505) 983-0036 (facsimile)
e-mail: lindsay@lindsaylovejoy.com

1 MR. LOVEJOY: I'm going to try to identify
2 the exhibits which I think are related exclusively to
3 disposal. They are the following, NIRS/PC Exhibit
4 201, which is Yu et al, Data Collection Handbook to
5 Support Modeling Impacts of Radioactive Material in
6 Soil.

7 CHAIR BOLLWERK: That has already been
8 admitted.

9 MR. LOVEJOY: It has?

10 CHAIR BOLLWERK: Yes. Just check your
11 list, that is fine, it is not a problem. Let's make
12 sure. If it has already been admitted, then you are
13 in good shape. If it hasn't, then we will take care
14 of it.

15 MR. LOVEJOY: I have number 204.

16 CHAIR BOLLWERK: That has been admitted.

17 MR. LOVEJOY: Okay. Number 205?

18 CHAIR BOLLWERK: That has been admitted.

19 MR. LOVEJOY: Number 206?

20 CHAIR BOLLWERK: Same, it has been
21 admitted.

22 MR. LOVEJOY: Good.

23 CHAIR BOLLWERK: I have, 222 might be one
24 you might take a look at.

25 MR. LOVEJOY: Yes, 222, is the SAR

1 revision 2, July 2004, extracts from that.

2 (Whereupon, the above-
3 referenced to document was
4 marked as NIRS/PC Exhibit No.
5 222 for identification.)

6 CHAIR BOLLWERK: That one has not been
7 admitted, we need to take care of that one. Let's go
8 ahead and mark that one for identification, 222, as
9 described by counsel.

10 How about 259?

11 MR. LOVEJOY: I had, also, 249.

12 CHAIR BOLLWERK: It has been admitted
13 already.

14 MR. LOVEJOY: Exhibit 259, that is Utah's
15 Administrative Rules, Rule 313-15.

16 CHAIR BOLLWERK: Let's go ahead and mark
17 259, NIRS/PC 259, as identified by counsel, is marked
18 for identification.

19 (Whereupon, the above-
20 referenced to document was
21 marked as NIRS/PC Exhibit No.
22 259 for identification.)

23 MR. LOVEJOY: And rule 260, Washington
24 Administrative Code, Title 246.

25 CHAIR BOLLWERK: All right, NIRS/PC 260 as

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 identified by counsel is marked for identification.

2 (Whereupon, the above-
3 referenced to document was
4 marked as NIRS/PC Exhibit No.
5 260 for identification.)

6 MR. LOVEJOY: Now, I see number 262.

7 CHAIR BOLLWERK: That has already been
8 admitted.

9 MR. LOVEJOY: Yes, I was going to say.

10 CHAIR BOLLWERK: The next one I have is
11 263.

12 MR. LOVEJOY: Yes, 263, the March 2, 1995
13 ASLB decision.

14 CHAIR BOLLWERK: All right, then exhibit
15 263, as identified by counsel, the March 2, 1995
16 Licensing Board decision is marked for identification.

17 (Whereupon, the above-
18 referenced to document was
19 marked as NIRS/PC Exhibit No.
20 263 for identification.)

21 MR. LOVEJOY: Now, we have 265, 266, 267,
22 and 268, they were late added exhibits. These relate
23 to disposal. I don't believe that they are referred
24 to in the direct testimony. Dr. Makhijani may be
25 referring to them in cross examination.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 CHAIR BOLLWERK: That is fine. If they
2 come into cross we will deal with them at that point.

3 MR. LOVEJOY: Well, as to the ones we have
4 just identified, I offer them in evidence.

5 CHAIR BOLLWERK: All right. Any
6 objections?

7 (No response.)

8 CHAIR BOLLWERK: There being none then
9 NIRS/PC exhibits 222, 259, 260, and 263 are admitted
10 into evidence.

11 (The document referred to,
12 having been previously marked
13 for identification as NIRS/PC
14 Exhibit Nos. 222, 259, 260, and
15 263 were admitted into
16 evidence.)

17 MR. CURTISS: Mr. Chairman, at this point
18 maybe it is appropriate to raise the question, I note
19 that Dr. Makhijani has a laptop computer here. Is
20 this for the purpose of calculations, or are there
21 references and information in there that he intends to
22 rely on, that have not been disclosed?

23 WITNESS MAKHIJANI: No, it is just for the
24 convenience having FGR-13, which I think is already
25 part of the reference list, all the numbers are in

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 there.

2 MR. CURTISS: Thank you.

3 WITNESS MAKHIJANI: And I did some numbers
4 for reference, but I don't need to refer to them.

5 CHAIR BOLLWERK: You are satisfied then?

6 MR. CURTISS: That is fine.

7 CHAIR BOLLWERK: At this point, then, I
8 believe we are ready for additional testimony you wish
9 to --

10 MR. LOVEJOY: Thank you, Your Honor.

11 CHAIR BOLLWERK: Hold on one second.

12 (Pause.)

13 CHAIR BOLLWERK: All right, good.

14 EXAMINATION BY MR. LOVEJOY OF

15 ARJUN MAKHIJANI

16 MR. LOVEJOY: Dr. Makhijani, have you been
17 present in the hearing room, through the testimony of
18 the LES panel witnesses, and the NRC Staff panel
19 witnesses on disposal issues?

20 WITNESS MAKHIJANI: Yes, apart from a
21 short absence.

22 MR. LOVEJOY: Okay. Perhaps reflecting on
23 what you have heard in those, in that testimony, and
24 from your general resources, can you explain the
25 approach that you think is appropriate in applying

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 10CFR Part 61 particularly subpart C, to the
2 assessment of near-surface disposal sites?

3 WITNESS MAKHIJANI: Yes. A number of
4 things have been mentioned, both by the LES and the
5 Staff panel in regard to that.

6 First of all, there are the dose limits,
7 and one particular thing to observe, that I want to
8 stress, since I will be talking about my calculations,
9 and the ones that Dr. Smith and I did, is that it also
10 contains a maximum exposed organ dose limit, other
11 than the maximum full body limit.

12 The other thing is that it is very clear,
13 in the regulation, that there is no time limit for an
14 intruder dose. It says at any time. And it does say
15 that an intruder needs to be protected. That
16 particular paragraph does not contain a, 61.42, I
17 think.

18 If I could have, actually --

19 MR. LOVEJOY: You might want to refer to
20 LES exhibit 101, if it is nearby.

21 WITNESS MAKHIJANI: I believe it is 61.42
22 that has the intruder, and 61.44 is what I wanted to
23 refer to.

24 Yes, that is the question of stability.
25 And, as has been discussed, the surveillance and

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 monitoring need to be carried out with minor custodial
2 care, and that is linked, in my mind, to 61.59, where
3 the institutional period is 100 years.

4 So I think that it is very clear that
5 after closure provision needs to be made for
6 monitoring for 100 years. And the period between 100
7 years and the period after that, whatever you assume,
8 1,000 years, 10,000 years, 100,000 years, must be
9 assumed to be without institutional controls or
10 monitoring of any kind.

11 MR. LOVEJOY: Now, in saying that, what do
12 you have in mind by way of institutional controls that
13 have come into the conversation here?

14 WITNESS MAKHIJANI: Well, the general
15 assumption in this kind of calculation, for very long
16 periods of time, as has been said, there are quite a
17 lot of uncertainties.

18 And so the National Academy of Sciences,
19 National Research Council, various other bodies,
20 research studies have developed approaches to deal
21 with long periods of time and uncertainties, not only
22 in this country, but in other countries.

23 I directed a study, for instance, to
24 examine the French repository program research that I
25 presented in France, this year, that was done for the

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 official citizen advisory board, which is government
2 funded.

3 And I examined the approaches that are
4 taken for very long time periods, when there are no
5 time limits. And in these approaches the general
6 assumption is there is no monitoring, no institutional
7 control.

8 So people can go and live there, and you
9 have to assume, based on what we know today, without
10 considerations of evolution, or anything like that, or
11 changes in technology, based on what we know, how we
12 live today, what the doses might be to an unrestricted
13 access to the site.

14 JUDGE ABRAMSON: Can I cut through,
15 perhaps, some time here? Dr. Makhijani, is the
16 principal issue that can increase dose, the removal of
17 the cover?

18 WITNESS MAKHIJANI: Your Honor, in a dry
19 site the principal issue is the removal of the cover,
20 or an intrusion that might involve construction.

21 JUDGE ABRAMSON: So something that gets
22 direct exposure to the waste?

23 WITNESS MAKHIJANI: The removal of the
24 cover, of course, creates inhalation doses, external
25 doses, and so on. Yes.

1 JUDGE ABRAMSON: So why don't we start
2 with a premise, here, that we are far enough in the
3 future that that has happened, institutional controls
4 are gone, cover is gone, let's talk about that.

5 Because the real question in front of us
6 is we understand the premise that at some point in the
7 future this could happen. So why don't we just start
8 with that premise and move forward from there? It
9 might make it easier.

10 WITNESS MAKHIJANI: Yes, I think so. I'm
11 also interested in brief testimony.

12 MR. LOVEJOY: You referred to the organ
13 dose limit. Where exactly is that?

14 WITNESS MAKHIJANI: It is in 61.41.

15 MR. LOVEJOY: Okay. Now, in general,
16 perhaps in a generic way, what studies have been done
17 with respect to disposal of depleted uranium in large
18 quantities, such as are at issue here, in near-surface
19 mode?

20 WITNESS MAKHIJANI: Well, a number of
21 studies have been done. There is the Baird study, that
22 has been talked about, there is the Kozak study, that
23 has been talked about, that was done in connection
24 with the CEC case.

25 There is the famous programmatic

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 environmental impact statement that has, that was
2 prepared by the Department of Energy. And of course
3 there are studies that Dr. Smith and I did.

4 MR. LOVEJOY: And what is your view, as a
5 scientist, of the Baird report?

6 WITNESS MAKHIJANI: Well, I was rather
7 incredulous at some of its contents, because they are
8 physically impossible.

9 MR. LOVEJOY: Would you like to look at
10 the Baird report?

11 WITNESS MAKHIJANI: I have my copy, but if
12 you give me an exhibit number --

13 MR. LOVEJOY: It is exhibit 170. In the
14 record it is NIRS/PC exhibit 170. Do you care to
15 point out what you are talking about?

16 WITNESS MAKHIJANI: Yes. On page 5-13,
17 there is a whole string of numbers. Was it 170?

18 MR. LOVEJOY: Yes.

19 WITNESS MAKHIJANI: Page 5-13, I will just
20 use one of the items, there are many items like this.
21 So it is not one mistake. I just use U238 as an
22 example, since it is a dominant radionuclide we are
23 considering.

24 It says, at the top of the left-hand set
25 of columns, intruder explorer dose criterion at 25

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 millirem per year. And the third column says,
2 allowable concentration in waste picocuries per gram.

3 That means that is the concentration and
4 waste that would be allowed that would produce a dose
5 of 25 millirem per year to an intruder.

6 And the number that is provided for
7 uranium 238 is 5.2 times ten to the 37th picocuries
8 per gram. I did a little number work on that, and
9 that turns out to be maybe four orders of magnitude
10 bigger than the weight of the earth.

11 That is all compressed into a single gram
12 of Utah soil. I know it has been much sought after,
13 but I didn't know it was that much sought after.

14 JUDGE KELBER: Is that perhaps because it
15 is alpha emitters, and the depleted uranium absorbency
16 emission in approximately less than a millimeter?

17 WITNESS MAKHIJANI: No, Your Honor. I
18 looked at the reasonableness of all these --

19 JUDGE KELBER: Did you look at the self
20 absorption?

21 WITNESS MAKHIJANI: I looked at the one
22 picocurie per gram.

23 JUDGE KELBER: Did you look at the self
24 absorption, I'm asking you.

25 WITNESS MAKHIJANI: I didn't look at the

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 self absorption, I looked at the one picocurie per
2 gram. Am I allowed to give an answer about what I
3 said, Your Honor? I just wanted to be clear.

4 JUDGE KELBER: All I wanted was a yes or
5 no.

6 WITNESS MAKHIJANI: I looked at the one
7 picocurie per gram soil number that is given in the
8 second column there. And it says millirem per year
9 per picocurie per gram.

10 And I know how they derived the ten to the
11 37, is that they have a dose, estimated dose of 4.8
12 time ten to the minus 37 millirem per picocurie, per
13 gram.

14 If you assume any credible scenario,
15 whatsoever, you cannot get that number. You assume a
16 nanocurie of this soil per cubic meter of air, which
17 would be pristine pure, in a national park, maybe.
18 And you breathe that for a year, or even an hour, you
19 would get a much bigger -- you would get a bigger --
20 you would get a pretty big dose, a much bigger dose
21 than what is indicated here, in terms of ten to the
22 minus 37.

23 These calculations are simply wrong. And
24 physically impossible, and incredible. And the fact
25 that the Utah license is based on these kinds of

1 calculations indicates that this report had no quality
2 assurance, and the department of radiation, in the
3 State of Utah, has given a license to Envirocare in
4 what I would describe as a very careless manner, based
5 on a report that has not been quality assured, and
6 that contains absurd results.

7 JUDGE ABRAMSON: And we take your point
8 about you have concerns about the results in the
9 report that was, apparently, used by the State of
10 Utah, but the State of Utah's license is not at issue
11 here.

12 If you think that -- if NIRS/PC believes
13 that NRC has some sort of a gap in its arrangement
14 between itself and the State of Utah, as an agreement
15 state, this is not the forum to bring it up.

16 WITNESS MAKHIJANI: Your Honor, the reason
17 I'm bringing it up is I understood Ms. Clark to say,
18 yesterday, that they have relied on this report, and
19 the existence of this report, I presume is part of
20 their own oversight generally, and is part of their
21 function in this proceeding, to allow a plausible
22 strategy and cost determinations to be made, that
23 Envirocare would be a plausible option for disposal.

24 And what I'm saying is that that
25 determination that has happened, in this specific

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 case, cannot have happened with any reasonably
2 standard, defined standard of care.

3 MS. CLARK: Maybe I should respond,
4 because that is not, as I recall, any characterization
5 of my testimony or that of the Staff's.

6 WITNESS MAKHIJANI: I don't know, I think
7 we need --

8 CHAIR BOLLWERK: Right. I think we have
9 gotten the answer we wanted. I think Dr. Makhijani's
10 finished his answer, you've made your statement. I
11 think it is time for another question.

12 MR. LOVEJOY: Do you agree, I think there
13 was testimony here today that the report was
14 scientifically reasonable. I think those words were
15 used. Do you concur with that?

16 WITNESS MAKHIJANI: No, I do not. I think
17 there may be pieces of this report that have
18 scientifically correct results. There are certainly
19 pieces of this that certainly look more reasonable
20 than the page I'm pointing out, which I have talked
21 about before.

