U.S. NUCLEAR REGULATORY COMMISSION

RESPONSE TO FREEDOM OF INFORMATION ACT (FOIA) REQUEST

NRC FOIA REQUEST NUMBER(S): **FOIA – 96-378**

RESPONSE TYPE: [X] FINAL [ ] PARTIAL

DATE: OCT 07 1996

DOCKET NUMBER(S) *(If applicable)*:

REQUESTER: Marc Fioravanti

PART I.– AGENCY RECORDS RELEASED OR NOT LOCATED *(See checked boxes)*

- [ ] No agency records subject to the request have been located.
- [ ] No additional agency records subject to the request have been located.
- [ ] Requested records are available through another public distribution program. See Comments section.
- [ ] Agency records subject to the request that are identified in Appendix(es) _____ are already available for public inspection and copying at the NRC Public Document Room, 2120 L Street, N.W., Washington, DC.
- [X] Agency records subject to the request that are identified in Appendix(es) A are being made available for public inspection and copying at the NRC Public Document Room, 2120 L Street, N.W., Washington, DC, in a folder under this FOIA number.
- [ ] The nonproprietary version of the proposal(s) that you agreed to accept in a telephone conversation with a member of my staff is now being made available for public inspection and copying at the NRC Public Document Room, 2120 L Street, N.W., Washington, DC, in a folder under this FOIA number.
- [ ] Agency records subject to the request that are identified in Appendix(es) _____ may be inspected and copied at the NRC Local Public Document Room identified in the Comments section.
- [ ] Enclosed is information on how you may obtain access to and the charges for copying records located at the NRC Public Document Room, 2120 L Street, N.W., Washington, DC.
- [X] Agency records subject to the request are enclosed.
- [ ] Records subject to the request have been referred to another Federal agency(ies) for review and direct response to you.
- [X] Fees NONE (Fee waiver Granted)
  - [ ] You will be billed by the NRC for fees totaling $ _____.
  - [ ] You will receive a refund from the NRC in the amount of $ _____.
- [ ] In view of NRC's response to this request, no further action is being taken on appeal letter dated _____, No. _____

PART II. A–INFORMATION WITHHELD FROM PUBLIC DISCLOSURE

- [ ] Certain information in the requested records is being withheld from public disclosure pursuant to the exemptions described in and for the reasons stated in Part II, B, C, and D. Any released portions of the documents for which only part of the record is being withheld are being made available for public inspection and copying in the NRC Public Document Room, 2120 L Street, N.W., Washington, DC in a folder under this FOIA number.

COMMENTS

The records identified on enclosed Appendix A are responsive to your request. Copies of these records are enclosed.

This completes NRC's action on your response.

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FIAI

SIGNATURE, DIRECTOR, DIVISION OF FREEDOM OF INFORMATION AND PUBLICATIONS SERVICES

FOIA

ieer

INSTITUTE FOR ENERGY AND ENVIRONMENTAL RESEARCH

Washington, D.C. office

Fax: (301) 270-3029
Laurel Avenue
Takoma Park, MD 20912

Phone: (301) 270-5500

FOIA/PA REQUEST
Case No: 96-378
Date Rec'd: 9-24-96
Action Off: Pugh
Related Case:

September 20, 1996

Russell Powell, Branch Chief
Division of Freedom of Information and Publications Services
Office of Administration
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

SUBJECT: Freedom of Information Act Request

On behalf of the Institute for Energy and Environmental Research (IEER) and pursuant to the Freedom of Information Act, 5 U.S.C., Section 552 et. seq. (FOIA), I request the following documents:

All notes, calculations, background data, memoranda, correspondence, or reports that were considered or relied on in determining the solubility of transuranic waste ("TRU"), as reported in the following documents filed in the licensing proceeding for the Clairborne Enrichment Center, In the Matter of Louisiana Energy Services, L.P. (Clairborne Enrichment Center) Docket No. 70-3070:

a. Affidavit of Yawar H. Faraz (February 6,1995);

b. Letter from Eugene H. Holler, Counsel for NRC Staff, to Administrative Judges and enclosed revised Affidavit of Yawar H. Faraz (February 14, 1995).

