NUREG-0170
VOL. 2

FINAL ENVIRONMENTAL STATEMENT ON THE TRANSPORTATION OF RADIOACTIVE MATERIAL BY AIR AND OTHER MODES

Docket No. PR-71, 73 (40 FR 23768)

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CHAPTER 8
COMMENTS ON NUREG-0034 AND MAJOR CHANGES THAT HAVE OCCURRED SINCE NUREG-0034 WAS ISSUED

8.1 INTRODUCTION

The purpose of this chapter is twofold: (1) to provide a brief outline of the major changes made since the issuance of the draft version of this report (NUREG-0034), most of which were in response to comments received during the public review period and (2) to give detailed responses to each of these comments. A list of all comments received is given in Appendix J.

8.2 MAJOR CHANGES SINCE NUREG-0034 WAS ISSUED

Major changes in the Draft Environmental Statement were made both in response to certain public comments and as a result of new information. The purpose of this section is to outline these changes, both editorial and technical, and to discuss briefly the impact of these changes on the overall results. The changes are listed chapter by chapter. Items that affect the results are marked with an asterisk and are discussed in more detail in Section 8.3.

8.2.1 CHANGES IN CHAPTER I (INTRODUCTION)

*1. Data from the recently issued 1975 Radioactive Material Shippers Survey are now included and form the basis of the standard shipments model.

2. A section on experience with radioactive material transportation has been added.

3. The discussion from Chapter III of NUREG-0034 on radioisotope uses has been rated into Chapter 1.

4. Figure I-2 (HTGR fuel cycle diagram) has been deleted.

5. Table I-1 (Radioisotope Shipment Summary - July 1, 1975) and Table I-2 (Standard Shipments for the Nuclear Industry) of NUREG-0034 have been replaced by a summary of the standard shipment model information from Appendix A.

6. Table I-3 (Radioactive Material Shipments) of NUREG-0034 has been expanded to include packages per year, TI per year, curies per year, miles per year, and the expected number of latent cancers per year computed in this assessment and incorporated into Table 1-2.

7. The discussion in NUREG-0034 of the fault-tree/logic-model approach has been eliminated.

8.2.2 CHANGES IN CHAPTER II (THE REGULATIONS GOVERNING RADIOACTIVE MATERIALS TRANSPORT)

1. The consolidation of the DOT regulations into Title 49 of the Code of Federal Regulations has been incorporated.

2. "Exempt" quantities are now referred to as "limited" quantities.

3. Miscellaneous errors in Table II-5 of NUREG-0034 have been corrected.

8.2.3 CHANGES IN CHAPTER III (RADIOLOGICAL EFFECTS)

1. The concept of RBE is explained more fully.

2. Table III-1 of NUREG-0034 has been expanded.

3. The discussion in NUREG-0034 of background radiation has been significantly expanded.

*4. The discussion in NUREG-0034 of hazards of radiation has been subdivided into three separate sections: acute effects, carcinogenesis, and genetic effects. Genetic effects are now quantitatively discussed.

5. A discussion of sensitivities of other life forms to radiation has been added.

6. The section in NUREG-0034 on radiological properties of transported radionuclides has been eliminated. Certain selected sections of that discussion have been incorporated into Chapter 1.

7. Table III-8 of NUREG-0034 has been deleted. Selected values have been incorporated into Appendix A.

8. Figure III-3 of NUREG-0034 has been revised to incorporate new data concerning early effects of inhaled, long-lived, alpha-emitting isotopes.

8.2.4 CHANGES IN CHAPTER IV (TRANSPORT IMPACT UNDER NORMAL CONDITIONS)

1. References and figures in NUREG-0034 concerning the original fault-tree/logic-model methodology have been deleted.

2. Figure IV-1 has been redrawn.

*3. The normal dose calculations are based on the new standard shipments model.

*4. Some aspects of the computational scheme used to determine normal dose have been changed. The entire scheme is discussed in Appendix D (replacing Appendix E of NUREG-0034).

*5. Discussions of maximum individual dose have been added for each population subgroup.

*6. A revised demographic model has been incorporated and is explained in Appendix E.

7. The section on nonradiological impacts has been rewritten.

8. The section on abnormal occurrences has been expanded.

*9. A section on import and export shipments has been added.

*10. Results of the genetic effects analysis have been added.

8.2.5 CHANGES IN CHAPTER V (EFFECTS OF TRANSPORT UNDER ACCIDENT CONDITIONS)

1. The title of the chapter has been changed to "Impacts of Transportation Accidents."

2. The chapter has been reorganized into what is felt to be a more logical sequence.

3. The explanation of the concept of "risk" has been expanded.

4. All equations in NUREG-0034 have been deleted from the text and placed in Appendix G, where they are explained.

5. Figure V-1 has been revised and expanded.

6. The logic model figures in NUREG-0034 have been deleted.

*7. The computations are based on the new standard shipments model.

*8. The new demographic model has been incorporated into the calculations.

*9. The severity derating scheme for aircraft accidents on real surfaces has been revised, and a description of the derating is given in Appendix H.

*10. The overall accident rate for aircraft has been revised to incorporate a newer and more substantial data base.

11. The Integrated Container Vehicle has been added as the primary mode for transport of recycle plutonium in 1985.

*12. The values for fractions of accidents occurring in various population zones for trains have been modified.

13. A section on waterborne transport (barge and ship) has been added.

*14. The release fraction model has been modified based on recent test data. Three additional sets of release fractions are used; for Type B plutonium containers, one release fraction

set for 1975 Pu containers has been introduced and one for 1985 Pu containers. A second release fraction model has been introduced for casks.

*15. The atmospheric dispersion model has been modified to include dry deposition and resuspension. In connection with this, a section on surface contamination has been added.

*16. The "worst case" analysis has been expanded to include other materials. Both consequences and probabilities are presented for category VIII accidents involving these materials in an urban area with a population density of 15,400/km^2.

17. Figures V-10, -11, -12, and -13 and Tables V-8, -9, -10, and -11 of NUREG-0034 have been deleted.

*18. The dose calculations (both early and long-term) are no longer based on Pu-239 dosimetry. The new dose calculation methodology is discussed in Appendix G, and the parameters used are given in Appendix A.

*19. The method used to compute early fatality probability has been revised and is explained in Appendix G.

*20. Results of the genetic effects analysis have been added.

8.2.6 CHANGES IN CHAPTER VI (ALTERNATIVES)

*1. The following alternatives are no longer considered: all cargo-only air shipments shifted to passenger aircraft, VFR-only flights, daytime-only flights, specific aircraft model requirements.

*2. The following alternatives have been added: a 0.5-mrem/hr maximum dose at seat level in passenger aircraft, all feasible irradiated fuel shipments by barge, and aircraft package monitoring. The discussion of the alternative to restrict irradiated fuel shipments to special trains has been revised and expanded.

*3. The alternatives evaluated for plutonium only in NUREG-0034 are now evaluated for all "high-hazard dispersible" materials. (These are defined in Section 6.2.4.)

4. Only the alternatives that were found to be cost effective are now included in the summary at the end of the chapter.

8.2.7 CHANGES IN CHAPTER VII (SECURITY AND SAFEGUARDS)

1. A section discussing the potentials for misuse of SNM and radioactive isotopes and waste has been added.

2. The section on "Transportation Security Systems" has been revised to contain an assessment of current physical protection measures. It has been renamed "Physical Protection of Highly Enriched Uranium and Plutonium During Transit."

3. An Alternatives section has been added. This section consists of a discussion of the Federal Guard Force, the ERDA Transport System, the Department of Defense, protection against a higher level threat, and restricting transport (of SNM) to a particular mode.

8.2.8 CHANGES IN APPENDIX A (ENVIRONMENTAL IMPACT LOGIC MODEL)

1. Appendix A of NUREG-0034 has been deleted.

8.2.9 CHANGES IN APPENDIX B (PLUTONIUM)

1. Appendix B of NUREG-0034 is now Appendix C.

2. Figure B-1 of NUREG-0034 has been deleted.

*3. Tables B-1 and B-2 of NUREG-0034 have been revised and expanded to include dosimetric effects.

4. A figure showing deposition fractions versus particle size has been added.

5. A section on genetic effects has been added.

6. The section on toxicity has been revised and expanded.

8.2.10 CHANGES IN APPENDIX C (INCIDENTS REPORTED TO DOT INVOLVING RADIOACTIVE MATERIALS)

1. Appendix C of NUREG-0034 is now Appendix F.

2. An introductory section has been added.

3. A figure showing the Incident Report form has been added.

8.2.11 CHANGES IN APPENDIX D (REGULATIONS)

1. Appendix D of NUREG-0034 is now Appendix B. No further changes were made.

8.2.12 CHANGES IN APPENDIX E (POPULATION DOSE FORMULAS FOR NORMAL TRANSPORT)

1. Appendix E of NUREG-0034 is now Appendix D.

*2. The methodology used to compute dose to crew, dose to surrounding population while moving, dose to population on the transport link, and dose while stopped has been revised. The revised equations were derived from first principles.