22 Those pages did not incite any alarms.
23 But a few days ago, when I was reviewing this, and
24 when there is something like this, it certainly throws
25 the credibility of the whole report into doubt as to

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 how it was reached.

2 CHAIR BOLLWERK: And you are right, that
3 question was asked, and now we have Dr. Makhijani's
4 views on that. You are absolutely correct. Thank
5 you.

6 MR. LOVEJOY: Dr. Makhijani, would you
7 just briefly explain what examination you have done of
8 the issue of near-surface disposal of large quantities
9 of depleted uranium in, say, dry areas?

10 WITNESS MAKHIJANI: Well, since this
11 proposal was put forward, in this case, Dr. Smith and
12 I discussed some possible calculations. One normal
13 way to do calculations for near-surface disposal is
14 the use of a standard program, RESRAD, developed at
15 Argonne National Lab.

16 We discussed what might be the appropriate
17 parameters for screening calculations, which we
18 presented in our November report. And the results are
19 there, in the November report.

20 The doses are thousands of times bigger
21 than the 25 millirem limit, even if the whole body
22 dose is counted.

23 JUDGE ABRAMSON: At what point in time did
24 those doses --

25 WITNESS MAKHIJANI: These doses are far

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 into the future. So, Your Honor --

2 JUDGE ABRAMSON: In the first thousand
3 years were they a problem?

4 WITNESS MAKHIJANI: In the first thousand
5 years they would generally be a problem if you have an
6 intruder --

7 JUDGE ABRAMSON: But only the intruder
8 scenario.

9 WITNESS MAKHIJANI: -- intruding into the
10 thing. The kinds of calculations that were done,
11 under the RESRAD erosion scenarios that we've talked
12 about, assume that the cover is eroded away.

13 And then the time when the dose goes to
14 zero is actually when the waste is completely
15 dispersed. And that happens, it is dispersed before
16 the radionuclides half lives.

17 JUDGE ABRAMSON: So the first, if I
18 understand you correctly, your calculations indicate
19 that the problem originates from erosion, and from the
20 daughter products, and that is relatively -- that is
21 well more than a thousand years out, is that correct?

22 WITNESS MAKHIJANI: Yes, except for
23 construction, for now, yes. If you don't have
24 uncovered waste, and if you don't have, as Judge
25 Kelber has pointed out, there are alpha emitters,

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 there is radium, of course, that develops over a
2 period of time.

3 JUDGE ABRAMSON: Right.

4 WITNESS MAKHIJANI: But if you have
5 several meters of cover you are going to be shielded.
6 And so, essentially, the problem of very high doses
7 arises at dry sites only in those cases. We did not
8 look at climate change questions, because these doses
9 are so high, and our conclusion was so clear, we
10 didn't need to do anything more.

11 JUDGE ABRAMSON: No, I think I understand
12 the proposition, and I understand the premise. And it
13 really comes back down to the same issue we have been
14 saying all along, which is the question of whether or
15 not the absence of a time limit, in the -- in Part 61
16 informs us, and whether it should inform us as to how
17 Part 61 should be applied, and I appreciate that.
18 Thank you.

19 MR. LOVEJOY: You, I think you were kind
20 of in the middle of your answer, explaining the
21 investigations you had done of near-surface disposal
22 of depleted uranium in dry sites.

23 And you talked about what you had done, I
24 think, in the screening calculations. Would you
25 capsulize the investigations you undertook, that I

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 think were reported in the later report, which is
2 number 224?

3 WITNESS MAKHIJANI: Yes. In the later
4 report, after the November report the question of the
5 WCS site in Texas came up. It is also another dry
6 site and can be used as site-specific, or as a
7 reference site.

8 But there were some different parameters
9 there. The parameters that are in the report, or in
10 the WCS license application, so the parameters that we
11 used are easily obtainable.

12 The difference between the Envirocare type
13 of assumptions that we made, they weren't exactly
14 Envirocare assumptions, but generally it doesn't
15 change a lot, if you change those assumptions.

16 And the WCS type of disposal, the WCS
17 disposal is much deeper. And so that, of course, the
18 erosion takes much longer. It was claimed, by the
19 Applicant, that the site would build up soil over the
20 years, rather than erode away.

21 So we looked at the documentation from the
22 State of Texas, about the site, and we also
23 commissioned an independent evaluation from an expert
24 that we had not worked with before, and who did not
25 take any money from us, he wanted to provide just

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 truly pro bono independent opinion, he is from the
2 University of Nevada.

3 And he concurred that this was an erosive
4 site. And, of course, then it depends on what erosion
5 rate you use. And so we spent quite -- and so far as
6 I know, in this particular case, for shallow land
7 burial, the calculations in the reports that Dr. Smith
8 and I did, are the only ones that actually have been
9 done, presented and talked about, and the only ones
10 that actually cover the issue of erosion and what
11 happens.

12 JUDGE ABRAMSON: And did you find a
13 generally similar result, Dr. Makhijani? That is that
14 a thousand years, with the exception of somebody going
15 in and doing construction things look good, but when
16 you get out many thousands of years, and after the
17 erosion has uncovered things, that is when you have a
18 problem?

19 WITNESS MAKHIJANI: Yes. And one of the
20 kind of reasonableness checks we found in our
21 calculations, I think the Kozak report is very good,
22 I looked at it, some recently, and in much more detail
23 in the years that went by the last time around.

24 And our numbers are similar orders of
25 magnitude to theirs, in like intrusion scenarios, and

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 uncovered waste scenarios, and so on.

2 And so I -- and I think they are similar
3 to the PEIS calculation is not bounding, the PEIS
4 calculation of ten rem in the case of erosion is
5 generally that your orders of magnitude away, even if
6 you are effective dose equivalent, and once you go to
7 the maximum dose, you are another order of magnitude
8 farther away.

9 MR. LOVEJOY: I don't know whether you got
10 to the point of capsulizing the results you obtained
11 in your July report. What did you find out for the
12 sites you examined, as far as results go?

13 WITNESS MAKHIJANI: Well, in the results
14 we had inhalation doses that were in the several rem,
15 and external doses in the tens of rems. So much, much
16 more larger doses than any limits we are talking
17 about.

18 And, as I said, these inhalation doses of
19 a few rem were whole body doses. And once you go to
20 the critical organ you are talking ten times, fifteen
21 times that.

22 MR. LOVEJOY: Now, do you have some
23 experience with regulations in, say, parallel or
24 similar context, concerning the licensing or
25 permitting of radioactive waste disposal facilities?

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 WITNESS MAKHIJANI: Yes.

2 MR. LOVEJOY: And do some regulations of
3 that type address time limits for modeling and
4 projection and performance?

5 WITNESS MAKHIJANI: Yes. Usually there is
6 a time limit implemented, time limit used in the
7 implementation of the regulation. In all cases that
8 I know about, that -- there are time limits in the
9 regulation, as in the decommissioning regulation that
10 was cited yesterday, the TEDs to be calculated at
11 1,000 years, the mill tailings regulations that was
12 cited, has 1,000 year time limit.

13 So the time limits that are used are
14 specified when the rule was made, the calculations
15 were done, the rationale was provided.

16 MR. LOVEJOY: And is there a time limit in
17 the regulations for WIPP?

18 WITNESS MAKHIJANI: Yes.

19 MR. LOVEJOY: Is there a time limit in
20 regulations -- there have been time limits in the
21 regulations addressing Yucca Mountain, have there not?

22 WITNESS MAKHIJANI: There have been, and
23 now they have been lifted.

24 MR. LOVEJOY: And people fight about those
25 things, because they are important, right?

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 WITNESS MAKHIJANI: Yes, they are
2 important. I mean, the question of uncertainties in
3 regaRd to maximum doses have been raised, and I think
4 the point is well taken.

5 And I recently gave my comments in the
6 Yucca Mountain hearings that the EPA is holding on the
7 draft standard. And my suggestion to the EPA was
8 somewhat different than many others have given based,
9 largely, on the experience of examining the French
10 repository program in great detail over a two year
11 period, and looking at their rule.

12 They do recognize, they don't recognize
13 thousand years, like the EPA they have said 10,000
14 years, and I think the calculations for Part 61 rule
15 also go out to 10,000 years, I don't remember I
16 haven't looked at it, all the number work recently.

17 Generally it has been felt, throughout the
18 world, that you can, if you do it right, you can say
19 things with some confidence on 10,000 year time
20 frames, maybe it refers to the pyramids, I don't know,
21 somehow that idea has stuck.

22 And I think it is fairly reasonable,
23 because I have been to the pyramids, maybe. Beyond
24 10,000 years everybody recognizes that we have a
25 problem in terms of having waste that we don't know

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 how to talk about reasonably.

2 And the way the French approached it,
3 which I personally like a great deal, and I recommend
4 it to the EPA, and might command your examination, is
5 they say that for 10,000 years you should try to
6 evaluate as precisely as possible, specify your
7 parameters, you can study things.

8 And they have done a lot of very fine
9 studies, including on climate change. And beyond
10 10,000 years, they try to specify maximum parameters
11 for calculation, so they don't have to do uncertainty
12 calculations.

13 And when they have a dose limit they say
14 we are confident because the maximum parameters, that
15 are reasonable to assume today. And that is how they
16 approach it, and that is how I think it ought to be
17 approached.

18 MR. LOVEJOY: And is there any pattern to
19 how various regulations deal with the issue of
20 institutional control over disposal sites?

21 WITNESS MAKHIJANI: Yes, generally,
22 including in Part 61, you assume there is some
23 maintenance of institutional control, and academic
24 studies, and regulations, generally recognize that
25 there is going to be a failure of institutional

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 control after some time.

2 MR. LOVEJOY: Is there -- do regulations
3 generally put a time limit on the period over which
4 you can assume institutional controls to be in action?

5 WITNESS MAKHIJANI: Well, usually it is
6 100 or a few hundred years. I don't recall all the
7 regulations in terms of institutional control.

8 MR. LOVEJOY: There is 100 year limit in
9 10CFR Part 61 right?

10 WITNESS MAKHIJANI: Yes.

11 MR. LOVEJOY: Okay. Now, having heard
12 what you heard today and yesterday, do you have a view
13 you would like to express on the basis, or at least
14 the apparent basis for Utah acting to authorize
15 disposal of depleted uranium in large quantities at
16 the Envirocare site?

17 WITNESS MAKHIJANI: Yes. I think this
18 whole thing rests on a phone call, because so far, and
19 the summary of that phone call from April of this
20 year.

21 So far as I have been able to determine,
22 leaving aside the Baird report, which I won't talk
23 about again, unless asked, so far as I can determine,
24 from the Oakridge study, and from the bibliography
25 that has been handed out, the last full performance

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 assessment was done in the year 2000.

2 This performance assessment did not look
3 at large quantities of depleted uranium. I know that
4 the Department of Radiation Control has said that you
5 can bring large quantities of depleted uranium and
6 there is no specific activity limit.

7 And even if that is true, and you ignore
8 the questions of specific activity limits, what is at
9 issue and what the Commission has said, in Wednesday
10 of last week, is that the main issue is the large
11 quantities of depleted uranium and its environmental
12 impact.

13 And so far as I can see apart from any
14 hydrogeological and water pathway doses relating to
15 four millirem from the water pathway, no evaluation
16 has been done. And that is why I believe the NRC
17 Staff is choosing to rely on the Baird report.

18 But -- and that is why they have said they
19 are relying on the Baird report, because I don't think
20 there is any evidence that has been presented that any
21 of the Staff, or LES experts, have done their own
22 calculations for the Envirocare site, any site like
23 Envirocare, any dry site, any reference site, any
24 site.

25 MS. CLARK: I have to object to Dr.

1 Makhijani characterizing the Staff testimony, because
2 I don't think that is a correct characterization.

3 CHAIR BOLLWERK: One second. Do you have
4 a response?

5 MR. LOVEJOY: I'm sure she will go into
6 that on cross.

7 CHAIR BOLLWERK: I think that is something
8 you can go ahead and explore on cross with him. He
9 has characterized it, if you don't agree with his
10 characterization, you indicated you disagree, and you
11 can go into that on cross examination, as to why it
12 isn't true.

13 WITNESS MAKHIJANI: Could I ask a
14 procedural question, Your Honor?

15 CHAIR BOLLWERK: Surely.

16 WITNESS MAKHIJANI: I know the transcripts
17 of these hearings are made, we all rely on memory in
18 the absence of a transcript. But when there are
19 specific questions of deferring memory and this, of
20 course happens, is it possible to refer to specific
21 portions of the transcript?

22 Because I'm reasonably certain that when
23 you look at the testimony, so far as I understand, no
24 one has done calculations of performance assessment
25 for large quantities of depleted uranium recently, at

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 the Envirocare site.

2 And I believe that has been the testimony.
3 And I think that on cross examination, if I'm going to
4 answer further anything different than this, I would
5 certainly like to see some transcripts.

6 CHAIR BOLLWERK: Well --

7 WITNESS MAKHIJANI: If it is possible.

8 CHAIR BOLLWERK: Unfortunately the
9 transcript for today won't be available until
10 tomorrow. Having said that, there is a possibility of
11 a read back. I'm not sure that that would be
12 appropriate here, and necessary.

13 But we can, if it comes to a specific
14 question. Normally with a read back, it is a specific
15 statement by an individual. This sounds more like --
16 I want to say summary of what was said, and that may
17 be a little bit more, a little longer than we can do.

18 But we can explore that if you think it is
19 appropriate.

20 WITNESS MAKHIJANI: Fair enough --

21 MS. CLARK: And I would just like --

22 WITNESS MAKHIJANI: -- Your Honor.

23 MS. CLARK: I'm sorry. But Dr. Makhijani
24 has not been proffered here to testify as to the
25 position of the NRC staff. And he is welcome to

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 discuss his own views, his own opinions, and the
2 technical basis for these views.

3 But I object to him characterizing the
4 Staff's position when I think it is clearly at odds
5 with what the Staff has testified to.

6 WITNESS MAKHIJANI: Ms. Clark, if I might
7 just clarify, and this might avoid a lengthy
8 questioning. I was expressing my understanding of the
9 testimony that was given, not what the Staff believe.

10 MS. CLARK: The testimony by the NRC
11 staff, you mean?

12 WITNESS MAKHIJANI: NRC and LES staff.
13 And as an expert I think I'm entitled to have an
14 opinion about what was said. And I'm offering my
15 opinion, not the Staff's opinion.

16 CHAIR BOLLWERK: All right. Anything
17 further you want to say?

18 MS. CLARK: No.

19 CHAIR BOLLWERK: All right, let's move on,
20 then.

21 MR. LOVEJOY: Dr. Makhijani, do you recall
22 testimony concerning the investigations said to have
23 been carried out by the Utah regulators, in which they
24 decided it was appropriate to examine the performance
25 of the Envirocare site under assumptions that various

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 scenarios, various intrusion scenarios, land use
2 possibilities, and agriculture, residential use, all
3 of those scenarios could be eliminated, do you
4 remember that testimony?