Copies of these documents are attached. This request includes but is not limited to documentation of the NRC's calculations for the solubility of TRU in both reducing and oxidizing conditions. It also includes but is not limited to any documents that discuss the NRC staff's basis for changing its representation of TRU solubility from 1.6×10^{-10} Ci/m^3 to 5.2×10^{-1} Ci/m^3.

If, for any reason, you determine that any information in these documents is classified, privileged, or otherwise exempt under FOIA, please release all segregable nonexempt portions of the documents. In addition, please describe the reasons for withholding any information and the exemption which applies.

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Pursuant to 10 C.F.R. 9.41, IEER requests that the NRC waive the fees associated with this FOIA request, and provides the following information in response to the eight criteria listed in Section 9.41(b):

1) Purpose of request:
IEER has conducted extensive research on the production, testing and disposal of nuclear weapons and related materials. This request is part of ongoing work in this area. IEER is preparing a report on DOE's cleanup and waste management activities and we expect that our report will be very useful to the public and policymakers in improving these programs.

2) Extent to which IEER will extract and analyze the substantive content of the records:
As discussed above, the documents will be used in the evaluation of the DOE's cleanup and waste management activities. IEER will fully review and evaluate the documents that are provided.

3) Nature of the specific activity or research in which the records will be used and IEER's qualifications to utilize the information for the intended use in such a way that it will contribute to public understanding:
IEER will evaluate the records obtained to evaluate the adequacy and reasonableness of the DOE's activities in the management and cleanup of its nuclear legacy. IEER is a non-profit organization actively involved in the collection and dissemination of information relative to various safety, health and environmental issues. It is among the leading public interest organizations doing technical work in these areas, with the primary aim of informing the public.

4) Likely impact on the public's understanding of the subject as compared to the level of understanding of the subject prior to disclosure:
IEER's work is likely to contribute significantly to public understanding of the operations or activities of the government. Through various publications, IEER has demonstrated its ability to convey the requested information to other interested members of the public.

5) Size and nature of the public to whose understanding a contribution will be made:
The public affected by the requested disclosures includes residents in the immediate vicinity of DOE nuclear facilities, as well as the general public who have an interest in seeing that nuclear sites in this country are cleaned up adequately and economically.

6) Means of distribution of the requested information:
IEER has published six books in the last five years and also publishes two quarterly newsletters. The books and the newsletters are used in courses taught in universities in the United States and much of our work is published in other languages and used in other countries. IEER is registered as an educational institution with Teachers Insurance and Annuity Association--College Retirement Equities Fund. The requested documents will be distributed in similar fashion to IEER's previous work.

7) Whether free access to information will be provided:
Information will be provided to the public at no charge. There is no charge for our newsletters, and our reports that we do charge for are also available free by special request.

8) Commercial interest by IEER or any other party:
Because IEER is a non-profit, public interest organization, no commercial interest exists which would be furthered by disclosure of the information.

Thank you for your cooperation. As provided in the Freedom of Information Act, IEER will expect a reply to this request within ten (10) working days. If IEER does not receive a response within this time, IEER will treat this request as denied and will pursue the necessary appeal.

IEER will be pleased to work with you and your staff to explain or reformulate this request as necessary to comply with its terms.

Sincerely,

Marc Fioravanti
Staff Engineer

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. 70-3070-ML
	)	
(Claiborne Enrichment Center)	)	
	)	

AFFIDAVIT

I, Yawar H. Faraz, being duly sworn, do hereby state as follows:

1. I am employed by the U.S. Nuclear Regulatory Commission, Office of Nuclear Material Safety and Safeguards. My business address is:

Yawar H. Faraz
Division of Fuel Cycle Safety and Safeguards
Office of Nuclear Material Safety and Safeguards
U. S. Nuclear Regulatory Commission
Washington, D.C. 20555

2. I am currently assigned to serve as the Project Manager in the Enrichment Branch, Division of Fuel Cycle Safety and Safeguards, Office of Nuclear Material Safety and Safeguards for the staff of the Nuclear Regulatory Commission's (Staff's) review and processing of the application to construct and operate the Claiborne Enrichment Center, submitted by Louisiana Energy Services, L.P., to be located near Homer, Louisiana.