8.2.13 CHANGES IN APPENDIX F (PRODUCTION OF A NUCLEAR EXPLOSION BY AMATEURS)

1. Appendix F of NUREG-0034 has been deleted.

8.2.14 CHANGES IN APPENDIX G (SENSITIVITY ANALYSIS)

1. Appendix G of NUREG-0034 is now Appendix I.

2. The method used to analyze the sensitivities of the radiological risks to the parameters used in their determination has been revised.

8.2.15 CHANGES IN APPENDIX H (STATE AND LOCAL REGULATORY AGENCIES)

1. Appendix H of NUREG-0034 has been deleted.

8.2.16 NEW CHAPTERS AND APPENDICES

1. Chapter 8 has been added. This chapter discusses changes that have been incorporated since the draft version was published and addresses public comments in detail.

2. Appendix A has been added. This appendix discusses the development of the Standard Shipments Model used for the risk analysis in Chapters 4, 5, and 6.

3. Appendix E has been added. This appendix discusses the demographic model used in Chapters 4, 5, and 6.

4. Appendix G has been added. This appendix specifies the calculational scheme used for the accident calculations in Chapters 5 and 6.

5. Appendix H has been added. This appendix discusses the aircraft accident derating model introduced in Chapter 5.

6. Appendix J has been added. This appendix consists of copies of each of the comments received by NRC during the public review period.

7. Appendix K has been added. This appendix consists of copies of the comments received after a February 1977 meeting of the Working Group on Transportation of the Advisory Committee on Reactor Safeguards at which the February 1977 draft FES was discussed.

8.3 MAJOR CHANGES THAT HAVE RESULTED IN CHANGES IN CONCLUSIONS/ANALYSIS SINCE NUREG-0034

1. The incorporation of the shipment data from the 1975 shippers survey increased the number of packages by a factor of 4, the number of curies by a factor of 100, and the number of TI by a factor of 16. The net effect produced by these and the analysis changes was an increase in the annual normal LCF by a factor of 1.02 and in the annual accident LCF by a factor of 8.4.

2. The incorporation of the new demographic model changed population densities as follows:

	Population Density (km^{-2})	
	NUREG-0034 (Draft)	NUREG-0170
Rural	40	6
Suburban	400	719
Urban	4000	3861

3. The relative contributions of the various population subgroups to the normal risk differ from those in the Draft as a result of both the new standard shipments model and the new method of computing the normal dose, as outlined in Appendix D. The changes are evident in the following table:

Population Subgroup	Percent Contribution to Normal Risk	
	NUREG-0034 (Draft)	NUREG-0170
Passengers	9.03	23.8
Crew	0.88	32.1
Attendants	0.56	1.1
Handlers	6.1	17.8
Off-link	55.0	4.3
On-link	1.4	4.0
Stops	14.9	11.1
Storage	12.0	5.8

4. Estimates of maximum individual dose are included in Chapter 4 in an attempt to add additional perspective on the normal impact of radioactive material transport.

5. Export and import shipments were analyzed explicitly and were found to make only a small contribution to the total risk.

6. The results of the revised real-surface derating scheme for aircraft are compared below with that used in NUREG-0034:

Accident Severity Category	Fraction of Real-Surface Accidents of a Given Severity	
	NUREG-0034	NUREG-0170
I	0.57	0.447
II	0.16	0.447
III	0.099	0.0434
IV	0.077	0.0107
V	0.033	0.0279
VI	0.036	0.0194
VII	0.022	0.0046
VIII	0.003	0.0003

7. The aircraft accident rate in NUREG-0034 was 5.6×10^{-8} per mile for cargo aircraft and 1.8×10^{-8} per mile for passenger aircraft. The value used in this assessment is 2.3×10^{-8} per mile for all air modes.

8. The fraction of train accidents occurring in each population zone are revised as follows:

Accident Severity Category	NUREG-0034			NUREG-0170		
	Urban	Sub.	Rural	Urban	Sub.	Rural
I	0.1	0.45	0.45	0.8	0.1	0.1
II	0.1	0.45	0.45	0.8	0.1	0.1
III	0.1	0.45	0.45	0.3	0.4	0.3
IV	0.1	0.45	0.45	0.3	0.4	0.3
V	0.1	0.45	0.45	0.2	0.3	0.5
VI	0.1	0.45	0.45	0.1	0.2	0.7
VII	0.1	0.45	0.45	0.1	0.1	0.8
VIII	0.1	0.45	0.45	0.05	0.05	0.9

9. The values for release fractions for Type A and Type B packagings (not used for shipping plutonium) have been revised as indicated below:

Accident Severity Category	Type A Package		Type B Package	
	NUREG-0034	NUREG-0170	NUREG-0034	NUREG-0170
I	0	0	0	0
II	0	0.01	0	0
III	0	0.1	0	0.01
IV	0	1.0	0	0.1
V	0.1	1.0	0	1.0
VI	0.2	1.0	0	1.0
VII	0.5	1.0	0.1	1.0
VIII	1.0	1.0	0.5	1.0

In this assessment the containers are conservatively assumed to begin to fail just above the severity at which they were tested.

10. Three additional packaging categories, B-Pu-1975, B-Pu-1985, and Cask have been added. The release fractions for Type B-Pu containers reflect recent test data for plutonium shipping containers and apply only to plutonium shipments. The cask data allows for cracking of a massive cask with subsequent direct exposure hazards.

11. The atmospheric dispersion model was revised to consider dry deposition and to restrict upward diffusion of the debris cloud to 1400 meters. The net effect of this revision is to reduce the downwind concentrations of the transported material that is available for inhalation.

12. The dose calculations were modified to allow for dose resulting from the resuspension of deposited material.

13. An extreme urban population density of 15,444 persons/km^2 based on New York City census information was used in assessing the consequences of certain class VIII accidents in urban areas.

14. The dose calculations are now based on a standard dosimetric model, not on Pu-239 data. The dosimetric calculations are explained in Appendices A, D, and G.

15. The dose-probability calculation for early fatalities has been changed. The derivation of the equations used in the revised calculation is presented in Appendix G.

16. The combination of the revised standard shipments model and revised release fractions, aircraft accident rates, real-surface deratings (particularly classes VII and VIII), meteorology, dosimetry, population densities, etc., resulted in an increase in the overall accident LCF by a factor of 8.5 and a decrease in the accident LCF resulting from plutonium shipments by a factor of 8.4. The greatest contributions to the accident LCF are made by Po-210 and mixed fission/corrosion product shipments, each contributing approximately one-fourth of the total. Plutonium shipments account for about 15% of the total accident LCF. This result is significantly different from that of the draft version of this document, in which it appeared that plutonium shipments completely dominated the accident risk.

17. Because the shipments of plutonium do not dominate the accident risk as in NUREG-0034, shipments of all "high-hazard, dispersible" materials, including plutonium, are considered for the various alternatives that previously considered only plutonium. The criteria used to determine which dispersible material shipments are to be considered "high-hazard" are a rem-per-curie inhaled value greater than 10^6 and a quantity per shipment greater than 100 curies.

8.4 DISCUSSION OF COMMENTS RECEIVED DURING PUBLIC RESPONSE PERIOD

NUREG-0034 was issued in March 1976, and a public comment period ending May 17, 1976, was provided. Comments received during that period are compiled and presented in their entirety in Appendix J to this document. This section addresses each of the comments received individually. In order to make the reader's task easier, each comment is presented, followed by the staff response to that comment.

General Comments: 1

City of New York - Comment 1

"The rule-making proceeding to which this DES is addressed arises from a nationwide expansion of the nuclear material transportation program. However, even if the DES at issue were adequate (as it is not) as a generic environmental statement, if the rules purport to apply to transportation within and through New York City, there must be an additional DES prepared for shipments in and through New York City."

State of Georgia - Comment 7

"In addition to the general considerations of transportation of nuclear materials throughout the United States, specific consideration must also be addressed with regard to large metropolitan areas such as Atlanta, ports of entry, and other large transportation centers. NRC has a definite and specific responsibility in the development and application of proper procedures for the transportation of nuclear materials through such areas in order to insure the complete protection of the citizens of the area. Such procedures must be useable and acceptable by the States that are impacted."

State of Georgia - Comment 5

"In general, the EIS is too general and non-specific to be of much use as a planning tool for specific areas. As was stated in above, NRC has the obligation and responsibility to issue a report that is useable by the States."

Staff Response - The annual risk estimates in this report are made using average population density values of 3861, 719, and 6 persons per square kilometer, respectively, for urban, suburban, and rural areas. Appendix E shows that only 18 cities in the United States have population densities exceeding 3861 persons per square kilometer, including New York City, which in the 1970 census had an average urban density of 15,444 persons per square kilometer. This higher population density was used in the evaluation of severe accident consequences in Section 5.6 of this report. Since average urban population density is used in the risk analysis, the risk to individual urban areas is included in the total risk assessed.

General Comments: 2

ERDA - General Comment 1

"This document contains much pertinent information relative to NRC and the Department of Transportation regulations for the shipment of fissile and other radioactive material and reflects considerable work in summarizing information concerning personnel exposure limits and radiological effects. However, it was difficult to verify results presented due to incomplete discussion of the material in the text. Although we are familiar with the subject and the associated technology, we found the organization of the statement somewhat difficult to understand.

We would like to suggest that you may wish to revise the organization of the statement for better continuity."