5 WITNESS MAKHIJANI: Yes.

6 MR. LOVEJOY: Do you have a view on that
7 approach?

8 WITNESS MAKHIJANI: Well, yes, a couple of
9 things, briefly. One is, I think if you want to
10 restrict time frame, and not examine climate, it might
11 be -- if you eliminate all the parameters that might
12 cause intrusion, for instance, then you don't have to
13 do any calculations, you don't have to revisit, except
14 I would always give the caveat that all of these
15 things are based on the Baird report.

16 But with that caveat I think they haven't
17 done any new work to eliminate these scenarios. They
18 have just said the climate and water are unsuitable.
19 I note the Imperial Valley has quite a lot of
20 agriculture, as does Amargosa Valley, and Las Vegas
21 would not have been thought to be a thriving city 200
22 years ago.

23 And so I think my own view of these kinds
24 of -- I think the removal of such scenarios, to some
25 extent, is speculative.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 To the extent that it says you won't use
2 salty water for irrigation I think is much less
3 speculative. And I, generally, wouldn't want to go in
4 places where you would have desalination, because we
5 run out of water, and so on, because that is, in
6 itself, a lot of speculation.

7 I think the normal approach to long-term
8 calculations, beyond institutional control, has been
9 adopt a resident scenario, in order to be
10 conservative. Not that it is going to happen, but
11 because you want to be protective of the population,
12 and because you are asked to protect an intruder at
13 any time, you have to assume a reasonable intruder.

14 In this case it may be reasonable to
15 exclude the groundwater pathway, and I would agree
16 with that. The funny thing that I noted, in that
17 regard, was they have only seemed to have studied the
18 groundwater pathway, and then said people won't drink
19 the water, so the automatic result, of course, is the
20 dose is zero.

21 But you have to study the erosion
22 pathways, and the other pathways. And I don't think
23 elimination of that is reasonable.

24 MR. LOVEJOY: Do you have exhibit 170, the
25 Baird report, right nearby?

1 WITNESS MAKHIJANI: Yes.

2 MR. LOVEJOY: I'm looking at page 4-4 at
3 the bottom. You may want to look at the last sentence
4 on that page, it goes over to the next.

5 WITNESS MAKHIJANI: I believe I recall it,
6 4-4. The only use of land in the immediate vicinity
7 of the Clive site, prior to the disposal of the
8 tailings was for grazing sheep, jackrabbit hunting,
9 and occasional recreation vehicle driving.

10 So here we have kind of, how do you call
11 the recreational vehicles that raise a lot of dust?

12 MR. LOVEJOY: ATVs?

13 WITNESS MAKHIJANI: Yes, ATVs. So here you
14 have a scenario where you don't have somebody to live
15 there, but in case -- that could, itself, cause a
16 tremendous amount of erosion. And we know this is
17 happening even in National Parks, today.

18 This is a subject of constant dispute. So
19 I think eliminating this kind of thing is simply not
20 reasonable for long time frames.

21 CHAIR BOLLWERK: Why don't we stop for one
22 second Judge Abramson had to dash out and take care
23 of a piece of business. Let's hold on one second
24 before he comes back, because I want him to hear this.

25 Why don't we take a two minute break.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 (Whereupon, the above-entitled matter
2 went off the record at 11:52 a.m. and
3 went back on the record at 11:56 a.m.)

4 CHAIR BOLLWERK: Let's go back on the
5 record. And I believe we were talking about ATVs.

6 MR. LOVEJOY: Yes, where we were, I think,
7 was on page 4-4 of the Baird report, exhibit 170.

8 Dr. Makhijani, looking at the last
9 sentence on page 4-4, what does that suggest to you
10 about appropriate scenarios in connection with this
11 site?

12 WITNESS MAKHIJANI: The last sentence on
13 which page, sorry?

14 MR. LOVEJOY: On 4-4, the only use of the
15 land --

16 WITNESS MAKHIJANI: Yes, as I said just
17 before the break, I think for the long term, at this
18 particular site, it would be reasonable to assume a
19 significant amount of human activity, up to
20 residential, but certainly grazing, recreation,
21 hunting, which has happened in living memory.

22 It would be unreasonable to exclude those,
23 because we know these things have happened. And for
24 long term projections at least you should take into
25 account what you know has happened for after loss of

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 institutional control.

2 And so I think exclusion of all intruder
3 scenarios, at this site, is unreasonable.

4 MR. LOVEJOY: And looking, then, at --

5 WITNESS MAKHIJANI: Oh, one other caveat
6 I would like to put, just for the record, is if this
7 site is settled, I would assume that the water would
8 be brought in from outside.

9 As I have said, you know, I would not
10 assume that the groundwater at this site would be used
11 by people who are there.

12 MR. LOVEJOY: Now, do you have a view on
13 the question of whether erosion, or climate change,
14 other natural processes should be considered in a
15 performance assessment of this site?

16 WITNESS MAKHIJANI: Yes, whenever you have
17 long term, and in these days, in regard to climate
18 change long term is becoming shorter and shorter,
19 unfortunately.

20 And my experience in studying these kinds
21 of issues, including quite a lengthy study on the
22 problem of ozone layer depletion, is that there are
23 nasty surprises often in these kinds of things, and we
24 are witnessing some of these nasty surprises, as we
25 speak.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 So I think it is quite imperative to
2 consider climate change questions, if you are going to
3 -- we didn't do it because near-surface disposal,
4 without any of these other more complex considerations
5 seemed so out of the question, for this material, if
6 there are no time limits for peak dose, or anything
7 like that.

8 It is not necessary, because you have to
9 go to other kinds of disposal.

10 JUDGE KELBER: Dr. Makhijani, earlier in
11 describing particularly the French work on disposal of
12 certain wastes, you advocated a consistently
13 conservative, I think that is right, a consistently
14 conservative approach --

15 WITNESS MAKHIJANI: For choice of
16 parameters, reasonably conservative choice of
17 parameters. I was just describing the French
18 regulation.

19 JUDGE KELBER: And also I believe you said
20 for those purposes you would suggest not assuming any
21 particular changes in either climate, or other
22 environmental, or biological properties.

23 WITNESS MAKHIJANI: No, I --

24 JUDGE KELBER: I'm paraphrasing, but I
25 think --

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 JUDGE ABRAMSON: I think he --

2 JUDGE KELBER: -- assumed that conditions
3 today are the conditions then. And that is how I
4 would paraphrase it.

5 WITNESS MAKHIJANI: That was partly
6 correct, Your Honor. I said that in terms of human
7 activities I think a reasonable long term assumption
8 is we are going to eat like we eat today, and live
9 like we live today.

10 But in terms of climate I did say that the
11 French have studied it, and I think in many respects
12 done a very good job. Some limitations are always in
13 these things, this is a difficult subject.

14 I was describing the French regulations,
15 which I learned a lot from studying them, and
16 evaluating their research program. And I think they
17 have adopted a very sensible approach. France is
18 always held up as a kind of model country for nuclear
19 development.

20 And I think in this respect their
21 regulations are really worth studying. And they have
22 a 25 millirem suggested kind of limit for -- they
23 don't have a maximum organ dose, but they have a 25
24 millirem ED. So we are in the same kind of ball park.

25 JUDGE ABRAMSON: We should not spend a lot

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 of time on this. We understand --

2 WITNESS MAKHIJANI: Your Honor, may I say
3 one more thing about this, and then I won't return to
4 the French, unless asked. It is that the current
5 program in France includes the disposal of what they
6 class B wastes, or intermediate level wastes.

7 Which would be, generally, of the similar
8 orders of magnitude of specific activity in large
9 quantities that we are talking about.

10 JUDGE ABRAMSON: By the way, the disposal
11 and any changes in the regulations, or policy
12 decisions that are not for this forum. So let's not
13 spend a lot of time on that. It is nice to get some
14 stuff in the record, but we are focusing on whether
15 the EIS is sufficient, and whether the cost numbers
16 are sufficient.

17 MR. LOVEJOY: With that I have no further
18 examination of this witness.

19 CHAIR BOLLWERK: At this point you said
20 you had -- well, you have now heard the testimony. Do
21 you still think you have three hours?

22 MR. CURTISS: No, I don't think it will
23 take the full three hours. In fact I suspect if we
24 can get direct answers, without collateral
25 discussions, like we had in the initial, what was

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 going to be a 20 minutes examination here, I can get
2 through that in an hour.

3 I will tell you exactly what I'm
4 interested in. This witness has testified that the
5 Staff analyses, and the analyses of others, do not
6 meet the quality requirements that you would associate
7 with modeling for an analysis of that type.

8 I'm not going to independently ask the
9 witness about that. But this witness is here to urge
10 this Board to view the performance of a disposal site
11 that would accept large volumes of DU, based upon the
12 analyses that were done in the November and July
13 reports.

14 I have a very simple but important set of
15 questions, where I would like to ask the witness just
16 simply factual questions. And, in particular, what
17 were the inputs, how was the model conceptualized,
18 including but not limited to, what Judge Abramson
19 identified as two key issues, the time frame for the
20 evaluation, and the intruder dose scenario.

21 Because, frankly, it is not transparently
22 obvious to me what all those parameters were. We do
23 not have the output files, we don't know what the
24 inputs were, and we have a series of questions to try
25 to understand, in a transparent way, the basis for

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 reports that he is urging be considered and adopted as
2 the basis for how this Board ought to evaluate the
3 question.

4 And I would like to do that in an
5 uninterrupted but focused way. And if we can do it in
6 a focused way, understanding I'm just asking for
7 answers about how the analysis was done, and not
8 seeking to disagree or agree with whether it was
9 correct.

10 I think we can complete that rather
11 efficiently.

12 CHAIR BOLLWERK: And the Staff, then, in
13 terms of --

14 MS. CLARK: Yes, I don't expect I would
15 have very much additional beyond what Mr. Curtiss
16 described.

17 CHAIR BOLLWERK: All right.

18 JUDGE ABRAMSON: And I understand that you
19 are also going to focus, Mr. Curtiss in near term
20 versus far term, is that right?

21 MR. CURTISS: Well, I am --

22 JUDGE ABRAMSON: Well, let's worry about
23 it when we get there.

24 MR. CURTISS: I don't think it will take
25 the full three hours.

1 JUDGE ABRAMSON: No, I understand. And I
2 also think it is clear, and correct me if I'm wrong,
3 Dr. Makhijani, that the principal issues that you have
4 arise well after 1,000 years?

5 WITNESS MAKHIJANI: Yes. I have been
6 quite clear about that. I think it is important to be
7 transparent about it. The numbers are there, in the
8 July report actually the years are mentioned, and in
9 a very low erosion we've even said zero dose.

10 So in that respect it is not different
11 from what is in the PEIS. So I don't think there is
12 much argument.

13 CHAIR BOLLWERK: Let me just ask one other
14 question. You had indicated you may have had some sur
15 rebuttal, additional testimony, and you want to put
16 your witness panel back on again?

17 MR. CURTISS: Yes, sir.

18 CHAIR BOLLWERK: And that will happen as
19 well, you think?

20 MR. CURTISS: I believe we should
21 anticipate that.

22 CHAIR BOLLWERK: Okay. Approximately how
23 long?

24 MR. CURTISS: I don't think that should
25 take more than an hour.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 CHAIR BOLLWERK: An hour, all right. Is
2 there anything you want to say on the subject, Mr.
3 Lovejoy?

4 MR. LOVEJOY: From here on I'm not
5 projecting.

6 CHAIR BOLLWERK: All right, thank you.
7 Sometimes we can't predict these things, just like
8 10,000 years, or whatever. At this point, then --

9 MS. CLARK: I have one additional
10 administrative matter.

11 CHAIR BOLLWERK: Yes?

12 MS. CLARK: I would like to introduce the
13 Final Environmental Impact Statement as an exhibit.
14 And my question is whether I need to bring additional
15 copies beyond those for the -- those three copies.

16 Do the parties need --

17 MR. CURTISS: LES has a copy.

18 MS. CLARK: Would the Board like copies?

19 CHAIR BOLLWERK: I think we have one up
20 here. So I think if you bring enough for the record
21 itself, which is an original and two, then we are
22 fine.

23 MS. CLARK: Very good.

24 CHAIR BOLLWERK: Okay. We will reconvene,
25 promptly, at one o'clock.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25

JUDGE ABRAMSON: We will start at one o'clock.

CHAIR BOLLWERK: We promise we will be here. Thank you.

(Whereupon, at 12:10 p.m., the above-entitled matter was recessed for lunch.)

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25

A-F-T-E-R-N-O-O-N S-E-S-S-I-O-N

1:00 p.m.

CHAIR BOLLWERK: Let's see, when we took our lunch break we were ready, I guess, to start with the cross examination of Dr. Makhijani by LES.

MR. CURTISS: Thank you, Mr. Chairman, I appreciate you accommodating our desire to do this, in this time frame. I will try to be as efficient as possible.

EXAMINATION BY MR. CURTISS OF

ARJUN MAKHIJANI

MR. CURTISS: Dr. Makhijani, I think, as I understand your testimony in this proceeding, and in the depositions that you have given, that you are urging this Board to rely on the analyses that you performed, as an expert in this proceeding, in November of 2004 and July of 2005.

Those documents, those expert reports have been entered into the record, as I think you know, as exhibits 190 and 224, NIRS/PC exhibits. So you are welcome to refer to those, as such, and it might be helpful, for purposes of the questions that I have, if you have them handy there.

WITNESS MAKHIJANI: Which?

MR. CURTISS: I think they are 190 and

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 224, if I have that correct, NIRS/PC exhibits.

2 WITNESS MAKHIJANI: Yes, I have them in my
3 own copies. Which one are you going to ask me about
4 first, Mr. Curtiss?

5 MR. CURTISS: Well, I'm going to ask you
6 a set of questions and you can answer them in the
7 context of either.

8 WITNESS MAKHIJANI: Okay, I'm just going
9 to open up both.

10 MR. CURTISS: As you testified earlier,
11 these two reports present the results of your analyses
12 of the disposal of depleted uranium in near-surface
13 disposal facilities.

14 WITNESS MAKHIJANI: If I might just make
15 one comment, on your preparatory remarks. We are
16 asking the Board to rely on these, as well as on other
17 analyses that have shown similar results.

18 So it is not an exclusive thing. We think
19 our analyses show --

20 MR. CURTISS: And I understand, that is a
21 fair point. My focus, in the discussion today, is
22 going to concentrate on these two reports.

23 Let me, perhaps, begin Dr. Makhijani with
24 the discussion that took place yesterday, with the LES
25 panel. Were you present during that testimony?

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 WITNESS MAKHIJANI: I believe I was
2 present all day yesterday.

3 MR. CURTISS: And did you hear the
4 discussion of Mr. Potter, one of the LES witnesses,
5 when he described, in general terms, the approach that
6 is typically taken in formulating the framework for
7 conducting performance evaluations?