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3. I am certified in the comprehensive practice of health physics by the American Board of Health Physics and familiar with the regulations in 10 C.F.R. Part 61 and with the Staff's review of LES's decommissioning plan. A summary of my professional qualifications and experience is attached hereto and incorporated herein by reference.

4. I have reviewed "Citizens Against Nuclear Trash's Petition For Waiver of 10 C.F.R. § 61.55(a)(3) and 10 C.F.R. § 61.55(a)(6) And For Classification of Depleted Uranium Tails As Greater Than Class C Radioactive Waste," dated January 17, 1995.

5. The purpose of this affidavit is to explain differences between hazards associated with disposal of depleted uranium and TRU waste isotopes.

6. TRU waste, which is a waste type produced primarily in activities conducted by the Department of Energy (DOE), includes alpha emitting transuranic radionuclides with half-lives greater than 20 years, and concentrations greater than 100 nCi/g. Radioactive waste containing less than 100 nCi/g of TRU alpha contamination is classified and managed by DOE as low-level waste (LLW). Most TRU waste exists in solid form (e.g., items such as protective clothing, paper trash, rags, glass, miscellaneous tools, and equipment that have become contaminated with TRU radionuclides).

7. The potential hazards associated with disposal at the WIPP facility of DOE's retrievably stored TRU waste inventory as of 1992, are significantly higher than those for depleted uranium tails. The reasons are as follows:

7a. Inventory

For deep radioactive waste disposal facilities such as the one anticipated by the Staff for tails generated at the CEC and the WIPP facility, the primary mechanism by which an individual may be exposed to waste radionuclides in the absence of human intrusion is transport via groundwater to a well or stream down gradient from the disposal facility with subsequent ingestion of the well or stream water. Groundwater transport, to a large extent is dependant on the radionuclide inventory. Between 1970 and December 1992, DOE had placed in retrievable storage, approximately 106,000 m^3 of TRU waste in a variety of packaging (metal drums, wooden and metal boxes). This volume of TRU waste containing about 1,000,000 Ci of TRU activity, and newly generated TRU waste from defense-related activities, is destined to be disposed of at the Waste Isolation Pilot Plant (WIPP) which has been designed to emplace about 175,000 m^3 of waste material 650 meters below ground in a mined salt formation. Operation of the CEC at 1.5 million SWU per year for thirty years would result in the generation of about 30,000 m^3 of DU_3O_8 containing about 30,000 curies of uranium activity.

7b. Activity Concentration

The specific activity or the highest attainable uranium radiological concentration in pure DU_3O_8 is about 350 nCi/g. This activity concentration applies to separation cascade product and tails assays of 5.0 and 0.2 percent U-235, respectively. The cumulative radioactivity concentration of DOE's retrievably stored TRU waste at the end of calendar year 1992 was 17,500 nCi/cm^3. Disregarding the byproduct radionuclides contained in TRU waste, the average concentration of TRU radionuclides in retrievably stored TRU waste is more than 6,000 nCi/cm^3. Assuming a density of 2 g/cm^3 for the TRU waste (see Petition at 19) would result

in a TRU waste activity concentration which is about 10 times greater than the activity concentration of DU_3O_8. It should be noted that a significant fraction of the entire TRU volume of 106,000 m^3 containing Pu-238, Pu-239 and Am-241 will have concentrations much higher than the average of 6,000 nCi/cm^3. Theoretically, the concentration could be as high as the specific activities of the three radionuclides which range from $6.0x10^7$ to $1.7x10^{10}$ nCi/g.