State of Georgia - Comment 1

"The draft EIS deals with the transportation of all types of radioactive materials, including pharmaceutical as well as spent fuel. It is broad, general, and non-specific. Because of the way it is organized and presented, it is practically impossible to sort out the real issues and impacts associated with an area of prime interest such as the transportation of spent fuel. The NRC should separate out the issue of spent fuel and do a separate detailed and factual EIS on its transportation aspects."

Staff Response - The general discussion in Chapters 4 and 5 has been expanded, and more detailed derivations have been provided in Appendices D and G. It is hoped that these clarifications and reorganizations will enable the reader to extract the desired information. In all cases, impacts due to shipment of irradiated fuel are specifically delineated.

General Comments: 3

ERDA - General Comment 4

"Our staff also strongly recommends that a more thorough evaluation be given to the need for decontamination after an accident involving rupture of containment. The ingestion pathway discussed in Appendix A should be carefully evaluated for the radionuclides which may cause special problems."

Staff Response - Section 5.5 on contamination/decontamination has been added to Chapter 5. Ingestion problems are discussed in that section.

General Comments: 4

ERDA - General Comment 3

"Because of the subject matter of this statement, we would suggest that a glossary be added at the beginning of the statement. Some examples are transport index, half-life, effective half-life, latent cancer fatality, competent authority certification, and others. We feel that such an addition would be quite helpful to all readers. Furthermore, NRC might wish to consider the use of photographs in the statement to also assist the reader."

Staff Response - In view of the extensive references to source documents that include photographs and explanations of terms, neither photographs nor a glossary have been added to this document.

General Comments: 5

City of New York - Comment 4

"The DES purports to review a 30-year program but fails to include increases in nuclear shipments beyond 1985. Nor is there adequate basis for the DES's forecast of a 250% increase of shipments."

Staff Response - The DES does not "purport to review a 30-year program." The 30-year period mentioned on page ii refers only to the period during which cancers induced in 1975 would prove fatal. The basis for the projections to 1985 is discussed in Appendix A.

General Comments: 6

Mrs. Virginia Karstedt - Comment 3

"You are badly in need, it seems to me, of more current data. I ran an average of the dates for all references listed at ends of chapters. The average age of your data is 4 years. Some of your references date back to 1958. Yet you went ahead and published your draft without fresh material. It's just a rehash of old studies."

Staff Response - The technique to "average the dates of all references" to gauge the applicability of the references is totally invalid. The 1958 reference cited was used in an historical background section and is considered to be a standard reference. Current data from ongoing studies were used where available and applicable. This document is not a "rehash of old studies," since no generic transportation study of this sort has been issued previously. Data from many sources have been compiled for the report and each datum was carefully reviewed for validity and applicability before it was included.

General Comments: 7

City of New York - Comment 5a

"While the DES purports to be evaluating certain existing regulations, there is no attempt to deal with the critical issue of compliance with, and enforcement of those regulations. The NRC, in the course of its purportedly close supervision over shipments of nuclear materials, appears to have no accurate idea of how many shipments are made per year, where they go, by what route they go and to what extent their transport is in accord with applicable law. We submit that no proper assessment of the environmental impact of the nuclear transportation program can be made in the absence of both accurate data and an evaluation of the extent to which existing rules and regulations in fact achieve their purpose."

State of New York - Dept. of Environmental Conservation - General Comment 8

"Information should be added to the Draft Statement that clearly establishes the level of enforcement action being undertaken by the U.S. Department of Transportation, the Nuclear

Regulatory Commission and various states in connection with the transportation of radioactive materials. This information should include tabular material about the number of inspections relating to radioactive materials that have been undertaken and the type and number of enforcement actions that have been taken in connection with radioactive materials during the last five years. There should also be an indication of the number of inspections that are scheduled during the coming year."

State of New York - Dept. of Environmental Conservation - General Comment 24

"It is recommended that the environmental statement be expanded to include Federal monies expended, (1) in the development of regulations and (2) in the enforcement of regulations followed by a discussion as to the optimal amount of money that should be expended to effectively minimize the hazard to the Public from the transportation of radioactive materials."

Staff Response - The goal of the DES was to evaluate the environmental impact resulting from the shipment of radioactive materials. The data used were obtained by NRC in the course of its regulatory function as well as from other reliable sources. Compliance with regulations has been assumed in calculation of the impacts, with a conservative estimate made for the additional impact brought about by a level of noncompliance estimated from a limited amount of bad experience. Recent studies have shown relatively good compliance with those regulations directly affecting radiological impacts.

The costs involved with the inspection and regulation programs are not germane to this statement since the aim is to establish the extent of the environmental impact and the changes that would be realized for various alternative actions. The costs involved in regulation would be more appropriately included in the analyses associated with specific regulation changes resulting from this statement.

General Comments: 8

HEW - Comment 1

"We note that the June 1975 public comments on the proposed rulemaking concerning air transportation of radioactive materials are not included in the draft document."

Staff Response - Those comments are for consideration in the rule making portion of the proceedings, not the impact assessment portion.

General Comments: 9

State of New York - Dept. of Environmental Conservation - General Comment 4

"The draft statement should reference and thoroughly discuss the safety analyses performed for the development of spent fuel shipping containers and the accident parameters used to develop safety analyses."

Staff Response - The regulatory design criteria, including the Type B package accident parameters, are specified in 10 CFR Part 71. A reference to 10 CFR Part 71 in this context is included in Section 2.3 of the Final Statement.

General Comments: 10

State of Georgia - Comment 3

"With reference to accident analysis, the EIS seems to look at alternatives in a broad, general context and only related to the average exposure concept. It is questionable as to whether some of these same alternatives would still be valid if the maximum exposure concept were used."

Staff Response - The alternative impacts are also presented in terms of reduction in early fatalities. There is no reason to believe that any of the alternatives considered would reduce the population dose and at the same time increase the maximum individual exposure.

General Comments: 11

ERDA - General Comment 5

"We agree with the general conclusions of the statement that the risk from radioactive material shipments is low compared to other societal risks. However, we are concerned that the accident risk analysis overestimates the transportation accident risk and is too simplified to make valid comparisons of the relative risks between the various radioactive materials. The danger in this is that people might scale the accident risk results in an attempt to determine the shipping level at which the accident risk would become unacceptable. When and if the industry approaches this shipping level at some future time, the overestimation could lead to unwarranted concern over the accident risk."

Staff Response - In the absence of data or valid analysis, realistic but conservative assumptions were made. Wherever this was done, it was clearly stated. If newer data show the values used in the DES to be excessively conservative, the analysis can be updated. However, it would be improper to formulate a document to be used for decision making that involves public safety on unsubstantiated facts or "ballpark estimates."

General Comments: 12

State of New York - Dept. of Environmental Conservation - General Comment

"The various modes of transportation including options within each mode should be subjected to systematic analysis wherein all of the risks, (i.e., normal transportation; accidents and security consideration), are interrelated so that both the impact and a transportation strategy could be developed. The Draft Environmental Statement fails to perform this function and, therefore, does not provide a meaningful comparison of the benefits and risks of alternative transportation modes."

Staff Response - Chapter 6 addresses both the normal and accident risks quantitatively for each alternative evaluated. The analysis includes many of the most likely alternatives but not all possible permutations of actions that might be taken. The impact of specific changes in regulations can be addressed as they are proposed.

General Comments: 13

State of New York - Dept. of Environmental Conservation - General Comment 1

"In spite of low probability of a major release of plutonium, the severe consequences of the accident merit attention to the further analysis of the alternative transportation and packaging modes and security implications thereof in order to futher reduce the probability of plutonium release in an accident. Therefore, New York State suggests that the alternative modes of transporting plutonium be considered separately from other radionuclides. In such a separate review, the need for developing an 'air-safe' container for plutonium shipment must be considered as part of the requisite overall analysis of the environmental consequences (in normal and accident situations) of alternative modes of plutonium transportation and packaging and the security requirements associated therewith."

Staff Response - Shipment of plutonium is the specific subject of several recently issued or ongoing reports. The development of "air-safe" containers is also being considered and evaluated separately in connection with recent congressional action that caused NRC to prohibit plutonium-air shipments pending development of such a container. However, it is appropriate to include plutonium with the other radionuclides in this generic statement since it is intended to form a picture of the industry as of mid-1975. Note that several alternatives considered impinge on plutonium shipments and represent activities currently under way relating to plutonium shipping safety.

General Comments: 14

State of New York - Dr. John Gofman - General Comment 1

"These comments will be limited to the subject of plutonium and its health hazards, in the context of the DES. The DES is totally unacceptable in its evaluation of the inhalation hazard of plutonium, since the errors in treatment of this subject are numerous and large. Consequently all the evaluations of the consequences of plutonium dispersal in the event of container failures are not only irrelevant to the true problem, but they do a severe disservice in grossly underestimating the true medical cost of such dispersals."

State of New York - Dr. Marvin Resnikoff - Comment 2

"We have examined certain parts of the DES dealing with toxicity of materials, containerization, dispersion, crash environments and risk analyses of various modes of transportation and it is our conclusion that the DES is a fatally defective document and, as such, cannot be relied upon as an accurate or adequate document by the Congress or the public."