8 WITNESS MAKHIJANI: When he was talking
9 about RESRAD?

10 MR. CURTISS: No.

11 WITNESS MAKHIJANI: There has been a lot
12 said.

13 MR. CURTISS: The approach of
14 conceptualizing the framework and identifying, sort
15 of, what the key parameters are that you are
16 interested in looking at. I will come to RESRAD in a
17 minute.

18 But did you hear that discussion?

19 WITNESS MAKHIJANI: Yes, generally there
20 were a lot of words, but I know he testified about
21 performance assessment, I don't remember the specific
22 words, I'm sorry.

23 MR. CURTISS: In the general framework
24 that he described about how you conduct a performance
25 evaluation, and in the context of a RESRAD run, or

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 RESRAD model, is that an approach that you generally
2 agree with?

3 WITNESS MAKHIJANI: I don't remember
4 everything that he said, so I don't want to
5 characterize my opinion on the basis of what he said,
6 on the basis of memory. I can tell you what we did.

7 MR. CURTISS: Okay. You just referred to
8 the RESRAD code that Mr. Potter referred to yesterday.

9 WITNESS MAKHIJANI: Yes.

10 MR. CURTISS: And my understanding is you
11 used that code here in conducting the analyses that
12 you've undertaken?

13 WITNESS MAKHIJANI: Yes, Dr. Smith and I.

14 MR. CURTISS: And why did you select that
15 code?

16 WITNESS MAKHIJANI: Well, this code is
17 very typically used in a very standard way, developed
18 at Argonne National Lab, in order to study the dose
19 effects of various pathways from near soil
20 contamination.

21 And it show you how much winds up in the
22 water, what external dose, it examines food pathways.
23 You can turn things on and off. It is a very, very
24 standard model that is used in these kinds of
25 calculations.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 MR. CURTISS: Do you recall what version
2 of the code you used?

3 WITNESS MAKHIJANI: I believe it was 6.21,
4 but the one that we used is in Dr. Smith's computer.
5 And I will have to, maybe, check with him at the
6 break, and give you the exact number. The 6.21 is the
7 one on my computer, so it comes up on my --

8 MR. CURTISS: Version 6.21?

9 WITNESS MAKHIJANI: I believe so.

10 MR. CURTISS: And when was that latest
11 version?

12 WITNESS MAKHIJANI: Could I just check
13 with Dr. Smith, just so that we don't have to go back
14 and correct the record?

15 MR. CURTISS: Actually I would like to ask
16 you the question.

17 WITNESS MAKHIJANI: Okay, that is fine,
18 6.21 is from last year, I think.

19 MR. CURTISS: Last year, okay.

20 WITNESS MAKHIJANI: To the best of my
21 memory.

22 MR. CURTISS: And are you personally
23 familiar with that code?

24 WITNESS MAKHIJANI: Well, I don't know the
25 internal code. But, yes, I'm familiar with RESRAD.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 MR. CURTISS: Could you describe your
2 experience in running the RESRAD code?

3 WITNESS MAKHIJANI: I run RESRAD off and
4 on over the years. These particular calculations I
5 asked Dr. Smith to do.

6 MR. CURTISS: Have you had any experience
7 with the Pathway code?

8 WITNESS MAKHIJANI: No.

9 MR. CURTISS: Okay. Do you know that is
10 the code that was used in the review of the Envirocare
11 site?

12 WITNESS MAKHIJANI: I don't recall.

13 MR. CURTISS: Okay, thank you. Tell me a
14 little bit about what is produced when you run a code?
15 Because as I recall your testimony this morning, you
16 had some significant concern about the quality of the
17 work that the Staff had done, because you could not go
18 back, and I'm thinking here among others, in looking
19 at the CEC analysis, and understand how that analysis
20 was conducted, because it was not transparent to you.

21 How, in the case of the comments that you
22 had this morning, in what you could not see, in the
23 Staff's analysis, would you typically address in the
24 context of running a code, what would you expect the
25 Staff to do?

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 WITNESS MAKHIJANI: Well, usually the
2 parameters are provided, and it has been discussed,
3 are you talking about the deep disposal parameters, or
4 near-surface disposal, or what are you referring to?

5 MR. CURTISS: We are talking about the
6 criticism, and we can look back at the record, if you
7 like, but I think you will recall it, because it was
8 just this morning, the criticism that you made of the
9 Staff's CEC analysis in the first instance, and the
10 discussion based upon the Staff's cross examination of
11 their panel.

12 That you, it wasn't transparent, you
13 didn't understand the basis for how the Staff got the
14 numbers, and you couldn't recreate them.

15 WITNESS MAKHIJANI: I don't recall making
16 any criticism of the CEC this morning. I did
17 criticize the Baird report. But did I discuss the
18 deep disposal calculations this morning? I don't
19 recall that I did.

20 MR. CURTISS: Okay. Let me just ask the
21 question a little bit differently. Is the CEC
22 analysis transparent in your view, and is it based
23 upon what has been identified in Appendix A of the
24 Final Environmental Impact Statement for CEC,
25 sufficiently transparent analysis?

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 WITNESS MAKHIJANI: No, it is not. Some
2 of the parameters are specified, some important ones.
3 We asked of our hydrogeologist consultant, the results
4 are incredible, as --

5 MR. CURTISS: I'm not asking about the
6 results, I'm just asking about the --

7 WITNESS MAKHIJANI: Well, let me tell you
8 my method of thinking as to how something, what the
9 process of developing an estimate, and an idea of
10 whether something is right, and the parameters have
11 been provided. I'm trying to answer your question.

12 And sometimes the answer may take a
13 paragraph, but it will take two, if you don't let me
14 finish.

15 MR. CURTISS: Well, let me rephrase my
16 question so that you understand what I'm asking. My
17 question is, in terms of the transparency of computer
18 code analysis, I'm not asking about the
19 appropriateness of parameters that were selected, I
20 will get to that in a minute.

21 But in terms of the QA question that you
22 raised this morning, or that was raised this morning,
23 in looking at the analysis what, from a standpoint of
24 the transparency, would you look for to understand
25 what those parameters were, that were used?

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 WITNESS MAKHIJANI: This morning I talked
2 about the QA of the Baird report. And to use the same
3 illustration, which also applies to the CEC case, when
4 you look at outputs that are completely incredible, in
5 the case of the Baird report, physically impossible,
6 and clearly wrong, you question what went, then there
7 has to be something that is wrong, either in the
8 computer model, or in the inputs and its
9 implementation.

10 If it is an isolated number that is a
11 problem, then you might imagine a transcription error.
12 If there are whole series of numbers that were wrong,
13 as they were wrong in the Baird report, and as I
14 believe incorrect in the CEC report, because they had
15 the opposite problem there, the reported doses are so
16 incredibly low, that the dose to an individual would
17 be, I think, approximately equal to ionizing one
18 hydrogen atom.

19 And many, many orders of magnitude from
20 the uranium that there is in ordinary groundwater, I
21 suspected the -- that there was something wrong in the
22 implementation. That is just a suspicion.

23 In order to verify that there is something
24 wrong, we commissioned our own analysis from a
25 hydrogeologist who ran the model with parameters that

1 had been supplied.

2 That model yields results that are many
3 orders of magnitude bigger, and are generally in the
4 range that you might expect with knowing the
5 properties of uranium.

6 And we were not able to reproduce the
7 results and we, therefore, believed that there is some
8 -- there has been some use of parameters and
9 assumptions that we are not able to fathom --

10 MR. CURTISS: That is really where I would
11 like to --

12 WITNESS MAKHIJANI: -- as to how NRC got
13 its results.

14 MR. CURTISS: That is really where I would
15 like to go. You had testified, and I think what you
16 are saying here is that there wasn't sufficient
17 information for you to be able to find how they
18 arrived at their results.

19 WITNESS MAKHIJANI: When we ran the model
20 we got completely different results, and more
21 reasonable results. The NRC results are not
22 reasonable.

23 MR. CURTISS: In the context of modeling,
24 and I ask this question with all due deference to
25 expertise on the Board that exists on the issue of

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 modeling, so I will beg the Board's indulgence on what
2 I'm sure is just --

3 JUDGE ABRAMSON: Lay it on, McDuff.

4 MR. CURTISS: Please interrupt at any time
5 if you think I've got the question wrong, or anything
6 else.

7 When you run a model what is typically
8 produced in terms of the determination of your model
9 run?

10 WITNESS MAKHIJANI: Well, you can derive
11 different types of inputs, outputs, depending on what
12 you ask the model to give you. But, typically, you
13 would get some array of external doses, and internal
14 doses, total doses, you could get organ doses.

15 And you would get them over time. So you
16 would get an evolution of how the doses would be at
17 time equal to zero. And RESRAD goes up to 100,000
18 years.

19 MR. CURTISS: How are those results
20 documented when you run the model?

21 WITNESS MAKHIJANI: Those results are
22 documented in a series of output files.

23 MR. CURTISS: And what is an output file?

24 WITNESS MAKHIJANI: An output file is what
25 is generated by the computer program as a table, when

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 it is finished doing a computation. And then it
2 produces a file on the screen that you see as a set of
3 numbers.

4 MR. CURTISS: Please.

5 JUDGE ABRAMSON: And, Dr. Makhijani, if
6 you wanted to try to reproduce those results you would
7 need to have the input file, right?

8 WITNESS MAKHIJANI: Yes. And for our
9 models have been documented, the output files,
10 together with the input parameters, from our November
11 reports, were supplied --

12 JUDGE ABRAMSON: I understand that.

13 WITNESS MAKHIJANI: -- with the report,
14 and our July report is similarly complete.

15 JUDGE ABRAMSON: Right, I understand that.
16 So let me just finish the thought. I understand that
17 you did that, and what you are telling us is that with
18 respect to the output, the selected output that you
19 saw, was it in the Baird report, or the selected
20 output you saw from CEC, and the limited number of
21 input parameters, you could not regenerate the
22 results, and you believe that is because either you
23 didn't have all the input, or the input they gave you
24 -- or that there is something that they didn't supply
25 you was different from what you would ordinarily

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 assume.

2 Or because what they gave you was
3 erroneous. But without the entire input file you
4 can't tell that, at least without the dominant input
5 numbers?

6 WITNESS MAKHIJANI: Your Honor, we did
7 different things with regard to the two reports. The
8 Baird report I discovered this problem only a few days
9 ago.

10 JUDGE ABRAMSON: So you haven't tried to
11 replicate --

12 WITNESS MAKHIJANI: So we have not tried
13 to look at the input parameters, and so on. In the
14 case of the CEC report, we found that there were
15 important parameters, like carbon dioxide, which
16 determines acidity, for example, that are missing.

17 And we ran our own Phreeque program run,
18 model run, we collectively, Mr. Rice did. And came up
19 with results. Well, the ways in which the results in
20 the CEC are not credible are documented in my report.

21 JUDGE ABRAMSON: Yes, I understand.

22 WITNESS MAKHIJANI: I won't go over it.

23 JUDGE ABRAMSON: And what you did to do
24 that is you made an assumption about CO2 because it
25 wasn't, you didn't have the information?

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 WITNESS MAKHIJANI: That is right.

2 JUDGE ABRAMSON: Okay.

3 MR. CURTISS: Let me follow-up on that.
4 Thank you, Judge. The output file that is produced
5 from running the code is, if an independent reviewer,
6 and I think this is what you are saying about the
7 Staff's analysis, if an independent reviewer wanted to
8 examine the inputs that were modeled, the conceptual
9 approach and the inputs, the output file would be the
10 documentation of what the inputs were. Is that
11 correct?

12 WITNESS MAKHIJANI: Well, usually you get
13 the input documentation and the output files. It
14 depends on how it is save, and what you preserve,
15 normally you preserve an output summary.

16 MR. CURTISS: I have a different question.

17 WITNESS MAKHIJANI: Yes.

18 MR. CURTISS: Not usually you get the
19 inputs, and usually get the outputs. I'm asking about
20 the documentation of the results which if I'm correct,
21 in what you've said, the formal documentation of
22 running a code is an output file.

23 WITNESS MAKHIJANI: Yes.

24 MR. CURTISS: Is that correct?

25 WITNESS MAKHIJANI: Yes.

1 MR. CURTISS: And if an independent
2 reviewer wishes to understand, and this is a criticism
3 you have of the Staff review, what the inputs were,
4 the only QA, quality assurance mechanism to do that,
5 is to look at the output file, isn't that correct?

6 WITNESS MAKHIJANI: I wouldn't say it is
7 the only quality assurance mechanism, but certainly if
8 the output file is complete enough, you should be able
9 to reproduce the results.

10 The inputs, of course, contain lots of
11 assumptions about the parameters. And you have to
12 check on the research. So that just tells you about
13 the computer program, it doesn't tell you about, you
14 know, what went into the program, and how good it was.

15 MR. CURTISS: I'm just trying to
16 understand, both in the context of the way you view
17 the information available from the Staff, and the way
18 the Board ought to review, and view your two reports.

19 The documentation, if we are looking at
20 this from a quality assurance standpoint, and I'm free
21 to be contradicted here, it would be an output file.

22 JUDGE ABRAMSON: Provided that the output
23 file also had the input numbers listed in it, which it
24 may or may not, depending on how the program is set
25 up, and how it is run.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 MR. CURTISS: Right. Now, in this
2 circumstance, where -- in fact, let me ask you, in a
3 run of the code, for an analysis such as you've done
4 here, how extensive would an output file normally be?

5 WITNESS MAKHIJANI: Well, there is a
6 summary file, and then the detailed output file is
7 pretty extensive, because it gives you all the organ
8 doses by year, and go on for quite a number of pages.

9 MR. CURTISS: Have you reviewed the output
10 file from the WCS proceeding?

11 WITNESS MAKHIJANI: Not recently. I
12 believe I have, I looked at it probably when it was
13 done, but it was a while back. I'm producing a lot of
14 reports, and I don't recall.

15 MR. CURTISS: Do you recall that it was
16 over 1,000 pages?

17 WITNESS MAKHIJANI: No, I don't recall
18 that.

19 MR. CURTISS: Okay. Let's turn to the
20 reference that you made earlier here, and I think
21 earlier today, but I don't recall now, so I will just
22 talk about it in the context of your comment about Mr.
23 Rice's role.

24 What analyses, first of all, who is Mr.
25 Rice?

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 WITNESS MAKHIJANI: He is the hydrogeology
2 consultant for NIRS/PC.

3 MR. CURTISS: And he has testified,
4 previously in this proceeding, I think the Board is
5 aware.

6 What analyses did he perform in support of
7 your analysis?

8 WITNESS MAKHIJANI: Well, the analysis he
9 performed are described in the November 2004 report,
10 I will just point you to the pages. He ran the
11 Phreeque program with the specified inputs, and the
12 inputs were provided.

13 The general, it wasn't, it was meant to be
14 a kind of a screening run, as to see if we could
15 reproduce the CEC results, or the current results in
16 the FEIS, or since they are the same, we assumed that
17 the error would be corrected.