7c. Internal Dose

Table 1 provides internal dose conversion factors for U-238, Pu-238, Pu-239 and Am-241.

Table 1. Internal Dose Conversion Factors

	EDE Inhalation Dose Factor (Sv/Bq)			EDE Ingestion Dose Factor (Sv/Bq)		
	Class D	Class W	Class Y	f_1=X	f_1=Y	f_1=Z
U238	6.62E-7	1.90E-6	3.20E-5	6.88E-8 (X=.05)	6.42E-9 (Y=.002)	
Pu238		1.06E-4	7.79E-5	8.65E-7 (X=.001)	9.08E-8 (Y=.0001)	1.34E-8 (Z=.00001)
Pu239		1.16E-4	8.33E-5	9.56E-7 (X=.001)	9.96E-8 (Y=.0001)	1.40E-8 (Z=.00001)
Am241		1.20E-4		9.84E-7 (X=.001)		

When comparing the equivalent inhalation and ingestion dose conversion factors of uranium with Pu-238, which constitutes about 44% of TRU waste inventory, Pu-239, which constitutes about 11% of TRU waste inventory, and Am-241, which constitutes about 9% of TRU waste inventory, it is apparent that for equivalent radiological intakes, Pu-238, Pu-239, or

Am-241 would result in significantly higher committed effective doses than for intake of uranium (from about a factor of 2 to about a factor of 200).

The primary pathway of concern in the environmental evaluation of properly sited, operated, and designed radioactive waste disposal facilities is transport of dissolved radionuclides in groundwater and ingestion of potentially contaminated surface water or groundwater. For near-surface facilities where groundwater conditions are expected to be oxidizing, uranium and TRU elements are likely to speciate as soluble complexes. As shown in the table above, for soluble forms, the ingestion dose conversion factors of the TRU radionuclides are more than an order of magnitude larger than the dose conversion factor of U-238. For deeper disposal facilities where groundwater conditions are reducing, uranium and TRU elements are expected to speciate as less soluble hydroxides. For these insoluble forms, the ingestion dose conversion factor of uranium is less than the ingestion dose conversion factors of the two plutonium isotopes by more than a factor of 2 and much less than the ingestion dose conversion factor of Am-241.

7d. Solubility

Release of radionuclides from a disposal facility is expected to involve dissolution in water percolating through the facility and transport in groundwater to potential human receptors. The dissolution process is dependent on the chemical composition and thermochemical properties (e.g., eH) of the groundwater. Minimization of energy which provides the driving force for the dissolution process is appropriately referenced to a mass rather than activity basis. As mentioned above, groundwater conditions in a near-surface disposal facility are expected to be oxidizing while conditions in a greater-depth disposal facility are expected to be reducing. This difference is of great significance for uranium whose solubility under reducing conditions could

be as much as three orders of magnitude lower than under oxidizing conditions. In addition, the solid/water distribution coefficient of uranium is expected to be increased under reducing conditions resulting in a slower rate of transport through the environment. The dependence of the solubility of TRU elements on oxidation-reduction state is not expected to be as large as that of uranium. In particular, americium solubility is expected to show little dependence on eH over normally observed ranges and plutonium solubility dependence on eH is expected to be less dramatic than that of uranium.

Based on similar data used and methodology applied in the determination of solubilities of uranium, thorium and radium in Appendix A of the Claiborne Enrichment Center FEIS (NUREG-1484), the solubilities of plutonium and americium were determined. Under the reducing conditions expected at a greater-depth disposal facility, the solubility on a mass basis of uranium is expected to be greater than the solubility of plutonium and considerably less than the solubility of americium. See Table 2. On an activity basis, the solubility of depleted uranium is expected to be less than the solubility of Pu-238, comparable to the solubility of Pu-239, and several orders of magnitude less than the solubility of Am-241. See Table 3. For reducing conditions which are expected to be prevalent for the disposal of DOE TRU waste and DU3O8, the representative solubility of TRU radionuclides (1.6×10^{-10} Ci/m^3) is about four times higher than the representative solubility for DU3O8 (4.3×10^{-11} Ci/m^3).