City of New York - General Comment

"It is our view that the DES is fatally inadequate and thus cannot serve as a basis for determining the effectiveness of NRC's present rules governing the air transportation of radioactive materials and of possible alternatives to those rules."

Staff Response - Specific comments related to these general statements have been evaluated elsewhere. Where the comment had merit, an appropriate change in the document and/or analysis was made; otherwise the reason for not accepting the comment was given.

General Comments: 15

Dr. K. Z. Morgan - Comment 7

"There are too many rather arbitrary and unsubstantiated assumptions."

Dr. K. Z. Morgan - Comment 8

"There are serious inconsistencies between this and previous NRC reports and statements by NRC officials."

Staff Response - Without more specific reference to the assumptions or inconsistencies under discussion, no detailed answer to this comment can be provided.

General Comments: 16

ERDA - Comment 70

"It has been suggested that the report title be shortened to: 'The Transportation of Radioactive Materials.'"

Staff Response - The title of the report reflects the aims and limitation of the analysis as perceived by NRC.

DES Summary and Conclusions: 1

ERDA - Comment 1

"The first paragraph here gives the person-rem per year, but does not give the comparative person-rem per year in the U.S. from background radiation. We think it would be appropriate to make this explicit as the the conclusion on page v notes the small fraction contributed by the transportation phase. We did not find an explicit number anywhere in the text.

"We found no comparison of the excess exposure received by aircraft passengers and crew from cosmic radiation at flight elevation vs. the background radiation they would have received

had they stayed on the ground. The comparison of this number with that arising from exposure from packages containing radioactive material carried in the aircraft should be constructive."

Staff Response - Background exposure and exposure due to high altitude flight have been added.

DES Summary and Conclusions: 2

ERDA - Comment 2

"Page ii, Paragraph 3a states, '. . .an aircraft carrying a bulk shipment of plutonium oxide. There are presently less than 100 bulk shipments of plutonium per year. . .'

"The terminology, 'bulk' shipments, may be construed to be loose or unpackaged. We are unaware of any such shipments of plutonium. We suggest that these statements be reevaluated since they may convey a connotation different from that intended in respect to shipment of plutonium."

Staff Response - The word "bulk" has been changed to "large."

DES Summary and Conclusions: 3

State of New York - Dr. Marvin Resnikoff - Comment 20b

"The specific origin of the Latent Cancer Fatalities figure (20 per year for 30 years) (p. ii), which allegedly could be produced from the DES' plutonium accident scenario, cannot be found anywhere. Throughout the numerical presentations the reader is forced to do detective work to find the computational framework (often apparently guesswork) utilized by the authors, often without success."

Staff Response - The value of 20 per year for 30 years merely expresses the latency-plateau model for cancer risk. The total number of cancers expected are 600 and they are assumed to appear over a 30-year plateau period following a latency period of some 10-15 years.

DES Summary and Conclusions: 4

ERDA - Comment 3

"It is not clear in the text, page II-25 [III-25], whether curve A, B, or C is used. If A has been used in the calculations, then it would be appropriate to state in 'e' that no medical precautions are taken."

Staff Response - Curve B, which assumes that "supportive medical treatment" is provided, was used and a clarifying statement has been added to FES Figure 3-2.

DES Summary and Conclusions: 5

ERDA - Comment 4

"Another alternative which could be considered is requiring the carrier to survey packages prior to acceptance or loading. If this check and balance had been in effect, we might not have experienced some of the notable exposures in aircraft transportation."

Staff Response - An evaluation of this alternative is now included.

DES Summary and Conclusions: 6

State of New York - Dept. of Environmental Conservation - Comment 10

"The Draft Statement indicates (p. iv) that a few individual transport workers whose radiation exposures exceed the limits established for members of the general public should be, and in most cases are, monitored and otherwise treated as radiation workers. There does not seem to be clear indication of when such transportation workers are to be treated as radiation workers. It is necessary that workers required by their job to work with radioactive materials and radiation, whether in a laboratory or on a loading platform, are dealt with in a consistent manner. Therefore, it is important that the class of transportation workers and work situations involving significant shipments of radioactive materials should be identified so appropriate radiation protection measures can be taken."

Staff Response - The matter of when, if ever, transportation workers should be considered to be occupationally exposed to radiation is being studied by the staffs of DOT and NRC. Such a policy decision may ultimately involve other agencies as well.

DES Detailed Summary: 1

Dr. K. Z. Morgan - Comment 5a

"On page XIX we find the statement, 'It is estimated that the total annual population exposure resulting from normal transport is about 9600 person-rem.' Such a statement is completely meaningless and valueless because the year is not indicated and there is no indication of whether this man-rem is to the total body, thyroid, trabecular bone, deep lung compartment, etc."

Staff Response - The person-rem estimate is stated as being based on "current shipping practices," which is specified on page i to be as of June 30, 1975. This assumption is discussed in greater detail on DES pages I-15 and I-19.

The organs involved are discussed in detail in Chapters 3 and 4. It is clear from those chapters that the estimated person-rem refers to whole-body exposure.

DES Detailed Summary: 2

Friends of the Earth - Comment 3

"We refer the NRC to the affidavits of Drs. John Gofman, Marvin Resnikoff and Karl Z. Morgan, prepared for the New York State Attorney General in his lawsuit against the U.S. government to halt air shipments of plutonium. The above are leading scientists with expertise in plutonium toxicity and dosimetry; the NRC figures of one fatality and sixteen latent fatalities are unsubstantiated by any expert studies or data and are therefore indefensible."

Staff Response - Although the three persons referred to have made statements relating to plutonium toxicity, their conclusions are at variance with other experts in the field. Because there is disagreement between NUREG-0034 results and those of the "experts" doesn't mean that the NUREG-0034 results are "indefensible." Accident calculations are based on the best information known to NRC.

DES Detailed Summary: 3

ERDA - Comment 5

"What is the basis for the statement 'A Factor of twenty decrease in accident risk and consequences seems attainable by this technique (change in physical form) for plutonium shipments.'? We agree with the principle but question the technical basis of this factor."

Staff Response - It is shown in Section 6.4 that a reduction of 0.005 LCF in total accident risks would result if it were possible to change the form of the plutonium in such a way that the respirable fraction were limited to 1 percent.

DES Detailed Summary: 4

Friends of the Earth - Comment 2

"We take issue here, as elsewhere, with the reprehensible practice of averaging radiation exposure over large populations and thus submerging individual health effects. This averaging is misleading in that it infers lower radiation releases than actually occur; it also ignores the very real health effects, short- and long-term, on the individual who is unfortunate enough to contract cancer or leukemia, suffer genetic mutations, or give birth to a deformed infant. For this individual the risk is one, e.g., certainty.

"One could compare this habit of averaging to the argument used by nuclear proponents in trying to refute public concern over plutonium toxicity. These individuals denigrate public concern by saying that perfectly uniform dispersal and ingestion of plutonium oxide is highly unlikely and therefore we should not worry about plutonium releases. Here, however, it is the NRC that is guilty of assuming - for their own purposes of underplaying the seriousness of radiation releases - that radiation resulting from an accident will be uniformly dispersed and uniformly received by vast populations numbering in the hundreds of thousands, even millions.

Nuclear opponents and critics have never assumed such perfect dispersal, and we therefore insist that the NRC not make a similar assumption, and discontinue its use of the term man-rem."

Dr. K. Z. Morgan - Comment 9

"Average cases and the standard or reference man data are used in estimating cancer risk. Don't the children, the persons with respiratory diseases, etc., count? It seems we should protect them as well as the healthy adult worker to whom the standard man data apply."

Staff Response - In the normal transportation case the dose to those persons surrounding the transport links, passengers, handlers, etc., is calculated making estimates in each case of the number of persons exposed. A package in normal transport does give a small dose to a lot of people, because of the nature of the transportation process.

Nowhere is the assumption of uniform dispersal made in the accident case. The dispersion model, a Gaussian diffusion model, is discussed in Chapter 5.

The BEIR statistics used for latent cancer fatality assessment are adjusted to account for differences in the sensitivity of the fetus, child, or adult with respect to radiation-caused carcinogenesis (WASH-1400, Appendix VI, page G-4, para. G-1.2).

The question of potential synergistic effects of respiratory disease and lung cancer is not specifically addressed. Two points concerning this question should be noted: (1) The BEIR values are acknowledged to have large uncertainties associated with them. They are average values, not absolute values. (2) The fact that persons with respiratory illnesses have a shorter life span anyway might very well offset any increase in their susceptibility to radiogenic lung cancer.

DES Detailed Summary: 5

Friends of the Earth - Comment 4

"We take strong exception to the statement in paragraph d that nuclear fuels produce lower levels of gaseous and solid pollutants - not because the statement is false but because it compares apples and oranges, e.g., fails to note that nuclear fuels do in fact produce pollutants that are qualitatively different and much more lethal, namely radioactive fission products, in normal operation, through waste accumulation, activation products, and in unplanned releases. Furthermore, the potential for large radiation releases is always present in all parts of the nuclear fuel cycle, normal operational releases aside."

Staff Response - Although the nuclear pollutants are qualitatively different and may be more lethal in concentrated form, one cannot ignore the relative quantities of pollutants introduced into the environment by the various methods of producing electricity. The comment does have some validity, however, in that the paragraph implies less pollution from nuclear fuels than from conventional fuels, which, while probably true, is not within the scope of this document and has been deleted.