18 And those results are described, let me
19 just point you to the pages.

20 MR. CURTISS: Would it be around page 21
21 and 22 of your -- I'm now looking at your November
22 2004 report.

23 WITNESS MAKHIJANI: Yes, that is where it
24 is.

25 MR. CURTISS: And I can't tell here, from

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 the description, what he did, and what model he ran.
2 And at one point I understood the testimony, in this
3 proceeding, indicated that his analysis was attached
4 to this.

5 WITNESS MAKHIJANI: Yes.

6 MR. CURTISS: And the exhibit that I have
7 here, I don't think had an attachment to it. Is there
8 a separate document that Mr. Rice has produced?

9 WITNESS MAKHIJANI: Yes, he produced a
10 document that he has emailed us. I recall going over
11 it and discussing it with him, and with Dr. Smith, as
12 we were doing all of this.

13 And I have not looked at that document
14 recently, but I did look at it when it was produced.

15 MR. CURTISS: And his analysis, or
16 whatever he did, back of the envelope, or quick and
17 dirty, whatever it was --

18 WITNESS MAKHIJANI: No, no, he ran the
19 Phreeque model, he didn't do back of the envelope.
20 The same model that is described in the CEC, P-H-R-E-
21 E-Q-U-E, I believe.

22 MR. CURTISS: And he ran that model, and
23 you reviewed it, and this is the CEC analysis, that
24 has come under such sharp criticism this morning. He
25 ran that model and produced some sort of analysis that

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 you relied on here?

2 WITNESS MAKHIJANI: The analysis he
3 produced, the result of it, the central result that I
4 asked him for, because all we wanted to do in this
5 case, we didn't need a complicated output, he didn't
6 do any radiological calculations, he did the
7 hydrogeological parameters, and supplied us with how
8 much, what the concentration of uranium you would
9 expect in the water, given those parameters of range.

10 And that result is given on page 22, in
11 the first full paragraph there in the middle; 7.5
12 times ten to the minus seven, to 2.9 ten to the minus
13 six mols per litre.

14 MR. CURTISS: And your analysis here in
15 this report is based upon his having run that model?

16 WITNESS MAKHIJANI: Yes, just that piece
17 that is in the same sentence that says the drinking
18 water dose would be, that is the total body dose would
19 be equivalent, would be in the range of 10s of
20 millirem per year. Then, as I have testified the
21 organ dose would be bigger.

22 MR. CURTISS: I think the testimony --

23 WITNESS MAKHIJANI: That is all we did.

24 MR. CURTISS: -- earlier indicated that
25 that report, or document, or whatever he produced was

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 attached to this.

2 WITNESS MAKHIJANI: I believe it was. I
3 haven't looked at it recently.

4 MR. CURTISS: Well, could you point me to
5 this? I have the --

6 WITNESS MAKHIJANI: It is not attached to
7 the report. I believe it was attached to what we
8 sent, it wasn't like an appendix to the report. I
9 believe it was attached in what was sent to the
10 Commission, and to you at the time.

11 MR. CURTISS: Actually all I have here, in
12 this exhibit, if you are looking at the exhibit that
13 was introduced, is your report.

14 WITNESS MAKHIJANI: Yes.

15 MR. CURTISS: And I have a number of
16 questions about it. But one of the questions I have
17 is the basis for it. Has that analysis been produced?

18 WITNESS MAKHIJANI: I believe it was
19 produced, it has not been attached to the exhibit.
20 And I don't know how, you know, things wind up in
21 exhibits.

22 MR. CURTISS: Who did you produce it for?

23 JUDGE ABRAMSON: Let's let Mr. Lovejoy
24 talk about it.

25 MR. LOVEJOY: It was produced in November

1 of 2004, when the report was generated, and
2 distributed around.

3 JUDGE ABRAMSON: As part of --

4 MR. LOVEJOY: Along with the report.

5 JUDGE ABRAMSON: With the report?

6 MR. LOVEJOY: Yes.

7 MR. CURTISS: Our copy doesn't reflect
8 that it has been produced. But let's go through a
9 discussion, here, of what Mr. Rice did.

10 JUDGE KELBER: Excuse me, counselor, are
11 we discussing NIRS/PC exhibit 224?

12 MR. CURTISS: No, I'm sorry, NIRS/PC
13 exhibit -- the report, 190.

14 JUDGE KELBER: Thank you.

15 MR. CURTISS: And the page reference here
16 that is the subject of the past several questions and
17 answers, I think, as Dr. Makhijani indicated, page 22.
18 This is his November 2004 report, where he has relied
19 on an analysis performed by Mr. Rice.

20 Did Mr. Rice produce output files?

21 WITNESS MAKHIJANI: Yes, he sent us an
22 output file, and we have the inputs, and I think they
23 were part of what was produced.

24 MR. CURTISS: And tell me what parameters
25 were used, what inputs if you will, were employed in

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 the Rice analysis?

2 WITNESS MAKHIJANI: I don't recall. I
3 have not looked at it recently. This was just a
4 screening calculation, it is not anything that --
5 other than my opinion that the CEC calculations are
6 almost certainly wrong.

7 I have not relied on this for any of the
8 other opinions here.

9 MR. CURTISS: Would it, in a regulatory
10 context, would you say that a screening evaluation
11 would be sufficient for purposes of making regulatory
12 determinations?

13 WITNESS MAKHIJANI: I think it is
14 sufficient for the purpose of making a technical
15 determination that the Final Environmental Impact
16 Statement is wrong.

17 MR. CURTISS: Okay, I'm just asking --

18 WITNESS MAKHIJANI: So it would be
19 applicable to that extent in a regulatory setting, is
20 if you've got an FEIS that has a wrong set of numbers,
21 then it raises a whole set of issues, especially as
22 all the relevant inputs have not been produced, and
23 apparently the people who have produced those numbers
24 are no longer available, or were said not to be
25 available.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 And in my book you should be able to
2 reproduce scientific calculations, and the NRC Staff
3 hasn't been able to independently reproduce them, and
4 I would just note here that by contrast everything
5 that we've done here generally, not only falls in the
6 realm of what you would expect, knowing the
7 radiological characteristics of soil and uranium, and
8 what is in the water, and what is in background.

9 Our results, both for shallow land
10 disposal, as well as in the specific instance we are
11 talking about, are generally in accord with the Sandia
12 study that the NRC itself commissioned.

13 MR. CURTISS: But we are going to get to
14 the point of what we know about how you did your
15 analysis. I want to go through the inputs in the
16 analysis, because apparently an output file was not
17 generated, or not produced for your analysis.

18 And so I'm going to go through --

19 WITNESS MAKHIJANI: It was, sorry, I have
20 to say we got the inputs, and we have the outputs, and
21 we supplied them, I just haven't reviewed them
22 recently. I wasn't expecting to testify at length
23 about this particular matter today, because as I have
24 said, the only thing I've relied on, for this, is that
25 I believe it is my professional opinion that the

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 calculations in the Final Environmental Impact
2 Statement, in regard to mine disposal, are wrong.

3 JUDGE ABRAMSON: Let's move on. We
4 appreciate that NIRS/PC says they circulated the
5 output files, and that people can't find them, so
6 let's move on.

7 MR. CURTISS: I'm really focusing on two
8 things, I want to make sure you understand that they
9 have made the point that the output file for George
10 Rice's analysis has been produced, that is the
11 discussion on page 22.

12 JUDGE ABRAMSON: Right.

13 MR. CURTISS: There is a separate question
14 about whether the analysis has been done, and the
15 output files for Dr. Makhijani's analysis has been
16 produced. And understanding that in the case of WCS,
17 for a typical analysis, those are on the order of
18 1,000 pages, I don't think we received any output
19 files from Dr. Makhijani's various runs.

20 And I want to go through, for that reason,
21 and understand -- in fact I'm not sure they were
22 generated. But, in any event, we don't have a 1,000
23 page document, or anything near that, in our files.

24 And if I'm wrong I will stand to be
25 corrected that the output files were produced.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 WITNESS MAKHIJANI: In regard to what was
2 produced I think it is Mr. Lovejoy that has to, you
3 know, because I'm not aware of anything that was done.

4 JUDGE ABRAMSON: Let me make sure I
5 understand what we've got. What was done and what
6 might or might not be documented. Mr. Rice ran some
7 calculations with the Phreeque code.

8 WITNESS MAKHIJANI: Yes.

9 JUDGE ABRAMSON: Those results were,
10 according to NIRS/PC produced in November of '04.

11 MR. LOVEJOY: When the report was
12 generated, along with the other output files for the
13 report.

14 CHAIR BOLLWERK: And all those output
15 files were produced?

16 MR. LOVEJOY: They were copied and sent
17 around.

18 JUDGE ABRAMSON: Okay. Now, what I
19 thought I heard Dr. Makhijani saying is he then took,
20 and this was a scoping, what we would call a scoping
21 calculation, not a hairy detailed, get every node
22 right kind of calculation, but a scoping calculation.

23 And that Dr. Makhijani took that scoping
24 calculation and I didn't have the impression you did
25 further computer analysis.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 WITNESS MAKHIJANI: No.

2 JUDGE ABRAMSON: You looked at that, did
3 some back of the envelope numbers and said, this
4 doesn't make any sense. Is that right?

5 WITNESS MAKHIJANI: Right. What I did was
6 I simply used, I think I must have used FGR-13, dose
7 conversion factors, and two liters per day of drinking
8 water, and did some simple arithmetic on the order of
9 ten minus six moles per liter.

10 JUDGE ABRAMSON: Okay, and was that
11 written down anywhere?

12 WITNESS MAKHIJANI: Yes, that was reported
13 in the November report, that when you take the range
14 of dissolved uranium you will get a dose equivalent in
15 the range of ten submillirem per year. And that
16 result is so many orders of magnitude at variance with
17 what is reported in the Final Environmental Impact
18 Statement.

19 And also our result was in general accord
20 with the Sandia result, that we felt that there was
21 enough there to say that what is in the FEIS is
22 incorrect.

23 JUDGE KELBER: Counsel, may I interject
24 for just a minute?

25 MR. CURTISS: Please.

1 JUDGE KELBER: It has suddenly occurred to
2 me, after reading and rereading page 22, and 3, that
3 the focus of Dr. Makhijani's original concern, with
4 the Claibourne enrichment report, was in respect to
5 deep geological disposal. Is that correct?

6 WITNESS MAKHIJANI: That is correct, Your
7 Honor.

8 JUDGE KELBER: And that the numbers were
9 reported as very low. It appears to me that this may
10 be a fault of the computer output. Typically numbers
11 that are either extremely large, or extremely small
12 will be reported in terms of round off errors, which
13 in a modern computer might well be in the order of ten
14 to the minus 37th.

15 And it could be that the real number that
16 was reported there was zero. I wonder why we need to
17 go on with this? Because I'm looking a little
18 further, I have a habit of reading ahead, I like to
19 know who killed the person in the locked room.

20 And I see that in table 5, on page 25 of
21 the report, Dr. Makhijani's calculations, and I'm not
22 sure whether they were screening calculations, or back
23 of the envelope calculations, or what, but I see that
24 for a case of sand, and clay, and with low moisture,
25 and moderate erosion, the peak dose, in terms of rem

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 per year, occurs in the neighborhood of 10 to 20,000
2 years, and is remarkably low.

3 WITNESS MAKHIJANI: The peak dose is quite
4 high, Your Honor. That is rem.

5 JUDGE KELBER: Yes, I understand that, but
6 compared to the other doses, these are the low end.

7 WITNESS MAKHIJANI: I didn't think that
8 our calculations resulted in doses at the low end,
9 they are in the hundreds of rem.

10 JUDGE KELBER: Yes.

11 WITNESS MAKHIJANI: Per year.

12 JUDGE KELBER: Yes, that is like going to
13 your doctor's office for examination several times a
14 year, like I do. But, as I say, these are -- we can
15 question the assumptions how to get these, but they do
16 accord, I think, with the general observation that dry
17 sites, with moderate erosion, produce lower doses.

18 WITNESS MAKHIJANI: No, Your Honor, table
19 5 is shallow sites, they are in the way of
20 calculations that would be with parameters that were
21 representative selected from dry areas.

22 JUDGE KELBER: And would you expect that
23 if the Claibourne calculations were carried out to
24 this length, and under these conditions, they would
25 produce some similar results?

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 WITNESS MAKHIJANI: Your Honor, the
2 Claibourne calculation that we are talking about were
3 completely different than these. They were deep mine
4 calculations.

5 JUDGE KELBER: I understand that. But the
6 Claibourne calculations also did, the Claibourne
7 report also did calculations for shallow disposal.

8 WITNESS MAKHIJANI: Yes, Your Honor, I
9 don't recall the shallow doses, but I do recall that
10 they were quite high. And that is why it was thought
11 that shallow disposal was unacceptable.

12 JUDGE KELBER: That was for a wet site?

13 WITNESS MAKHIJANI: Yes, for a wet site.
14 And that was all that was done then.

15 JUDGE ABRAMSON: Why don't we let Mr.
16 Curtiss get back to what information he is trying to
17 generate?

18 MR. CURTISS: Well, I certainly welcome
19 any questions that the Board has. Let me try to get
20 right to it.

21 I think what our witnesses have testified
22 about, and will testify about, goes to, and the very
23 criticism, I think of the Staff analysis is that it is
24 not clear to me, Dr. Makhijani, in a transparent and
25 reproducible way, how you conducted your analysis.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 And I'm going to ask a series of questions
2 about that, to try to elicit what our technical
3 experts believe are important inputs.

4 JUDGE ABRAMSON: Let me just, before you
5 go too far down that line, let me just tell you,
6 anecdotally, what we did in a recent hearing, where we
7 had computer code output that didn't agree, even with
8 the same code.

9 And what we made the parties do, and I say
10 made the parties do, was iterate on the input, and
11 iterate on the modeling assumptions, until they
12 understood what each other did.

13 And if we are going to go down that path,
14 just be aware we will go down it.

15 MR. CURTISS: I just want to understand
16 the assumptions of the report, this hearing has
17 focused, in quite some detail today, about the
18 underlying assumptions, and the fact that they can't
19 be reproduced.

20 And I think at least the record ought to
21 reflect what the assumptions are that have been made
22 in the analysis that is being urged as the basis for
23 Dr. Makhijani's report.

24 Some very basic questions to go to the
25 point that the Commission emphasized, what volumes of

1 depleted uranium did you assume in your analysis?

2 WITNESS MAKHIJANI: If I might just say in
3 response to Judge Abramson, we would be happy to do
4 that.

5 JUDGE ABRAMSON: I'm sure all the parties
6 would if that is what it takes to resolve it. But
7 let's go down what Mr. Curtiss wants to know, which is
8 get some idea about the basic assumptions.