Table 2 CEC FEIS Elemental Solubilities, Mass Basis

Element	Solubility (g/m^3) Reducing Conditions[1]	Oxidizing Conditions[1]
Uranium	1.0×10^{-4}	3.5×10^{-1}
Plutonium	1.0×10^{-9}	1.0×10^{-9}
Americium	1.5×10^{-1}	1.5×10^{-1}

1 For reducing conditions, eH = -0.10 mV; for oxidizing conditions, eH = +0.05 mV

Table 3 CEC FEIS Solubilities, Activity Basis

Nuclide	Solubility (Ci/m^3) Reducing Conditions[1]	Oxidizing Conditions[1]
Depleted Uranium	4.3×10^{-11}	1.5×10^{-7}
DOE TRU	1.6×10^{-10}	1.6×10^{-10}
West Valley TRU	6.4×10^{-9}	6.4×10^{-9}
Pu-238	1.7×10^{-8}	1.7×10^{-8}
Pu-239	6.1×10^{-11}	6.1×10^{-11}
Am-241	5.2×10^{-1}	5.2×10^{-1}

1 For reducing conditions, eH = -0.10 mV; for oxidizing conditions, eH = +0.05 mV

7e. Other TRU Waste Characteristics

It is estimated that as much as 50 to 60% of TRU waste is mixed waste. In the plausible strategy proposed by LES, unlike for the anticipated disposal of waste at the WIPP facility, disposal of depleted uranium will not include concurrent disposal of hazardous waste and therefore, unlike as for TRU waste, strict RCRA permitting requirements would not be applicable.

If the direct radiation level at the surface of the package exceeds 200 mrem/h, the TRU waste package is classified as "remote handled" (RH). Otherwise the TRU waste package is classified as "contact handled" (CH). As of December 1992, DOE has designated about 2,000 m^3 of retrievably stored TRU waste as RH TRU waste. The relatively high direct radiation levels in TRU waste emanate in most part, from byproduct radionuclides such as Cs-137. The source of more than 40 percent of the radioactivity in CH TRU waste is a consequence of other than TRU radionuclides. In the case of RH TRU waste, this fraction exceeds 99 percent. The direct radiation level at the surface of a large volume of U_3O_8 will be significantly less than all RH TRU waste and a large fraction of CH TRU waste. To put the direct radiation hazard from depleted uranium in perspective, it is reasonable to note that at the surface of a 14 ton tails cylinder containing DUF_6, the direct radiation level is less than 2 mrem/hr. Also in the case of TRU waste, additional precautions may be warranted to limit inhalation doses to waste package handling workers since the higher radiological concentrations in conjunction with higher inhalation dose conversion factors could lead to comparatively higher doses. Therefore, for the disposal of TRU waste packages, more stringent packaging, transportation and handling practices

from the standpoint of radiation safety and additional engineered features such as shielding are expected to be instituted.

8. In conclusion, on the basis of these considerations, the Staff submits that DU is not like GTCC-TRU in the potential hazards associated with disposal of the two materials.

9. The information set forth above is true and correct to the best of my knowledge and belief.

Yawar H. Faraz

Yawar H. Faraz

Sworn and subscribed to before
me this 6th day of February 1995.

Notary Public

My commission expires: 12/1/97

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

OFFICE OF THE
GENERAL COUNSEL

February 14, 1995

Thomas S. Moore, Chairman
Administrative Judge
Atomic Safety and Licensing
Board
U.S. Nuclear Regulatory
Commission
Washington, D.C. 20555

Richard F. Cole
Administrative Judge
Atomic Safety and Licensing
Board
U.S. Nuclear Regulatory
Commission
Washington, D.C. 20555

Frederick J. Shon
Administrative Judge
Atomic Safety and Licensing Board
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

In the Matter of
LOUISIANA ENERGY SERVICES, L.P.
(Claiborne Enrichment Center)
Docket No. 70-3070-ML