DES Detailed Summary: 6

Department of Interior - Comment 1

"It would be helpful to summarize the proposed action more clearly at the outset of the environmental statement. We conclude that it is proposed to continue regulating the transport of radioactive materials under present Federal regulations, pending completion of further studies of the costs and effectiveness of alternate transportation systems. While these studies are referred to generally (i.e., page v, paragraph 3), we find no summary of the specific studies in progress or of their expected date of completion.

"The non-radiological consequences of accidents involving vehicles used solely for transport of radioactive materials are variously given as 'two injuries and less than one fatality each four years' (for example, page iii, page xx, page xxiii). It would be advisable to use the same terminology throughout. In addition, some indication should be given of what percentage of transport is by vehicles used solely for transport of radioactive materials; otherwise, the figures on non-radiological consequences of accidents have little or no meaning or relevance to an evaluation of overall risk to individuals."

Staff Response - This EIS does not refer to any specific proposed action. Rather, it is an evaluation of the current state of affairs and possible alternatives that might be applicable in the future.

The nonradiological effects are discussed in detail in Chapter 5. An estimate of the percentage transported by exclusive-use vehicles is included in that chapter.

DES Detailed Summary: 7

HEW - Comment 2

"As presently contained in the document, the detailed summary does not present the reader with a thorough examination of the probable effects expected to occur from a shipping accident involving radioactive materials. Information should be included in the final document on the individual effects of each of the various types of accidents that could happen, modes of shipment, and the identity and quantity of materials involved. These should be described with and without ameliorating actions and/or safeguards. Comparing the overall exposure to populations from accidents involving radioactive material to the overall exposure from other sources does not address the consequences of a shipment accident in absolute terms."

Staff Response - Some of the information is included in the summary section. More details relating to shipments, modes of transport, and accident effects are included in Chapter 5 and in the Standard Shipments shown in Chapter 1.

To provide the detail requested would increase the size of the document many times without providing any real increase in information. Certain accident scenarios with more severe consequences are considered explicitly, but most are treated implicitly in the accident risk estimate.

This gives the desired balance between detail and general treatment which seems necessary for a generic study.

DES Detailed Summary: 8

Mrs. Virginia Karstedt - Comment 2

"..., your statistical conclusions reported in the Summary and Conclusions at the beginning of the book do not include data about shipment of irradiated fuel from nuclear power plants. And your stated purpose of answering public concern about nuclear fuel cycle material is not answered."

Staff Response - The summary and conclusions sections include data from fuel cycle shipment from 1975 and best estimates of those in 1985.

DES Chapter I: 1

United Airlines - Comment 1

"This reference page states that the purpose of the publication is to assess the impact upon the environment from the transportation of radioactive materials, primarily by aircraft, etc.

"This would appear to indicate that an effort has been made to justify an increase in the allowable limits for air movement. We will need to be extra careful in reviewing future rule making actions."

Staff Response - NUREG-0034 is intended to evaluate the transportation of radioactive material, not justify changes. Changes in regulations may be considered based on conclusions on safety, security, or the cost/benefit ratio from NUREG-0034.

DES Chapter I: 2

State of New York - Comment 11

"The Draft Statement indicates (p. I-3) that updated shipment information will be available in time for use in the final version of the Statement. We urge that such shipping data be incorporated fully into the final Statement. The newer data, in other words, should be used not only to revise Tables I-2 and I-3 but also to recompute transport impacts and to reevaluate alternative transport modes in the event that the newer data warrant such effort. If this information significantly alters the results of the draft environmental statement, then NRC should issue another draft statement for comment prior to the issuance of a Final Environmental Statement."

Staff Response - The revised standard shipment model based on the new data is used throughout the Final Environmental Statement.

DES Chapter I: 3

State of New York - Comment 12

"This section should present quantitatively the various applications for which radioactive materials are used and the benefits to society from these applications."

Staff Response - Detailed analysis of the benefits arising from the use of radioactive materials is beyond the scope of this report. A statement of the uses for such materials is included to provide background information necessary to understand the breadth of the transportation industry. This statement deals only with the transportation of materials, not with the benefits derived from their uses.

DES Chapter I: 4

Department of the Interior - Comment 3

"Throughout the statement there is little information on the adequacy of regulations as applied to the transport of large-curie radiation sources that are stated to contain as much as hundreds of thousands of curies for use in large-scale sterilization operations (page I-9). These are described as consisting chiefly of the radioisotopes cobalt-60 and cesium-137. Large curie sources of up to 10,000 curies are also said to be shipped to cancer treatment centers both in the United States and abroad, with overseas transport by ship and domestic transport by truck or rail (page I-9, paragraph 2). However, we found little or no information on the size or weight of the casks, or particularly on the adequacy of protection afforded the transport of the large-curie radiation sources under existing regulations."

Staff Response - Specific information on size or weight of casks is not germane to the report. The size and weight of the cask are more a function of the type of radiation emitted from the contained radioactive material than of the total hazard of that material if released. The adequacy of large-quantity shipments of radioactive materials are explicitly considered (see Section 5.5).

DES Chapter I: 5

State of New York - Comment 13

"The DES uses a figure of 600,000 packages of radioactive material shipped annually. This differs from other estimates previously used, including an estimate of 800,000 packages cited by the U.S. Atomic Energy Commission on page 61 of WASH-1238, dated December 1972. The reason for using the 600,000 figure should be indicated."

Staff Response - The value of 600,000 was used as the best available information. The detailed PNL study indicated that the actual value is closer to 2.5 million, and that value is used in the final report.

DES Chapter I: 6

ERDA - Comment 6

"We suggest that these be revised to indicate the following: (1) there are no commercial reprocessing plants presently operating; (2) liquid high level wastes must be solidified within five years of production and (3) an acceptable waste disposal method, not just site approval, is needed before a permanent waste repository will be available."

Staff Response - A comment to the effect that there are currently no reprocessing plants has been added to the final report. Comments have also been added to reflect the current state of national radioactive waste management plans and the solidification requirement of Appendix F to 10 CFR Part 50.

DES Chapter I: 7

Friends of the Earth - Comment 5

"Paragraph 1 has an unfortunate error; the substitution of the word safeguards for the word security. Or is the NRC implying that highly radioactive spent fuel will never be the object of attempted diversion or sabotage because of its innate hazards? Or does the NRC mean that irradiated fuel needs no safeguarding, period?"

Staff Response - The context of the paragraph is safeguards, as is evidenced by reference to 10 CFR Part 73. Part 73 requirements do not include safeguarding of irradiated fuel because it is extremely unlikely that a thief could steal the plutonium from it. Security is a different subject, and the statement is never made that spent fuel could not be the target of attempted sabotage.

DES Chapter I: 8

HEW - Comment 3

"It is noted that the shipments listed and their modes of transport are representative of the radioisotope industry (Table I-1). There are no estimates for postal shipments, which probably use any and all modes of transportation. Although these are of small individual quantity, they may be large in volume."

Staff Response - "Limited" quantities of various materials shipped by the postal service are now included in the overall assessment and are explicitly mentioned in FES Table 1-1.

DES Chapter I: 9

ERDA - Comment 7

"Table I-1 lists shipments which include all nuclear fuel cycle material; however, the statement fails to address U-core, U_3O_8, normal and enriched UF_6, fresh and recycled fuel assemblies, and radioactive wastes. We suggest that these should be addressed in the statement.

"We also suggest that the category 'Low Level Wastes' shipped from 'Fuel Fabricator and Reprocessor' to 'Commercial Burial Site' by 'Truck or Rail' might be added to this table."

FEA - Comment 1

"The 'Standard Shipments' used in assessing potential environmental impacts include plutonium, but do not include enriched uranium. Although the concern expressed during the past year by public officials and others about the air shipment of special nuclear materials has emphasized plutonium, uranium has not been excluded. If the NRC is able to certify to the Joint Committee on Atomic Energy (JCAE) that a safe container for plutonium has been developed and tested which will withstand the crash of a high-flying aircraft, the public concern over air shipments could

shift to enriched uranium. Accordingly, we suggest that low enriched uranium typically used in light water power reactors be included in the 'Standard Shipments' analyzed in NUREG-0034."

ERDA - Comment 8

"We suggest that the category 'Fresh Fuel and Radioactive Waste Shipments' be added."

Staff Response - The front-end fuel-cycle shipments are included in the revised standard shipments model. Low-level wastes have been added to FES Table 1-1 and are also included in the revised standard shipment model.

DES Chapter I: 10

HEW - Comment 4

"Weapons shipments and all shipments in government-owned vehicles are not considered. These omissions may have seriously affected the calculations presented in the statement."

City of New York - Comment 2

"The DES is made virtually worthless by its unexplained exclusion, as 'outside the scope of this document' (I-19), of all government shipments. The degree of such shipments is unstated, but they are undoubtedly substantial in number and in degree of radioactivity. The cumulative impact on the environment of all shipments to and from an area must be assessed in a proper ES. Clearly, no meaningful assessment of cumulative impact, either nationwide or in a given area, can be made if a substantial portion of the shipments are arbitrarily excluded and treated, in effect, as if they make no adverse contribution to the environment. There is thus a failure to make the required comprehensive and integrated assessment of the environmental risks associated with the transportation of nuclear materials."