9 WITNESS MAKHIJANI: We used 133,000 metric
10 tons of uranium with a volume of 50,000 cubic meters.

11 MR. CURTISS: And what time period did you
12 use in your evaluation?

13 WITNESS MAKHIJANI: The calculations were
14 carried out to the limit of RESRAD, 100,000 years.

15 MR. CURTISS: And did you conduct an
16 evaluation of 1,000 years, would that be --

17 WITNESS MAKHIJANI: Yes, the output is
18 given as various years. What was reported in the
19 report was the peak dose and the year in which the
20 peak dose occurred. And there are other years that
21 the output generates.

22 MR. CURTISS: What values did you assume
23 for the hydrological parameters?

24 WITNESS MAKHIJANI: Well, which particular
25 model, are you talking about the November report, or

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 the July report?

2 MR. CURTISS: I'm talking about November
3 now. And there are actually three things that I would
4 like to know, the precipitation rate, the runoff, and
5 the evapotranspiration.

6 WITNESS MAKHIJANI: I believe the
7 precipitation rate was generally similar. I do not
8 recall exactly, but generally similar to what occurs
9 in the Envirocare site in Utah, 15 to 20 centimeters
10 per year, maybe.

11 I do not recall exactly.
12 Evapotranspiration was 90 percent evaporated. That
13 was not -- we did not have the parameter that has been
14 talked about specifically.

15 I think that -- and let me -- I think the
16 parameters are listed in the report on page 23. The
17 area of the U308 was 26,000 square meters, two meters
18 thick, seven point six meters of cover, unsaturated
19 zone, 20 meters from the underlying aquifer.

20 And the KD values were the default values
21 for these as listed for clay and sand in RESRAD. It
22 might be like on the order of 50 for sand and 1,500
23 for clay.

24 But, I do not remember exactly. And I do
25 not remember the rainfall exactly off the top of my

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 head. It's not listed. Maybe it's under the table.
2 Yes, it says here, as I said, it's between 15 and 20
3 centimeters, .178 meters per year rainfall under the
4 table five on page 24.

5 And the erosion rate is also listed, five
6 times ten to the minus four meters per year.

7 MR. CURTISS: Do you have a runoff rate
8 that you assume?

9 WITNESS MAKHIJANI: All the other
10 parameters, I think, are just -- whenever the
11 parameters are not specified they are the default
12 parameters in RESRAD.

13 And there are a lot of parameters in
14 RESRAD. And I don't know them all. But we just use
15 the default parameters, which is the standard practice
16 for this kind of capsulation.

17 MR. CURTISS: You referred to and the
18 report refers to the cover thickness of 7.6 meters, as
19 you referred on page 23.

20 WITNESS MAKHIJANI: Yes.

21 MR. CURTISS: In your run of the code, did
22 you assume any erosion protection at all?

23 WITNESS MAKHIJANI: Well, yes. The
24 erosion rate is rather low given in the -- so that
25 erosion protection is basically rolled into the

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 erosion rate.

2 It's five times ten to the minus four
3 meters per year low erosion and then variant on that
4 ten to the minus three meters per year. That's why
5 the peak dose actually happens at a very long time
6 after closure.

7 That's the result of assuming a low
8 erosion rate. And that's very similar to what's in
9 the PEIS.

10 MR. CURTISS: In your presentation results
11 you presented the all pathways result. Did you break
12 down the pathways?

13 WITNESS MAKHIJANI: Yes, the U238 doses,
14 U235 doses, the three different radionuclides are
15 given. The bypathway doses are not given an import.
16 They would have been in the output.

17 MR. CURTISS: And I just want to make sure
18 that the output files for this, as opposed to Mr.
19 Rice, were made available because we don't have a
20 record of having received them.

21 WITNESS MAKHIJANI: Mr. Lovejoy?

22 MR. LOVEJOY: There was a big fat bunch of
23 computer output on paper that were distributed around,
24 RESRAD output files, output files from Dr. Rice.

25 MR. CURTISS: We'll confirm that. But, I

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 wouldn't have these questions if we had the output
2 files for the run. I'm not questioning what's been
3 said --

4 WITNESS MAKHIJANI: And, just for the
5 record, Mr. Curtiss, you know, the way we normally
6 worked is Mr. Lovejoy sends these things out or my
7 office will send them out at his direction.

8 I'm not personally involved in sending
9 documents to the various parties. So, I think I have
10 to rely on --

11 MR. CURTISS: I understand.

12 WITNESS MAKHIJANI: -- on Mr. Lovejoy as
13 to what was sent out.

14 JUDGE KELBER: Counselor?

15 MR. CURTISS: Yes, sir.

16 JUDGE KELBER: If one turns to the next
17 page, and let me get the exact page number, one sees
18 an answer to your question about pathways. If you
19 look at the paragraph starting, in other words, when
20 the depleted uranium, the first mention is the gamma
21 pathways from -- let's see, direct plant uptake
22 exposure pathway, that's the first one.

23 And then, talking about higher moisture
24 and more effective diffusion, there is a drinking
25 water pathway. No other breakout is there that I can

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 see.

2 JUDGE ABRAMSON: Yes. And I think what we
3 heard from Dr. Makhijani is that the detailed breakout
4 is in the output, which Mr. Curtiss can't lay his hand
5 on at the moment.

6 MR. CURTISS: Right.

7 WITNESS MAKHIJANI: And, Your Honor, in
8 this screening calculation they are all pathways. In
9 the second calculation we did I believe the drinking
10 water was not assumed, just inhalation and external
11 dose.

12 JUDGE ABRAMSON: That's in the other
13 report?

14 WITNESS MAKHIJANI: That's in the other
15 report, yes.

16 JUDGE ABRAMSON: Was this also circulated,
17 as far as you know?

18 WITNESS MAKHIJANI: I believe so. Again,
19 I have to refer to Mr. Lovejoy as to what was
20 circulated.

21 MR. LOVEJOY: I am told that the inputs
22 were listed in the report.

23 JUDGE ABRAMSON: Listed in the report?

24 MR. LOVEJOY: Yes.

25 JUDGE ABRAMSON: This is in the other

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 report?

2 MR. LOVEJOY: The July report.

3 JUDGE ABRAMSON: Okay.

4 MR. CURTISS: The inputs for the July

5 RESRAD run or for the --

6 WITNESS MAKHIJANI: The July run.

7 MR. CURTISS: Okay.

8 WITNESS MAKHIJANI: The way the July --

9 there were three kinds of inputs into the July report,
10 Mr. Curtiss. They were either default parameters in
11 RESRAD which are there whenever you have RESRAD.

12 They were the inputs form the WCS
13 application, which is there on the web, or whenever it
14 was different from either of those, they are listed in
15 the report.

16 So they are the three sources. And you
17 have to, unfortunately, put those three together in
18 order to be able to get everything. But I believe
19 everything is there.

20 MR. CURTISS: Okay. Let me understand
21 from the discussion here on the pathways issue that
22 Judge Kelber has pointed to. Can you separate the
23 water related and the non-water related pathway?

24 WITNESS MAKHIJANI: In the November report
25 I can't. Let me look at it to see if we have

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 something here that will enable me to do that.

2 (Pause.)

3 WITNESS MAKHIJANI: I don't think we've
4 given it here. If you look at the discussion it
5 actually shows a sensitivity calculation as to what
6 was done in terms of if you have a drier area with
7 higher erosion the drinking water dose goes down but
8 the external dose goes up.

9 And so, you wind up with very high doses
10 whether you consider the groundwater pathway or not.

11 MR. CURTISS: I'm just interested in
12 knowing whether the water related dose has been broken
13 out.

14 WITNESS MAKHIJANI: I'm sorry. In this
15 case we don't have it. In the July report the water
16 dose was zero. Anything it's broken out inhalation
17 and external.

18 MR. CURTISS: Okay. Let me see. I'm not
19 going to go much longer. I don't have -- and we will
20 review the output files if they've been produced and
21 confirm that they should have, I think, Bates numbers
22 on them.

23 So, if Counsel can check as to whether
24 they've been numbered that way or when they were
25 produced.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 JUDGE ABRAMSON: Yes, and if you can't
2 find them, I think, just let us and Mr. Lovejoy know
3 and we'll try to find them.

4 MR. CURTISS: Absolutely. Just a couple
5 other questions in terms of the scenarios that you
6 assumed. What pathways were analyzed for the resident
7 scenario, do you recall?

8 WITNESS MAKHIJANI: As I look, you know,
9 we don't have all outputs here. But, as I understand,
10 the November report was an all pathway analysis, so
11 water, food, erosion, and so on.

12 And then you have different erosion rates.
13 So, the November report was an all pathway analysis.
14 The July report was more restricted.

15 MR. CURTISS: Okay. I think we'll stop
16 here with this witness. We may call our panel for
17 surrebuttal. We'd like to just talk with the panel.
18 We'll check the output files.

19 And if they answer our questions I think
20 we can work with counsel and see if that's in fact the
21 case. But we'd like to understand the outputs and the
22 assumptions that were not reflected here.

23 JUDGE ABRAMSON: Okay. And this all, I
24 think, relates to the challenge to the EIS, correct?

25 MR. CURTISS: Yes.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 JUDGE ABRAMSON: Okay. Not to the cost
2 side.

3 CHAIR BOLLWERK: Anything further then?

4 MR. CURTISS: No, I think at this point
5 I'll defer to the Staff if the Staff has questions.

6 CHAIR BOLLWERK: All right, thank you.

7 EXAMINATION BY MS. CLARK OF

8 ARJUN MAKHIJANI

9 MS. CLARK: Dr. Makhijani, have you done
10 a site specific analysis for the Envirocare site?

11 WITNESS MAKHIJANI: No. The November
12 analysis used some of the parameters typical of that
13 site. But that was not a site specific analysis to
14 the Envirocare site.

15 It was sort of like it, except that there
16 are the drinking water pathway and so on. So, in that
17 respect, we would have made assumptions like in the
18 Baird Report, although our results are different.

19 But we haven't done a site specific
20 analysis for Envirocare.

21 MS. CLARK: How did you determine the
22 characteristics for the site that you used?

23 WITNESS MAKHIJANI: Well, as I said, we
24 used some like the rainfall and erosion
25 characteristics generally for arid and semi-arid

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 areas.

2 We commissioned special study on the
3 question of erosion when we got into the specific
4 characteristics of an arid site in the case of WCS,
5 when we were confronted with the proposition from an
6 expert that there was no erosion because that's what's
7 in the license application, zero erosion.

8 And then we used a range of erosion values
9 that are specified. And variation of internal dose
10 with erosion is given. So, we looked at typical
11 characteristics of dry sites.

12 And then we also looked at the specific
13 characteristics of the Andrews County site.

14 MS. CLARK: In your analysis of the dry
15 sites, did you assume that groundwater would be
16 available?

17 WITNESS MAKHIJANI: Well, yes. In the one
18 screening case we assume the all pathway analysis.
19 And, in the other case we did not. In the other case
20 we only analyzed external gamma radiation of external
21 dose and inhalation dose. So we've done both.

22 MS. CLARK: For both for shallow land
23 disposal?

24 WITNESS MAKHIJANI: Both are for shallow
25 land disposal, yes.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 MS. CLARK: Okay. I don't think I have
2 any further questions at this time.

3 JUDGE KELBER: So that I might understand,
4 what does peak external dose mean? Is that a dose
5 that would be measured by a dosimeter placed on the
6 ground, or what?

7 WITNESS MAKHIJANI: No. The external
8 doses, of course, not measured by the dosimeter. That
9 would only be in an area of examination dose. Peak
10 external dose, Your Honor, will be the combination of
11 the external dose prominent to their station over
12 there and the inhalation dose in the case of the
13 second calculation at the time when you have the waste
14 uncovered and somewhat eroded away.

15 And then that dose -- there's actually a
16 very sudden rise in the dose when the cover goes away
17 and you have a sufficient amount of radium and thorium
18 and so on, not equilibrium, actually.

19 JUDGE KELBER: Okay.

20 WITNESS MAKHIJANI: And then after 20,000
21 years or some long length of time, that dose just
22 disappears and becomes very low because your waste is
23 completely eroded away and dispersed.

24 JUDGE KELBER: Excuse me. I think I
25 understand now where we're going. The peak inhalation

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 dose in the table on -- I think it's page --

2 JUDGE ABRAMSON: You're in 190, right?

3 JUDGE KELBER: I think 224, page 16.

4 WITNESS MAKHIJANI: Yes. I have it, Your
5 Honor.

6 JUDGE KELBER: The peak inhalation dose is
7 quite small compared to the peak external dose. It's
8 less than ten percent.

9 WITNESS MAKHIJANI: Yes, that's an EDE so
10 we can add them up. The peak organ dose, of course,
11 would be --

12 JUDGE KELBER: No, I'm just trying to
13 understand.

14 WITNESS MAKHIJANI: Yes.

15 JUDGE KELBER: What goes into computing
16 the peak external dose. I don't have a RESRAD manual
17 in front of me. And what does that mean?

18 WITNESS MAKHIJANI: That means that the
19 radium 226 as it builds up plays a very big role.
20 That's what it mean.

21 JUDGE KELBER: Yes, radium 226 emits an
22 alpha particle with an energy not too much different
23 from that of depleted uranium.

24 WITNESS MAKHIJANI: That's right, Your
25 Honor.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 JUDGE KELBER: Yes.

2 WITNESS MAKHIJANI: It has, however,
3 nearly 200 KeV gamma. That's where the external dose
4 comes from.

5 JUDGE KELBER: Okay. The external dose
6 comes from the gammas.

7 WITNESS MAKHIJANI: Yes.

8 JUDGE KELBER: And the gammas are not
9 shielded by the depleted uranium?

10 WITNESS MAKHIJANI: No, once the thing is
11 eroded away and you've got powder and you've got waste
12 that's exposed and it's compacted in soil, there is
13 some shielding, of course.

14 And RESRAD would take that shielding into
15 account. But you're into the waste layer. And
16 there's an aerial dose, just like there is --

17 JUDGE KELBER: Yes. Essentially it's
18 shine.

19 WITNESS MAKHIJANI: Yes.

20 JUDGE KELBER: But you have to tell RESRAD
21 where the depleted uranium is, how much is there.

22 WITNESS MAKHIJANI: Yes.

23 JUDGE KELBER: Okay.

24 WITNESS MAKHIJANI: And all of those are
25 inputs that are stated.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 JUDGE KELBER: But it's useful to know
2 what the inputs are and how that is modeled.

3 WITNESS MAKHIJANI: Yes. And those are
4 given in the reports.

5 JUDGE KELBER: And do those inputs
6 distinguish between -- well, let me put it
7 differently. The radium 226 is found embedded in the
8 uranium U308.

9 It doesn't diffuse out. Well, perhaps in
10 the length of time we're considering here some of it
11 might. But it's falling within these grains. Some of
12 these grains might be actually quite large, not
13 metallic grains, but even larger.