Dear Administrative Judges:

It has come to my attention that there are certain factual errors in the "NRC Staff Response In Opposition to Citizens Against Nuclear Trash's Petition For Waiver of 10 C.F.R. § 61.55(a)(3) and 10 C.F.R. § 61.55(a)(6) And For Classification of Depleted Uranium Tails As Greater Than Class C Radioactive Waste," dated February 6, 1995,(Staff February 6, 1995 Response) and affidavit of Yawar H. Faraz attached thereto that require correction. Pursuant to the enclosed February 13, 1995 affidavit (with corrected pages for his February 6, 1995 affidavit attached thereto) of Yawar H. Faraz, the Staff February 6, 1995 Response should be corrected as follows:

Page 8, second full paragraph:

> Mr. Faraz's affidavit at ¶7 details the reasons for this difference in potential hazards between DU and TRU. The radioactive inventory of TRU radionuclides in waste destined for the Waste Isolation Pilot Program (WIPP) facility is ~~about 50~~ more than 30 times the amount of radioactive uranium to be generated at the CEC. Also, the activity concentration of TRU radionuclides in waste destined for the WIPP facility is about ten times the uranium activity concentration in depleted U3O8. The internal dose from a unit radiological intake via the ingestion or inhalation pathway of the most commonly

occurring long-lived TRU radionuclides is 2 to ~~200~~ 150 times higher than uranium. Regarding solubility, on an activity basis, and for reducing conditions which are expected to be prevalent for the disposal of TRU waste and depleted U3O8, the representative solubility of TRU radionuclides (~~1.6×10^{-10}~~ 5.2×10^{-1} Ci/m^3) is about ~~four times~~ ten orders of magnitude higher than the representative solubility for depleted U3O8 (4.3×10^{-11} Ci/m^3). A higher solubility would result in greater dissolution in groundwater and therefore a higher leach rate of radioactivity from the waste. Further, more than half of the retrievably stored TRU waste is classified as mixed waste whereas disposal of tails in the form of depleted U3O8 ... .

A corrected page 8 for the Staff February 6, 1995 Response is attached hereto. The Staff regrets any inconvenience that this may have caused the Licensing Board and parties.

Sincerely,

Eugene Holler
Counsel for NRC Staff

Enclosure and attachments: As stated

cc: Service List

Further, as a basis for its argument that improper classification of DU will defeat the purpose of Part 61 and 10 C.F.R. § 70.25, CANT asserts that DU is comparable to greater than class C-transuranic (GTCC-TRU) waste. Petition at 15. CANT's characterization of DU as GTCC-TRU waste is not technically sound. As explained in the attached affidavit of Mr. Yawar H. Faraz, (Affidavit) there are significant differences between the hazards associated with the disposal of DU and TRU. The potential hazards associated with disposal of TRU waste are significantly higher than those for DU tails.

Mr. Faraz's affidavit at ¶7 details the reasons for this difference in potential hazards between DU and TRU. The radioactive inventory of TRU radionuclides in waste destined for the Waste Isolation Pilot Program (WIPP) facility is more than 30 times the amount of radioactive uranium to be generated at the CEC. Also, the activity concentration of TRU radionuclides in waste destined for the WIPP facility is about ten times the uranium activity concentration in depleted U3O8. The internal dose from a unit radiological intake via the ingestion or inhalation pathway of the most commonly occurring long-lived TRU radionuclides is 2 to 150 times higher than uranium. Regarding solubility, on an activity basis, and for reducing conditions which are expected to be prevalent for the disposal of TRU waste and depleted U3O8, the representative solubility of TRU radionuclides (5.2×10^{-1} Ci/m^3) is about ten orders of magnitude higher than the representative solubility for depleted U3O8 (4.3×10^{-11} Ci/m^3). A higher solubility would result in greater dissolution in groundwater and therefore a higher leach rate of radioactivity from the waste. Further, more than half of the retrievably stored TRU waste is classified as mixed waste whereas disposal of tails in the form of depleted U3O8