EPA - Comment 5

"With the exception of weapons-related shipments where the country's security might be compromised, we cannot understand the exclusion of government transportation statistics. Since this group of statistics is surely a large collection, the public release of this information is not only desirable but could certainly aid in the assessment of the environmental impact created by the transportation of radioactive materials."

Staff Response - The DES was in error in stating that shipments in government-owned vehicles were excluded from its scope. The scope of the EIS is the same as the scope of the Radioactive Material Shipments Survey (BNWL-1972) on which it is based and excludes defense-oriented shipments of weapons and weapons components and other shipments in military vehicles. These shipments are excluded because they are outside the jurisdiction of NRC and are controlled by other requirements. Also, the need for such shipments is judged on a totally different basis because of national security considerations - an area outside the scope of the Statement.

DES Chapter I: 11

Department of the Interior - Comment 4

"Tabular data in Chapter I, that appear to provide comprehensive information for most classes of radioactive materials shipments, provide little or no information on the large-curie radiation sources, which appear to be among the potentially most hazardous materials shipped. For example, Table I-2 (page I-20) shows no shipment class having an average of more than 5,000 curies per package. We feel that comparable information, including the number of packages shipped annually in 1975 and 1985, should be provided for the teletherapy sources containing up to 10,000 curies of radioactivity and for the radiation sources that contain as much as hundreds of thousands of curies of activity, particularly in view of the fact that some of the large-curie sources are said to be shipped to locations abroad and by means of truck, rail, and ship. These shipments appear particularly important for inclusion in this evaluation because it is noted that 6,600 industrial 100-curie sources were estimated to be shipped in 1975 (Table I-2), but a single shipment of a radiation source containing hundreds of thousands of curies of radioactivity appears to be potentially as hazardous as thousands of the 100-curie-source shipments."

Staff Response - Large radiography or teletherapy sources are included in the revised standard shipment model.

DES Chapter I: 12

Transnuclear - Comment 1

"Table I-2 on page I-20 shows a total of 370 spent fuel packages per year in 1975 with a truck/rail split of 14.2/85.8 percent. However, the Baseline Shipment Information as shown on Table IV-1, page IV-11, shows 54 shipments by truck and 326 by rail for a total of 380. The percentage split in Table I-2 is compatible with the number of shipments in Table IV-1, so perhaps the 370 total packages per year is incorrect."

State of New York - Comment 6

"The last sentence of the middle paragraph states: 'The annual numbers of spent fuel shipment for 1975 and for 1985 are estimated to be be 370 and 3600 respectively.' The NYS Department of Transportation notes that the number of 370 shipments for 1975 appears to be too low . . ."

State of New York - Comment 14

"Table I-2 indicates that 85.5% of the estimated 370 spent fuel shipments transported in 1975 were shipped by rail and that the other 14.2 percent were moved by truck. This information does not agree with information provided to 'the State' regarding 186 motor truck shipments of spent fuel to the West Valley, New York reprocessing plant in 1975."

Staff Response - The value used for the analysis was 380 shipments per year. This number has been significantly revised, however, in the new standard shipments model, which is based on the 1975 survey information. This model is intended to be generic, i.e., applicable to all transportation in, into, and out of the U.S. but not to segments thereof; therefore, although it covers the impact of transportation for all facilities, it may not reflect the actual mode split on shipments to or from a specific facility.

DES Chapter I: 13

Mrs. Virginia Karstedt - Comment 1

"... yet in Table I-3, p. I-21 you have excluded fuel cycle shipments - stating in a footnote that 'this data is expected to be updated by a more extensive survey now in progress. In other words you are not including fuel cycle shipments in this study because you do not have necessary data."

Mrs. Virginia Karstedt - Comment 5

"P.S. I note that Table I-3, p. I-21 is based on a speech presented in 1974 concerning transportation of hazardous material in air commerce. Yet in the table you do not make this clear. It looks like those are all packages shipped by any mode."

Staff Response - Table I-3 is a summary table of gross shipment numbers. It was not used in either the normal or accident evaluation. All types of shipments, including fuel cycle shipments, were included in this assessment. Although the information was presented at an Air Commerce Conference, it represents overall industry data. The only shipments excluded were shipments of weapons and weapons components and shipments on military vehicles.

DES Chapter I: 14

Friends of the Earth - Comment 6

"If the subject of possible accidents in transport of radioactive materials were not so serious, one could be amused by the NRC's use of the geometric mean of the extremes in curies per package for shipments. The statement 'The geometric mean was chosen to avoid attaching undue significance to the relatively few large quantity shipments' could be re-phrased to read: . . . 'to avoid undue attention to the potential hazards from radioactive releases of those shipments exceeding the geometric mean.'

"On hardly needs to point out that accidents do not space themselves out for our convenience so as to select only small-quantity shipments. An accident is as likely to occur to a large package as to a small one. Does the NRC mean to infer that the health effects from dispersal of a 100-kilogram plutonium shipment (such as those that took place at Kennedy Airport up until last year) are negligible? That the likelihood of large quantities being dispersed is smaller than that for small quantities? In this particular stochastic game, the NRC has fallen flat on

its face. One hopes that we do not need an accident involving plutonium to pull them to their feet."

Staff Response - The commenter implies that the use of a geometric mean is a deliberate attempt to cover up the consequences of accidents involving shipments of quantities greater than the geometric mean. On the contrary, accidents involving large-quantity shipments are considered explicitly as separate scenarios in the standard shipments model in both the draft and final versions of the EIS (see, for example, Section 5.6). The technique of using geometric means was used to estimate the total number of curies shipped for each type of radionuclide. The revised shipments model provides sufficient data to obviate use of that technique and instead uses the average value from the extensive survey data and explicitly includes large-quantity shipments.

DES Chapter I: 15

ERDA - Comments 9 & 10

"What is the basis for the statement that spent fuel shipments represent 'a significant transportation risk'? We could find nothing in Reference 7 to support this statement.

"What is the basis for and meaning of the statement that 'a similar risk occurs in the transport of high level radioactive wastes'?"

Staff Response - The implication is that these shipments are a significant transportation risk within the nuclear fuel cycle, not as compared to all other radioactive shipments. This is supported by both WASH-1238 and 1248. The statements in question have been deleted, however, and the detailed analysis of the revised standard shipments model (FES Appendix A) is used to specify which shipments represent the major parts of the small overall risk from all transportation.

DES Chapter I: 16

Dr. K. Z. Morgan - Comment 5

"On page I-24 we have another useless statement because of insufficient qualifications. I refer to, 'The total amount of Pu shipped annually is estimated to be 2000 kg.' Presumably, this was for 1974? From WASH-1327 we find that for a BWR-1.15 SGR fuel discharge after 120 days decay we have 574 kg of Pu. Thus the 2000 kg corresponds to only 2000/574 = 3.5 reactor discharges per year assuming 1000 MWe per reactor."

Staff Response - The 1975 shipments have been variously estimated as 2000 kg (NMIS) or 700 kg (PNL). WASH-1327 (GESMO) specifically addresses a 1990 equilibrium recycle situation (see page I-3, para. 4 of WASH-1327). Since there is currently no recycle and very little is projected for the early 1980's, the calculation indicated does not apply to the current shipments. Values used for plutonium in the revised standard shipments model are taken from the 1975 detailed survey performed by PNL.

DES Chapter I: 17

State of New York - Dept. of Environmental Conservation - Comment 15

"The first sentence of the second paragraph (page I-25) refers to 'Figure I-2.' It appears that it should refer to 'Figure I-3.'"

Staff Response - The typographical error has been corrected.

DES Chapter II: 1

ERDA - General Comment 2

"In Chapter II (p. II-3) where it is stated that ERDA was created by the Energy Reorganization Act of 1974, it would be desirable at this point to describe the role of ERDA in authorizing packaging for use by contractors."

Staff Response - ERDA's special role in issuing package approvals has been explained in Section 2.2, "Regulatory Agencies."

DES Chapter II: 2

ERDA - Comment 11

"The statement is made that implies the NRC regulations regarding packaging of radioisotopes are included in 49 CFR 174-177, clarification of this is in order."

Staff Response - The correct reference, 10 CFR Part 71, is now cited.

DES Chapter II: 3

ERDA - Comment 12

"In the requirements stated for 49 CFR 173.395(c)(2), we suggest the wording on the U.S. Atomic Energy Commission be updated."

Staff Response - Since the phrase appears in a direct quote, it would be inappropriate to change it.

DES Chapter II: 4

City of New York - Comment V

"In addition, in order for the public and Congress to be able to evaluate a DES, it is essential for the DES to explain the assumptions made therein. The DES at issue is replete with unexplained assumptions and references to what unspecified 'experimental work' or 'private communication' has shown (see, for example, pp. II-9, II-10, V-14, V-24). It is also replete with reliance on undocumented and apparently unrequired and unenforced industry 'practice' (see, for example, pp. II-8 and II-30). Such reliance hardly provides assurance to the public that the NRC has adequately evaluated the environmental impact of the nuclear transportation program."