14 How you distinguish in your input to
15 RESRAD as to where the depleted uranium is and where
16 the radium is may be quite critical to determining
17 what the effective gamma ray shine is.

18 Is it possible to do that in RESRAD? Or
19 do you just simply have to assume that there's a kind
20 of uniform deposition of --

21 WITNESS MAKHIJANI: Your Honor, it would
22 automatically be uniform because this is radium in-
23 growth in the depleted uranium. So it would be
24 intimately mixed in with the radium.

25 JUDGE KELBER: Oh, I agree.

1 WITNESS MAKHIJANI: There's still some
2 shine.

3 JUDGE KELBER: But the question is, what
4 is the self absorption?

5 WITNESS MAKHIJANI: The --

6 JUDGE KELBER: The reason I -- this is my
7 past history. I've done an awful lot of self
8 absorption calculations. And I see then what you're
9 discussing here is a possible conservatism in RESRAD
10 as RESRAD is a very conservative code then because it
11 assumes that the gamma emitters have as much
12 opportunity to emit as do the alpha emitters and has
13 not taken into account possible shielding of the gamma
14 rays.

15 JUDGE ABRAMSON: Well, we don't know.

16 WITNESS MAKHIJANI: I believe, Your Honor,
17 it does, to the best of my understanding. Gamma dose
18 all comes, I think -- the dose comes from the top few
19 inches.

20 The alpha is all absorbed. There's no
21 alpha external doses.

22 JUDGE KELBER: Yes, of course.

23 WITNESS MAKHIJANI: There's only alpha
24 internal dose because it's a kind of -- because of the
25 very large area over which this would be disposed of,

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 once it is exposed and you're well into the layer, it
2 is like an infinite plane calculation.

3 And, since it's a 200 KeV gamma and you
4 have it all over the surface, it's not like the
5 problem of having a soft X-ray from uranium or
6 something like that.

7 JUDGE KELBER: Well, we can discuss the
8 details of modeling. But I have, basing on my own
9 experience, now raised some questions about whether
10 RESRAD is overly conservative. Okay, thank you. I
11 wanted to understand this table.

12 WITNESS MAKHIJANI: Thank you, Your Honor.

13 CHAIR BOLLWERK: Anything else?

14 JUDGE ABRAMSON: No, I'm fully absorbed.

15 MR. CURTISS: We don't have further
16 questions. We would like to take five minutes. And
17 I think if we could have an opportunity for
18 surrebuttal we could talk about the need for that in
19 view of this.

20 And, if we do, we don't think that will
21 take more than half an hour. And we'll be prepared to
22 move into contingencies.

23 CHAIR BOLLWERK: Okay. Let me just see if
24 Mr. Lovejoy has any redirect based on anything we've
25 heard here.

1 MR. LOVEJOY: I understood he needed five
2 minutes to see whether he was finished with cross.

3 CHAIR BOLLWERK: Oh, okay.

4 JUDGE ABRAMSON: No, he's talking about
5 what he wants to do with surrebuttal.

6 MR. CURTISS: Okay, we'll finish.

7 CHAIR BOLLWERK: Or we could put -- no, if
8 you have some questions now in redirect --

9 MR. LOVEJOY: I have one or two.

10 EXAMINATION BY MR. LOVEJOY OF

11 ARJUN MAKHIJANI

12 MR. LOVEJOY: Dr. Makhijani, just so it's
13 clear, from the information you had in the CEC
14 Environmental Impact Statement, were you able to
15 reproduce the results using the information?

16 WITNESS MAKHIJANI: Well I unfortunately
17 didn't try. You know, we had Dr. Rice look at all
18 that and run the calculation.

19 MR. LOVEJOY: Okay.

20 WITNESS MAKHIJANI: Our team.

21 JUDGE ABRAMSON: Your team was not able,
22 correct? Your team was not able to reproduce.

23 WITNESS MAKHIJANI: Yes, I mean, I didn't
24 examine Dr. Rice in everything.

25 JUDGE ABRAMSON: No, no. But --

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 WITNESS MAKHIJANI: But he did, in all
2 honest. I asked him to look at the parameters, look
3 at the case, look at the issue, and give us some idea
4 of what the situation was. And I told you the numbers
5 he gave us.

6 JUDGE KELBER: Mr. Lovejoy, let me
7 interject one more question. Looking back at that
8 table, I noticed the top line, which has got a certain
9 erosion rate and you're at peak dose 100,000 reports,
10 effectively zero dose, is that an artifact of the code
11 that it expires at 100,000 years?

12 WITNESS MAKHIJANI: Yes, Your Honor. The
13 very lowest erosion rate that is used there, which I
14 believe is .01 centimeters per year, if I can look at
15 it, is so low.

16 And, in the case of WCS, the disposal plan
17 is so deep at the top of the oasis, 12.3 meters down.
18 So, any erosion rate below .123 per year will yield a
19 zero dose up to 100,000 years.

20 JUDGE KELBER: I understand.

21 (Pause.)

22 MR. LOVEJOY: Can you just, because Dr.
23 Smith's role has come in here a little bit, can you
24 just explain what training Dr. Smith has had in
25 RESRAD?

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 WITNESS MAKHIJANI: Yes, Dr. Smith has run
2 RESRAD a lot. We've talked about it and discussed the
3 model and what goes into it. But I thought I should
4 also send Dr. Smith to Argonne National Lab.

5 They also periodic courses to take a
6 course to see what was in the guts of the model, how
7 the parameters were set, how you could change the
8 models.

9 And he spent a week in Chicago with the
10 people who created the model so we could develop a
11 thorough understanding in the institution and what
12 goes on inside of it.

13 MR. LOVEJOY: I'm just looking for the
14 next number. I believe it's 277. The question is
15 actually this.

16 CHAIR BOLLWERK: It's 278.

17 MR. LOVEJOY: Oh, 278. Would you look at
18 what's been marked as Exhibit 278, an extract from a
19 news report coming from, I believe, Salt Lake City?
20 And my question is, first, can you identify this
21 document?

22 WITNESS MAKHIJANI: Yes, I read this on
23 the computer today, last night, I can't remember.

24 MR. CURTISS: Is this a cross examine
25 document or what is this?

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 MR. LOVEJOY: It relates. Let me just ask
2 the question. Have you had some information recently
3 come to you concerning the prospect of using the
4 Envirocare site for waste disposal of depleted
5 uranium?

6 WITNESS MAKHIJANI: Yes, I was rather
7 surprised to see the statement made here by the vice
8 president of Envirocare in regard to waste
9 classification issues and in light of the Commission's
10 ruling last week because that ruling said that this
11 proceeding was not to decide the classification
12 question but attend to the environmental impacts.

13 And that classification question in regard
14 to part 61 would be decided in a separate proceeding,
15 which of course would happen later. And here the Vice
16 President said that they would not take large amounts
17 of depleted uranium and denied that they had a bid
18 with the DOE and said if it's not class A then we're
19 clearly not interested.

20 So, it raised the question in my mind as
21 to whether there's a plausible strategy with
22 Envirocare until this question is decided, which is
23 not in this proceeding.

24 MR. LOVEJOY: Well, my thought actually
25 went this. Was there some information that came to

1 you concerning the use of the Envirocare site in
2 connection with the DOE option?

3 WITNESS MAKHIJANI: Well, yes. This news
4 report starts with the DOE option. And it says here
5 -- well, we can just see what is quoted. Of course,
6 this is a news report.

7 And, to be fair, news reports are news
8 reports. And, if you want to know what Envirocare
9 actually said -- so, in fairness to Envirocare
10 officials having had a lot of contact with the media,
11 sometimes they do a great job and sometimes it goes
12 down from there.

13 So, I have to say that what is -- I'm just
14 testifying about what is reported here and not about
15 what Envirocare can actually feel about this. But
16 they seem to have said, as quoted here, that they
17 don't know about this DOE waste might be going to
18 Envirocare and having bid on it.

19 JUDGE ABRAMSON: We can read it and we can
20 understand what it says. And we can understand its
21 source. We've seen a lot of this sort of thing over
22 the years.

23 MR. LOVEJOY: Okay.

24 CHAIR BOLLWERK: All right. Do you want
25 to go ahead and mark it for identification then?

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 MR. LOVEJOY: We did mark it for
2 identification. I'm sorry. I move it to
3 introduction.

4 CHAIR BOLLWERK: Well, first of all, let
5 the record reflect that Exhibit 278, which is a Daily
6 Herald Newspaper article, a web actually article dated
7 Wednesday, October 26th, 2005 entitled Bulk Uranium
8 Waste Disposal Raises Questions with Enviros and
9 Regulators, is being marked for identification.

10 (Whereupon, the above-
11 referenced to document was
12 marked as NIRS/PC Exhibit No.
13 278 for identification.)

14 CHAIR BOLLWERK: There's been a request
15 that it be admitted into evidence. Anyone have any
16 objections?

17 MR. CURTISS: No.

18 CHAIR BOLLWERK: Not hearing any
19 objections, the NIRS/PC Exhibit 278 is admitted into
20 evidence.

21
22
23
24
25

1 (The document referred to,
2 having been previously marked
3 for identification as NIRS/PC
4 Exhibit No. 278 was received in
5 evidence.)

6 MR. LOVEJOY: Thank you. No further
7 questions.

8 CHAIR BOLLWERK: All right. Anything
9 further based on those questions? Either party?

10 (No verbal response.)

11 JUDGE ABRAMSON: You need how long to talk
12 to your --

13 MR. CURTISS: If we could just take five
14 minutes. And, if we do have any surrebuttal, we don't
15 think it will go beyond 2:30. And then we're ready to
16 move to contingencies.

17 CHAIR BOLLWERK: Let's go ahead and take
18 seven minutes, there about or longer if we need to.
19 Then we'll come back. Make it ten after.

20 (Whereupon, the above-entitled matter
21 went off the record at 2:00 p.m. and
22 went back on the record at 2:15 p.m.)

23 CHAIR BOLLWERK: I think we're ready.
24 Lets go back on the record. I think we're going to
25 have some surrebuttal testimony from --

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 JUDGE ABRAMSON: Some more testimony.

2 CHAIR BOLLWERK: Right, some more
3 testimony from LES regarding disposal issue. Mr.
4 Krich and Mr. Potter are back and on the stand. Both
5 of you remain under oath.

6 Glad to see you both again. Thank you
7 very much for coming back.

8 MR. CURTISS: And we'll be brief, Mr.
9 Chairman. I don't think we'll go longer than maybe 20
10 or 30 minutes at the most.

11 CHAIR BOLLWERK: Okay.

12 MR. CURTISS: We've recalled this panel
13 and primarily Mr. Potter to provide an opportunity,
14 based upon the testimony that was given, to provide
15 additional comments on the November and July reports
16 and understand the question of the output files is a
17 matter that we've talked about off the record.

18 And we'll pursue that to make sure that we
19 have the necessary information. At this point in our
20 consultations with the Staff and in looking at the
21 reports, the reports don't reference the output files.

22 So I think that's why we're at a loss as
23 to where they are. But, if we've got them in our
24 files, we'll pull them out and undertake an
25 evaluation.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25

EXAMINATION BY MR. CURTISS OF

ROD KRICH

THOMAS POTTER

MR. CURTISS: In any event, with that preface, Mr. Potter, you've previously testified on the subject of the plausibility of disposal of depleted uranium generated by the NEF.

Have you reviewed the reports that have been referred to here, the November 2004 and the July 2005 reports prepared by Dr. Makhijani and that he spoke to earlier today?

WITNESS POTTER: Yes, I have.

MR. CURTISS: Do you have them before you?

WITNESS POTTER: Yes, I do.

MR. CURTISS: All right. Would you -- I'm going to, in the interest of accelerating this, just simply ask if, beginning with the November report, and based upon the comments that have been received, if you have any further comment to offer on that subject.

CHAIR BOLLWERK: That's Exhibit 190?

MR. CURTISS: Yes, sir.

WITNESS POTTER: I have reviewed those reports. And, particularly in light of determining the degree to which they are representative in making -- in supporting or evaluating -- in supporting a

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

(202) 234-4433

www.nealrgross.com

1 decision whether or not to dispose of this material at
2 Envirocare or a site like Envirocare.

3 And I've concluded, based on the
4 information I find in the report in terms of
5 description of scenarios evaluated and various
6 parameter values assumed, that those -- the analyses,
7 the RESRAD analyses and those reports are not suitable
8 for this purpose.

9 One important aspect that applies to both
10 reports is that the finding to the contrary in the two
11 reports is based in part on an assertion that the 25
12 millirem per year dose limit applies to the intrusion
13 scenario.

14 It is clear from the development of 10CFR
15 part 61, including the statements of consideration for
16 the Final Rule, that had there been a dose limit in
17 the Final Rule, it would not have been 25 millirem, it
18 would have been closer to 500 millirem, 500 millirem
19 is, after all, the basis for the classification in the
20 technical requirements section of the Rule.

21 And it would make no sense to classify
22 levels of waste acceptable when they deliver intrusion
23 doses of 500 millirem per year, if your limit is 25
24 millirem per year.

25 That applies to both analysis. With

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 respect to the details of the radiological analysis in
2 the November report, I note on page 23, in the
3 paragraph that begins, in all but the lower KD, that
4 sentence says, the peak dose reported in table 5 is
5 dominated by direct plant uptake through the roots,
6 occurring after the cover material has eroded away to
7 a thinner level, not been removed, understand, but
8 eroded away to a thinner level.

9 While in the other two scenarios, which
10 result in far larger peak doses, drinking contaminated
11 water is the dominant exposure pathway. It is
12 unclear, from looking at table 5, what the doses would
13 be from pathways not related to consuming plants, or
14 not related to drinking water would be.

15 But it is fair to conclude there would be
16 substantially less than the doses listed in table 5.
17 Consequently the doses listed in table 5 are not
18 suitable representations of the doses that one would
19 expect from reasonable scenarios, at a site like
20 Envirocare, or Envirocare, or a site like it.

21 For example, as Dr. Makhijani agreed, in
22 his testimony today, it would not be reasonable to
23 apply, to assume water related scenario, exposure
24 scenarios would apply at Envirocare or sites like it.

25 My testimony was along the same lines.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 Even if one wants to include -- and then the other
2 side of the issue, the plants, we have substantial
3 information on the record that the salinity of soil
4 there does not support, it is too high to support
5 plant production.

6 Consequently the plant dose, the plant
7 pathway should not be part of an intrusion scenario.

8 JUDGE KELBER: Mr. Potter, is radium 226
9 primarily taken up into plants, in considerations of
10 this sort, is that the importance of radium 226?

11 WITNESS POTTER: It depends very much on
12 the situation. And I understand, I heard some of your
13 earlier questions. And I must say that I think for --
14 to the extent that it is reasonable to do so, the
15 RESRAD code, and similar codes, do evaluate both
16 internal and external doses, from the radionuclides in
17 the library, in a reasonable sort of way.