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. 70-3070-ML
	)	
(Claiborne Enrichment Center)	)	
	)	

AFFIDAVIT

I, Yawar H. Faraz, being duly sworn, do hereby state as follows:

1. I am employed by the U.S. Nuclear Regulatory Commission, Office of Nuclear Material Safety and Safeguards. My business address is:

Yawar H. Faraz
Division of Fuel Cycle Safety and Safeguards
Office of Nuclear Material Safety and Safeguards
U. S. Nuclear Regulatory Commission
Washington, D.C. 20555

2. On February 6, 1995, I provided an affidavit explaining the differences between hazards associated with disposal of depleted uranium and transuranic (TRU) waste isotopes which the staff of the Nuclear Regulatory Commission (Staff) submitted as part of the "NRC Staff Response in Opposition to Citizens Against Nuclear Trash's Petition For Waiver of 10 C.F.R. § 61.55(a)(3) and 10 C.F.R. § 61.55(a)(6) And For Classification of Depleted Uranium Tails As Greater Than Class C Radioactive Waste," dated February 6, 1995.

3. The purpose of this affidavit is to correct several errors in my February 6, 1995 affidavit.

4. On page 5 of my February 6, 1995 affidavit, the second line should be corrected:

" ... (from about a factor of 2 to about a factor of ~~200~~ 150)."

5. On page 6 of my February 6, 1995 affidavit, the last sentence on the page should be corrected:

For reducing conditions which are expected to be prevalent for the disposal of DOE TRU waste and DU3O8, the representative solubility of TRU radionuclides (~~1.6x10^{-10}~~ 5.2x10^{-1} Ci/m^3) is about ~~four times~~ ten orders of magnitude higher than the representative solubility for DU3O8 (4.3x10^{-11} Ci/m^3).

6. On page 6 of my February 6, 1995 affidavit, Table 3 should be corrected:

Table 3 CEC FEIS Solubilities, Activity Basis

Nuclide	Solubility (Ci/m^3) Reducing Conditions[1]	Oxidizing Conditions[1]
Depleted Uranium	4.3x10^{-11}	1.5x10^{-7}
DOE TRU	~~1.6x10^{-10}~~5.2x10^{-1}	~~1.6x10^{-10}~~5.2x10^{-1}
West Valley TRU	~~1.6x10^{-10}~~5.2x10^{-1}	~~1.6x10^{-10}~~5.2x10^{-1}
Pu-238	1.7x10^{-8}	1.7x10^{-8}
Pu-239	6.1x10^{-11}	6.1x10^{-11}
Am-241	5.2x10^{-1}	5.2x10^{-1}

1 For reducing conditions, eH=-0.10 mV; for oxidizing conditions, eH=+0.05 mV

7. The information presented in paragraph 7a of my February 6, 1995 affidavit indicates that the radioactive inventory of TRU radionuclides in waste destined for the Waste Isolation Pilot Program (WIPP) facility is more than 30 times the amount of radioactive uranium to be generated at the CEC rather than "about 50 times" as stated in the "NRC Staff Response in Opposition to Citizens Against Nuclear Trash's Petition For Waiver of 10 C.F.R. § 61.55(a)(3) and 10 C.F.R. § 61.55(a)(6) And For Classification of Depleted Uranium Tails As Greater Than Class C Radioactive Waste," dated February 6, 1995 at page 8.

8. Copies of corrected pages 5, 6, and 7 of my February 6, 1995 affidavit are attached hereto.

9. The information set forth above is true and correct to the best of my knowledge and belief.

Yawar H. Faraz

Yawar H. Faraz

Sworn and subscribed to before
me this 14th day of February 1995.

Virginia Lee Thayer

Notary Public

My commission expires: 2/95

Am-241 would result in significantly higher committed effective doses than for intake of uranium (from about a factor of 2 to about a factor of 150).