Staff Response - The "unspecified 'experimental work'" referred to by the commenter is covered by the reference stated earlier in the paragraphs in question. The "industry practices" are merely means of complying with the regulations. The NRC does not specify how to comply, only that one does comply with dose and packaging requirements.

DES Chapter III: 1

ERDA - Comment 13

"The sentence reads as though the range of a 'one MeV gamma' is 11 cm in tissue. We suggest that NRC might consider expanding the discussion to correct this impression."

Staff Response - The sentence in question has been rewritten to clarify the presentation of the concept of gamma-ray half-thickness.

DES Chapter III: 2

EPA - Comment 1

"Last paragraph: It should be noted that the length of time over which energy is absorbed is also critical to creating biological effects."

Staff Response - The discussion has been modified to mention the fact that dose protraction may affect the biological effect of exposure.

DES Chapter III: 3

ERDA - Comment 14

"The statement and the equation following Table III-1 are misleading. Theoretically, the equivalent biological effect can be achieved when the relative biological effectiveness (RBE) of the radiation for each exposure consequence is known. The quality factor (QF) is used primarily for radiation protection purposes and in our opinion is not adequate for the purposes of comparing exposure risks from the mixture of sources discussed in this paper.

"Furthermore, neither quality factor or relative biological effectiveness are defined; they are not equivalent and should not be used interchangeably, particularly when such diverse effects as acute death and lung cancer are considered. We also suggest that NRC might want to consider expanding the discussion of the rem to rad conversion."

Staff Response - The discussion of RBE and QF has been expanded.

DES Chapter III: 4

EPA - Comment 2

"Since there were 5.5 million examinations in 1972 using technetium and the most useful form cited was used a mere 120,000 times, it is not clear what happened with the other 5,380,000 examinations."

Staff Response - The discussion of radioisotope uses has been moved to FES Chapter 1, and it has been modified to refer to an American College of Radiology report that quantifies the use patterns for radiopharmaceuticals. The cited discrepancy has been corrected in the new text.

DES Chapter III: 5

ERDA - Comment 15

"Inhaled naturally-occurring alpha emitters include thorium daughters as well as radon daughters."

Staff Response - The discussion of naturally occurring radioactivity has been expanded to include more detailed information from additional references.

DES Chapter III: 6

HEW - Comment 5

"It is stated that the Biological Effects of Ionizing Radiation (BEIR) report was used in the Health Effects Model. Actually, the Health Effects Model used is that found in Appendix VI of the Reactor Safety Study (WASH-1400). WASH-1400 significantly modified the risk estimates contained in the BEIR report by introducing 'Dose Effectiveness Factors' (Table VI, 9-70, Appendix VI, WASH-1400). These factors do not access a straight linear extrapolation, (as does the BEIR report), making those risk estimates of low doses and dose rates used in the draft statement lower by a factor of five than those found in the BEIR report. It is erroneous to give the impression that the health effects calculated in this draft document would be equivalent to those that would be arrived at by using the BEIR report.

"Also, references are made to studies which seem to indicate that rodents exposed to radiation have longer life spans. It has been theorized that radiation creates a more sterile environment, thus reducing the probability of respiratory infection in rodents, increasing their life span in a radiation environment. We are of the opinion that the draft statement should clearly state the reasons for an increased life-span among the rodents, as well as mention the above cited hypothesis."

EPA - Comment 4

"EPA believes that use of the BEIR report in its unmodified form is the most reasonable model to use to calculate health effects in this statement at this time. Since the debate over the health effects model in WASH-1400 is still continuing, it is premature to base this analysis on WASH-1400 premises."

Staff Response - The WASH-1400 health effects model was used for convenience in referencing a large block of information and analysis in one source, but the dose-effectiveness factors in WASH-1400 were not used in the DES as alleged. The values in Table III-9 are derived as

discussed in Section 9.3.2 of Appendix VI to WASH-1400 using population age-cohort adjustment. The section on the lengthening of the rodent life span has been deleted.

DES Chapter III: 7

EPA - Comment 3

"The statement, 'The dose limits proposed by NCRP and adopted by EPA . . .' is not correct. EPA is currently operating under the 1960 guidelines of the Federal Radiation Council (FRC). The EPA is currently working in an interagency effort to review and update the FRC guidelines; the NCRP dose limits are being consulted in this effort but have not been adopted."

HEW - Comment 6

"The source should be cited for the statement that declares that EPA has adopted the dose limits proposed by the National Council on Radiation Protection (NCRP). We are of the impression that EPA is in the process of reviewing these radiation standards but has not agreed to the limits proposed by NCRP."

Staff Response - The sentence has been revised to read "The dose limits proposed by NCRP, recommended as guidance for Federal agencies by FRC, and adopted for that purpose by the President of the United States on May 13, 1960, are tabulated in Table 3-6." Reference FR Doc. 60-4539 Filed May 17, 1960; 8:51 a.m.

DES Chapter III: 8

EPA - Comment 2

"We point out that EPA has proposed standards concerned with normal operations in the uranium fuel cycle (40 FR 23420) which include doses received during transportation of radioactive materials. These standards would limit individual doses to 25 mrem to the whole body. EPA believes that this will have little or no effect on the economics or operations of the transportation industry because, as it now exists, the dose levels appear to be less than 1 mrem per year, well below 25 mrem per year. The fact that EPA has formally proposed standards which would apply to the transportation of uranium fuel cycle materials and yet is not recognized in the draft statement is an oversight which should be corrected."

Staff Response - The EPA proposal in 40 FR 23420 has been incorporated into Section 3.5 of Chapter 3 and into Chapter 4.

DES Chapter III: 9

ERDA - Comment 9

"We suggest that this paragraph be rewritten since it implies that the MPC (air or water) is a unit of exposure rather than being based on the permissible exposure to critical organs."

Staff Response - The section on MPC has been rewritten to clarify the concepts of chronic exposure and critical organs.

DES Chapter III: 10

ERDA - Comment 17

"We suggest that the average or mean effect of radioactive transport be added to compare transport dose effect to background and medical dose effect."

Staff Response - The calculated effect of radioactive material transport has been added to FES Table 3-8.

DES Chapter III: 11

EPA - Comment 4

"We suggest rewriting the sentence beginning 'Technetium-99m can be given . . .' as, 'Technetium-99m can be given in relatively large amounts with little radiation exposure.' 'Relatively' emphasizes comparison with other isotopes and 'amounts' eliminates possible confusion resulting from using the word 'dose' which is used in a medical context rather than the radiological context in which it had previously been used."

HEW - Comment 7

"We suggest that line 12 in paragraph 2 read as follows: 'Technetium-99 can be given in rather large quantities with little radiation dose.' As presently used in the draft document, the word 'dose' refers to pharmaceutical dose (which in this instance is not the case). Also a discussion of the short half-life of Technetium-99 should be included in the final document as a means to support the above statement."

Staff Response - This section has been moved to FES Chapter 1 and rewritten to read "Relatively large amounts of Tc-99m can be administered with little radiation dose." Half-life information is included in the section.

DES Chapter III: 12

Friends of the Earth - Comment 7

"We question the reliance on the WASH-1400 health effects model. The Union of Concerned Scientists-Sierra Club critique of the Rasmussen reactor safety study has criticized the assumptions of low numbers of health effects posited by WASH-1400 on the grounds that the study assumed near-perfect evacuation of the metropolitan New York area within several hours, while simultaneously assuming that most of the population would be indoors or underground and therefore shielded from radiation. More recently, Dr. J. Martin Brown, Assistant Professor of Radiology at Stanford University School of Medicine has criticized WASH-1400 for neglecting to assess

long-term cancer deaths from a reactor core meltdown (Rasmussen uses only immediate deaths of people in the immediate vicinity). Nor does Rasmussen calculate genetic disorders, thyroid disease, etc."

Staff Response - The only aspect of WASH-1400 health effects model that is used is that relating to response to dose. No evacuation or shielding is assumed, and long-term fatalities (from cancers) are specifically addressed. The question of genetic effects is discussed in Chapter 3 and thyroid cancer is considered in Chapters 3 and 5.

DES Chapter III: 13

HEW - Comment 8

"It should be noted that the use of pertechnetate for brain scanning is relatively low, amounting to 1.5 million administrations during 1972. The impact of other technetium compounds and kits as well as ^{67}Ga, ^{75}Se, and ^{133}Xe should also be considered."

Staff Response - The standard shipments model has been revised to include the recently available 1975 survey data. The text in question will be revised to reflect the newer model and the survey data from the American College of Radiology. This section has been moved to FES Chapter 1.

DES Chapter III: 14

HEW - Comment 9

"It is important that the basis for simplifying assumptions be documented, even if only briefly, since they can significantly influence the risk estimates."

Staff Response - The assumptions used are briefly outlined.

DES Chapter III: 15

ERDA - Comment 18

"We suggest that the phrase 'specific radionuclide' replace the phrase 'radioactive specie' which is used throughout. The latter phrase is confusing since it could refer to animals or plants.

Staff Response - The phrase in question has been changed to the suggested one.

DES Chapter III: 16

ERDA - Comment 19

"For PuO_8 (sic) we feel that the biological half-life in liver and bone, as well as in lung must be stated and identified.