18 They take into account the kind of
19 concerns you had.

20 JUDGE KELBER: Thank you, that saves me
21 some labor tonight.

22 WITNESS POTTER: If you are interested,
23 the code is available for free download on the web,
24 just look up RESRAD in Google, it is easy to use. It
25 is easy to get in trouble with, but it is easy to use.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 But the point is that that November '94
2 analysis, those numbers cannot be applied to a
3 situation like Envirocare or a site like it, because
4 more reasonable numbers calculated there would be
5 less, and who knows how much less.

6 That is the November 2004 report. I'm
7 sorry, I'm still living in the last century.
8 Similarly, the analysis in the report for 2005, I
9 should add, I should add, that the fact in the 2004
10 report, that inhalation and external dose did not turn
11 out to be major contributors to dose, suggest that the
12 cover never did erode away, in any of those runs.

13 In the July 2005 report doses were
14 calculated for various periods of time, and the
15 exposure scenario in this case was, if I can describe
16 the human behavior conceptualization, a person living
17 on the site, on the waste material, or the waste
18 material as covered, and then the cover was allowed to
19 erode, for 8,000 hours a year, basically all outdoors,
20 no shielding from being in a building, or anything
21 like that.

22 The doses calculator or at least tabulated
23 were external dose, direct radiation from the deposit,
24 and inhalation dose, dose received from inhaling dust
25 suspended from the material.

1 Here the major problem, as I see it, is,
2 recalling my earlier comments about the general
3 applicability of a much higher dose limit, if you
4 will, although no dose limit is specified in 10CFR
5 Part 61.42, if one were to evaluate protection of an
6 individual from intrusion, one would, I expect, look
7 at a much higher dose.

8 JUDGE ABRAMSON: Before we go too far down
9 the line, I think we spent a fair amount of time
10 saying we weren't going to look at the history of
11 61.55, so unless you have a need to reopen that can of
12 worms, we would appreciate it if you would not go down
13 that path.

14 WITNESS POTTER: I'm simply trying to
15 establish how it would be reasonable to expect to
16 apply 61.42 in an application, in an actual
17 application. One would not apply the 25 millirem per
18 year, it would be inconsistent with the classification
19 level of 500 millirem per year in table 1.

20 JUDGE ABRAMSON: If that is where you are
21 going then --

22 WITNESS POTTER: I've started there and
23 gone. I'm just pointing out that 500 millirem ought to
24 be our benchmark for this kind of situation.

25 Then the other aspect of this is the

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 exposure time of 8,000 hours per year. For an
2 intrusion scenario, and remember here we are talking
3 about a site that is practically uninhabitable, and
4 sites like it.

5 An assumption of a full year of exposure
6 each year is not applicable. A year is 8,760 hours.
7 If one spent 88 hours a year, say a couple of weeks of
8 recreational activity, or whatever, if you wanted to
9 hypothesize that, these doses would be reduced by two
10 orders of magnitude.

11 And the doses, as I see them here, on page
12 16 of the 2005 report, the highest dose is something
13 on the order of 123, I'm adding now, the inhalation
14 and external, something like 123 rem per year for
15 grouted waste, and maybe 150 rem per year for
16 ungrouted waste, 150 rem per year, reduced by two
17 orders of magnitude, is 1.5 rem per year.

18 And we are not all that far from the --
19 from a reasonable dose criterion, let's say, to apply
20 in an intrusion scenario --

21 JUDGE ABRAMSON: Do you know what the
22 background radiation is in the Salt Lake City area?

23 WITNESS POTTER: In Salt Lake City?

24 JUDGE ABRAMSON: Yes. I mean, we know
25 what it is in Denver, because we have seen it in a new

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 EPA standard.

2 WITNESS POTTER: I don't know it off-hand.

3 JUDGE ABRAMSON: Does anybody remember
4 what it is in Denver?

5 WITNESS POTTER: My point, though, is that
6 I'm looking at numbers, in these two reports, that go
7 way beyond 1,000 years. I'm looking at the full
8 spectrum of time that was calculated by Dr. Makhijani,
9 and I'm concluding that reasonable extrapolations from
10 these reports suggested that these sites could be
11 licensed under 10CFR Part 61 regardless of what time
12 frame you looked at.

13 MR. CURTISS: Thank you. Do you have
14 anything further, Mr. Potter?

15 WITNESS POTTER: No.

16 MR. CURTISS: Okay. We have no further
17 surrebuttal.

18 CHAIR BOLLWERK: Mr. Lovejoy?

19 MR. LOVEJOY: Would you give me a moment
20 to consult?

21 CHAIR BOLLWERK: Sure, absolutely.

22 EXAMINATION BY MR. LOVEJOY OF

23 THOMAS POTTER

24 ROD KRICH

25 MR. LOVEJOY: There was testimony, Mr.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 Potter, about doses in the instance, I think you were
2 speaking of when uranium does not reach the aquifer.
3 Is that --

4 WITNESS POTTER: Are you speaking to what
5 I've just --

6 MR. LOVEJOY: What you've just testified
7 about, yes.

8 WITNESS POTTER: Okay.

9 MR. LOVEJOY: Did you notice the passage
10 in the November report on page 23? I think you were
11 referring to it. It's on 23 of my copy where its says
12 importantly, however, we found that for the scenarios
13 in which the uranium does not reach the aquifer with
14 the 100,000 year time frame analyzed by RESRAD, the
15 external radiation dose at the time of the peak dose
16 would alone exceed the 25 millirem annual limit by
17 1,270 to nearly 3,000 times. Is that the data that
18 you were trying to find?

19 WITNESS POTTER: Okay, I missed that. So
20 we can address that. Now, let's see. The time is not
21 specified there. But 25 millirem by a thousand,
22 that's 25 rem, 75 rem, if I --

23 MR. LOVEJOY: Approximately in the
24 vicinity of 75 rems, is that right?

25 WITNESS POTTER: If that's the case --

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 MR. LOVEJOY: And on table five do you see
2 the time, the years in the right column?

3 WITNESS POTTER: I do. In that case then,
4 since this is a resident scenario, again, we assume
5 we're assuming a substantial fraction of the time
6 being spent on the site.

7 And I don't know what that assumption was.
8 But typically in RESRAD the defaults would be at least
9 half and at least equivalent to half outdoors and
10 actually more than half with some shielding taken into
11 account for indoors.

12 Again, applying the same rationale about
13 the inhabitability of the site and the much more
14 reasonable assumption of a shorter exposure time for
15 an intruder scenario, that 75 rem would be much
16 reduced and, again, back down in the range of what I
17 would consider a much more reasonable criterion for
18 purposes of evaluation of intruder dose.

19 JUDGE ABRAMSON: Mr. Potter, two
20 questions, probably related to each other. Is there
21 a standard other than the 25 millirem in 61, part 61?

22 WITNESS POTTER: Only to the extent it's
23 applied in the definition of classification labels in
24 table one.

25 JUDGE ABRAMSON: Okay. So, if I look at

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 part C, 61 part C, the only number is the 25 millirem?

2 WITNESS POTTER: That's right. And that
3 applies to the general public.

4 JUDGE ABRAMSON: Okay. And --

5 WITNESS POTTER: It releases from the site
6 to the general public.

7 JUDGE ABRAMSON: And there is no numerical
8 value established in 61.42, is it, for intruders, is
9 that correct?

10 WITNESS POTTER: That is correct.

11 JUDGE ABRAMSON: And there's no time limit
12 set in 61, right?

13 WITNESS POTTER: That is correct.

14 JUDGE ABRAMSON: So all those matters are
15 matters that are beyond -- dealing with those are
16 beyond the jurisdiction of this tribunal. They are
17 matters of policy for the Commission.

18 And, while they are matters that are being
19 raised, they don't belong before us unless they impact
20 whether or not DEIS and the FEIS the Staff has taken
21 a sufficiently hard look.

22 So, have you looked at what the Staff did
23 in the EIS and whether -- how these relate to that?

24 WITNESS POTTER: Well --

25 JUDGE ABRAMSON: I think the argument that

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 I hear from NIRS/PC is they haven't taken a
2 sufficiently hard look because they didn't go out long
3 enough.

4 And, if they went out long enough and they
5 applied these conditions that are set out in the reg,
6 it doesn't meet it. Is that what I -- is that
7 correct?

8 Is that sort of a simple summary of the
9 argument?

10 MR. LOVEJOY: Well, of the scope of the --

11 JUDGE ABRAMSON: The NEPA scope.

12 MR. LOVEJOY: Okay, yes. It would be.

13 And may I go on?

14 JUDGE ABRAMSON: Yes.

15 MR. LOVEJOY: I think I have just one or
16 two.

17 JUDGE ABRAMSON: Yes, sorry. I just
18 wanted to make sure.

19 MR. LOVEJOY: Do you have the July '05
20 report in front of you? I'm looking at page 16.

21 WITNESS POTTER: I do.

22 MR. LOVEJOY: Would the doses to the
23 organs be greater than the ones shown in this table on
24 page 16, critical organ doses?

25 WITNESS POTTER: Yes. Well, critical

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 organ is not a concept that fits with the concept of
2 effective dose. But, certain organ doses would be
3 higher than these doses.

4 MR. LOVEJOY: Well, the regulation speaks
5 of what, dose to the thyroid?

6 WITNESS POTTER: Well, the section 10CFR
7 61.41, which is, have I've mentioned, is not the
8 section addresses intruders, includes dose limits that
9 include 75 millirem to the thyroid, 25 millirem to the
10 whole body, and 25 to other organs.

11 MR. LOVEJOY: To other organs, okay. Any
12 other organs?

13 WITNESS POTTER: Any other organs.

14 MR. LOVEJOY: Okay. And those are the
15 limits that we're dealing with here?

16 WITNESS POTTER: Those are the limits that
17 I would consider inapplicable.

18 JUDGE ABRAMSON: But not to intruders or
19 to intruders as well?

20 WITNESS POTTER: Inapplicable to
21 intruders.

22 MR. LOVEJOY: Did you say applicable to
23 intruders?

24 WITNESS POTTER: Inapplicable to
25 intruders.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 MR. LOVEJOY: Well --

2 JUDGE ABRAMSON: But the intruder section
3 has no limit set forth, is that correct?

4 WITNESS POTTER: That is correct.

5 MR. LOVEJOY: The intruder is to be
6 protected.

7 WITNESS POTTER: Right.

8 MR. LOVEJOY: Would the hunter with dune
9 buggy and the boots be a member of the public?

10 WITNESS POTTER: He would certainly be a
11 member of the public.

12 MR. LOVEJOY: And are the doses to that
13 person shown in the paragraph underneath the table
14 we've been talking about where it says that it would
15 take 1.44 to 2.87 hours on the site to violate the 25
16 millirem per year dose limit?

17 WITNESS POTTER: That member of the public
18 who would be an intruder would by these calculations
19 receive doses on that order.

20 MR. LOVEJOY: So you think anybody who is
21 on the land is an intruder?

22 WITNESS POTTER: I would judge them to be
23 an intruder. Intruder by definition of the intruder
24 scenario all the way along, an intruder is someone who
25 gets into the waste.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 MR. LOVEJOY: So he's not entitled to any
2 protection?

3 WITNESS POTTER: He is entitled to
4 protection.

5 MR. LOVEJOY: Isn't he entitled to be
6 protected by the 25 millirem limit?

7 WITNESS POTTER: Not necessarily. In
8 fact, I would argue that --

9 JUDGE ABRAMSON: This is, again, let me
10 just say, this is not for this tribunal. If you want
11 to take these issues, this is not the right place to
12 take them.

13 They relate to whether 10CFR properly
14 covers these people and how it should be interpreted
15 or how it should be amended. That's not what's in
16 front of us.

17 MR. LOVEJOY: Did you understand, Mr.
18 Potter, from the report that the occupancy assumption
19 of 100 percent presence was used so it was possible
20 then to calculate days and hours related to exposure
21 levels?

22 WITNESS POTTER: The purpose for that
23 assumption, I don't think, was very clearly stated.
24 That is it can be used for that. That's certainly
25 true.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 MR. LOVEJOY: Is that a sensible basis for
2 using that assumption so that you can then calculate
3 from it how many, what percentage of year, etcetera
4 required to take a certain dose?

5 WITNESS POTTER: A tabulation of doses
6 along those lines, I do not remember seeing anything
7 suggesting that these were unreasonable assumptions or
8 hypothetical assumptions, or assumptions used for
9 purposes of generating numbers that might be used for
10 something more reasonable.

11 (Pause.)

12 MR. LOVEJOY: That's all.

13 CHAIR BOLLWERK: All right, any other
14 questions based on that for anyone?

15 (No verbal response.)

16 CHAIR BOLLWERK: Can I just ask Mr. Krich
17 one quick question while he's here. This relates
18 generally to the question of disposal. Can you
19 explain to me the situation relative to the compact
20 process and how LES' waste is treated?

21 WITNESS KRICH: Well, of course, there's
22 two wastes. There's the normal low level radioactive
23 waste which would be treated within the compact or
24 external to the compact.

25 Right now, for example, New Mexico is

1 sending some of its low level radioactive waste under
2 contract to the Hanford site in the northwest compact.

3 Our depleted uranium byproduct, if we sent
4 to environment, for example, that's acceptable. We
5 have to get okay from our compact to send it, of
6 course, out of the compact.

7 And then the same holds true for sending
8 it to the northwest or to the Texas/Vermont compact we
9 would need to get an okay from our compact to send
10 that waste, export the waste, I believe, is the term
11 to another compact or to another site.

12 CHAIR BOLLWERK: Okay.

13 WITNESS KRICH: And then, I'm sorry,
14 Judge, there's always of course the other option,
15 which is the DOE option, which is DOE takes title to
16 material and then it's basically out of our hands.

17 CHAIR BOLLWERK: Right. And just so I
18 understand, what is a compact approval process?

19 WITNESS KRICH: Only a very, very cursory
20 approach to it. But there's some information, of
21 course, that we have to provide to the Board.

22 CHAIR BOLLWERK: Right.

23 WITNESS KRICH: And I believe it involves
24 working with the Board, the Rocky Mountain Compact
25 Board on what we would like to do and making sure that

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 we're within the parameters that they've set down for
2 the compact.

3 CHAIR BOLLWERK: All right. Thank you.
4 All right, gentlemen. Thank you both for your
5 testimony. I think, Mr. Potter, you're finished at
6 this point, I believe, unless someone else was going
7 to call you again.

8 Thank you, sir, for appearing before us,
9 Mr. Krich. Dr. Makhijani, I forgot to thank you also
10 for your disposal testimony. We appreciate it very
11 much, thank you.

12 Let's take a quick five minute break and
13 let everybody shift their papers around. Then we'll
14 be back and we will start with contingencies.

15 (Whereupon, at 2:40 p.m., the closed
16 portion of the above-entitled hearing was concluded.)

17

18

19

20

21

22

23

24

25