The primary pathway of concern in the environmental evaluation of properly sited, operated, and designed radioactive waste disposal facilities is transport of dissolved radionuclides in groundwater and ingestion of potentially contaminated surface water or groundwater. For near-surface facilities where groundwater conditions are expected to be oxidizing, uranium and TRU elements are likely to speciate as soluble complexes. As shown in the table above, for soluble forms, the ingestion dose conversion factors of the TRU radionuclides are more than an order of magnitude larger than the dose conversion factor of U-238. For deeper disposal facilities where groundwater conditions are reducing, uranium and TRU elements are expected to speciate as less soluble hydroxides. For these insoluble forms, the ingestion dose conversion factor of uranium is less than the ingestion dose conversion factors of the two plutonium isotopes by more than a factor of 2 and much less than the ingestion dose conversion factor of Am-241.

7d. Solubility

Release of radionuclides from a disposal facility is expected to involve dissolution in water percolating through the facility and transport in groundwater to potential human receptors. The dissolution process is dependent on the chemical composition and thermochemical properties (e.g., eH) of the groundwater. Minimization of energy which provides the driving force for the dissolution process is appropriately referenced to a mass rather than activity basis. As mentioned above, groundwater conditions in a near-surface disposal facility are expected to be oxidizing while conditions in a greater-depth disposal facility are expected to be reducing. This difference is of great significance for uranium whose solubility under reducing conditions could

be as much as three orders of magnitude lower than under oxidizing conditions. In addition, the solid/water distribution coefficient of uranium is expected to be increased under reducing conditions resulting in a slower rate of transport through the environment. The dependence of the solubility of TRU elements on oxidation-reduction state is not expected to be as large as that of uranium. In particular, americium solubility is expected to show little dependence on eH over normally observed ranges and plutonium solubility dependence on eH is expected to be less dramatic than that of uranium.

Based on similar data used and methodology applied in the determination of solubilities of uranium, thorium and radium in Appendix A of the Claiborne Enrichment Center FEIS (NUREG-1484), the solubilities of plutonium and americium were determined. Under the reducing conditions expected at a greater-depth disposal facility, the solubility on a mass basis of uranium is expected to be greater than the solubility of plutonium and considerably less than the solubility of americium. See Table 2. On an activity basis, the solubility of depleted uranium is expected to be less than the solubility of Pu-238, comparable to the solubility of Pu-239, and several orders of magnitude less than the solubility of Am-241. See Table 3. For reducing conditions which are expected to be prevalent for the disposal of DOE TRU waste and DU3O8, the representative solubility of TRU radionuclides (5.2×10^{-1} Ci/m^3) is about ten orders of magnitude higher than the representative solubility for DU3O8 (4.3×10^{-11} Ci/m^3).

Table 2 CEC FEIS Elemental Solubilities, Mass Basis

Element	Solubility (g/m^3) Reducing Conditions[1]	Oxidizing Conditions[1]
Uranium	$1.0x10^{-4}$	$3.5x10^{-1}$
Plutonium	$1.0x10^{-9}$	$1.0x10^{-9}$
Americium	$1.5x10^{-1}$	$1.5x10^{-1}$

1 For reducing conditions, eH=-0.10 mV; for oxidizing conditions, eH=+0.05 mV

Table 3 CEC FEIS Solubilities, Activity Basis

Nuclide	Solubility (Ci/m^3) Reducing Conditions[1]	Oxidizing Conditions[1]
Depleted Uranium	$4.3x10^{-11}$	$1.5x10^{-7}$
DOE TRU	$5.2x10^{-1}$	$5.2x10^{-1}$
West Valley TRU	$5.2x10^{-1}$	$5.2x10^{-1}$
Pu-238	$1.7x10^{-8}$	$1.7x10^{-8}$
Pu-239	$6.1x10^{-11}$	$6.1x10^{-11}$
Am-241	$5.2x10^{-1}$	$5.2x10^{-1}$

1 For reducing conditions, eH=-0.10 mV; for oxidizing conditions, eH=+0.05 mV

Corrected 2/14/95