"For Pu, the biological half-life listed is for the deep lung. The value for bone is 36,000 days. Using the isotopic composition and specific activities found in Appendix B, p. B-5 and the dose conversion factors from Table III-8, we find the following Pu dose conversion values, in rem/curie inhaled.

	Dose commitment over: 1y	50y
Lung	4.2×10^6 rem/Ci	1.1×10^7 rem/Ci
Bone	1.2×10^5	4.4×10^7

"We cannot agree with the value of 2×10^8 listed in Table III-7 for PuO_8 (sic). Conversion to rem/g yields 50 year dose commitment conversion factor of:

Lung	1.4×10^8 rem/g (inhaled)
Bone	5.4×10^8

"These values are closer but still do not agree with that listed in the table. We suggest that the data presented in the table be reevaluated in light of these comments."

Staff Response - The rem/curie values were based on a specific activity that did not include the β-emitter Pu-241. Thus the 2×10^6 rem/Ci was associated with a specific activity of 0.5 Ci/g. This has been revised to specifically account for the isotopic composition (including β-emitters) shown in Appendix B.

The biological half-life and effective half-life in bone are included in the ORNL code from which these data (which are also used in WASH-1400) were taken. Since the liver is not considered the critical organ for insoluble forms of Pu, it is not included.

DES Chapter III: 17

ERDA - Comment 20

"Is it not the relative risks that are to be compared and not the person-rem?"

Staff Response - The sentence has been rewritten to emphasize that the thrust is toward relative risk.

DES Chapter III: 18

HEW - Comment 10

"We do not agree with the statement made in paragraph one. Soluble Plutonium is listed in Table III-7 and represents a material that can enter the food chain. Since I-131 constitutes an inhalation hazard, it also represents a potential health threat to the food chain in the event that a dairy or truck farming area were to become contaminated."

Staff Response - As shown in DES Table III-7, the dose per curie ingested is 4 orders of magnitude lower than the dose per curie inhaled for plutonium. In addition, there are environmental dilution factors involved in resuspension, soil transport, and plant uptake that make the effect of ingested plutonium negligible as compared with inhaled plutonium, assuming a single accidental release (versus a continuing release).

The effects of I-131 on dairy products or cropland are addressed in the decontamination/interdiction section which has been added to FES Chapter 5.

DES Chapter III: 19

Dr. K. Z. Morgan - Comment 3

"Table III-8 is given without explanation and I have reason to question its reliability. I was chairman from the beginning until 1972 of the Internal Dose Committee of ICRP that made such calculations and set the standards for all these radionuclides (and I was chairman of the NCRP internal dose committee for 20 years). Since 1972, I have been busy with research and teaching at Georgia Tech, so I am not completely up-to-date with the latest ICRP calculations. However, the following Table shows discrepancies I found in your table for Pu radionuclides in comparison with ICRP Committee 2 values as of 1974, and I doubt there have been substantial changes since then.

Values of Rem/Ci Given by NUREG-0034 and by ICRP

Plutonium Radionuclide	Table III-8 Values			Values Given by ICRP (1974)				
	Lung	Bone	Marrow	Lung	Bone*	Marrow	Liver	Ovaries
Pu-238	3.1×10^{8}	7.6×10^{8}	1.3×10^{6}	3.1×10^{8}	4.0×10^{9}	6.7×10^{3}	3.6×10^{8}	1.7×10^{8}
Pu-239	2.0×10^{8}	8.7×10^{8}	1.5×10^{6}	2.9×10^{8}	4.6×10^{9}	4.4×10^{3}	4.1×10^{8}	2.0×10^{8}
Pu-240	2.0×10^{8}	8.7×10^{8}	1.5×10^{6}	3.0×10^{8}	4.7×10^{9}	7.6×10^{3}	4.1×10^{8}	2.0×10^{8}
Pu-241	5.8×10^{5}	1.7×10^{7}	3.2×10^{4}	5.5×10^{5}	9.8×10^{7}	1.3×10^{3}	8.3×10^{6}	4.4×10^{6}

* This value is for trabecular bone. I do not know for what type of bone the Table III-8 is representative.

"From the above it is seen there are some significant discrepancies. For example, the bone risk (where most of the malignancies develop from Pu) is underestimated by a factor of 5. The risk to the liver and ovaries may be as great as that to the lungs, but they are not even considered. Surely some consideration should be given to the genetic risk."

State of New York - Dr. John Gofman - Comment 1

"The lung dose per curie inhaled is given as 2×10^{8} in Table III-7 (for insoluble PuO_2). This value is manifestly incorrect. Gofman and Cohen agree that the dose is 2×10^{9} rems per

curie deposited. Correcting this, from deposited to inhaled, we should reduce the value four-fold. Therefore, the correct value is 5×10^8, which is 2-1/2 times as great a dose as presented in the DES. But this is only the beginning of the serious underestimate of dose from plutonium in the DES. All calculations of the DES are based upon the ICRP Model (Figure B-2 in Appendix B). That model makes the erroneous assumption that no plutonium is retained for long-term delivery of dose to the bronchial region, an assumption based upon no evidence whatever and totally in contradiction with evidence concerning the impairment of bronchial ciliary function in cigarette smokers and in non-smokers. When this is taken into account and when the small mass of the cancer-relevant bronchial tissue is taken into account, (one gram instead of the 570 grams of the whole lung), we end up with the following correction factors that must be applied to the DES estimates of dosage:

For cigarette smokers, dose must be multipled by 103 times,
For non-smokers, the dose must be multiplied by 8.2 times.

"Therefore, overall, incorporating these factors and the 2-1/2 factor above, the DES underestimates the dose for plutonium inhalation by 257.5 times for cigarette smokers and by 20.5 times for non-smokers. These errors, alone, are sufficient to invalidate all the consequences of dispersion estimated in the DES. But these are not the only serious errors concerning effects estimation."

State of New York - Dr. Marvin Resnikoff - Comment 18

"Another area of disagreement lies in the biological effectiveness (i.e., effect on tissue) of a given gram of plutonium. The DES uses a figure of 2.0×10^8 rems/curies. The NRC's WASH-1535 at Table II.G-10 presents a figure of 8.6×10^8 rems/curie. According to the USEPA (Id.), ICRP now uses 16.5×10^8 rems/curie for Pu-239. Since the DES relies on the Pu-239 value of 2.0×10^8 for its conversion calculation of the biological effectiveness of reactor type Pu (that shipped through a JFK) (Page B-4), it is clear that the danger of plutonium inhalation may be understated by the DES by over 8 times. At any rate, the resulting impact calculated from the 2.0×10^8 number cannot be considered a 'worst case' impact."

Staff Response - Table III-8 is taken (and referenced) from Appendix VI to WASH-1400. The values listed are for a single exposure to a log-normal particle size distribution with a mean size of 1.0 μm AMAD. The values cited by Dr. Morgan and Dr. Gofman represent chronic exposure to a uniform particle size of 1 μm, not a distribution, hence the larger dose per curie values in Dr. Morgan's tabulation.

The question of ciliary impairment has been addressed in rebuttals to Dr. Gofman's paper on Plutonium Cancer Hazards. In these rebuttals a strong argument is presented that Dr. Gofman has misinterpreted data on ciliary degradation and that his theory of lung clearance impairment leads one to the conclusion that all heavy smokers should be dead from respiratory blockage.

The question of "cancer-relevant tissue" is also addressed in rebuttals to Dr. Gofman's articles. It is merely a restatement of the so-called "hot-particle theory." Numerous agencies

(NAS, NRC, BEIR, NCRP, ICRP) and numerous reports have concluded that no experimental evidence has shown nonuniform lung deposition to be more hazardous than uniform deposition.

The statement that most Pu malignancies develop in bone is debatable. Bair has stated that no bone cancer has been reported in any animal specie after inhalation of $^{239}PuO_2$ (Biomedical Aspects of Plutonium, BNWL-SA-5230, 12/74) even though approximately 5 percent of the Pu eventually translocates to the skeleton. Cohen (Hazards of Plutonium Dispersal) suggests that the lung cancer risk from inhaled Pu is approximately a factor of 4 higher than bone cancer. Using information from WASH-1400, GESMO, and BEIR the cancer deaths per curie inhaled for lung and bone are roughly comparable (235 for lung and 258 for bone). The DES uses the WASH-1400 model.

The question of effects to the liver and ovaries are addressed by Bair (Biomedical Aspects of Plutonium). He states that bile duct tumors have occurred in experimental animals, but they also occurred in the control group (see DES Appendix B). He also states that only 0.05 percent of the concentration of Pu in the circulating blood deposits in the testes and 0.01 percent in the ovaries. It appears, therefore, that the stated ovary dose is the dose per curie deposited in the ovaries rather than the dose per curie inhaled. Since the gonadal deposition is so low, genetic effects from inhaled plutonium are considered to be negligible compared to other effects.

DES Chapter III: 20

ERDA - Comment 21

"The table [Table III-9] has not been correctly copied and adequately referenced. 'Whole body' is actually 'Total (excluding Thyroid).' Also the table contains those values used in WASH-1400 for external exposure. What was used in this analysis for internal exposure? The risk number shown for the thyroid is surely not a mortality estimate--morbidity maybe, but not mortality. Finally, if the estimates of Table III-9 are based on the absolute model, it should be so noted."

State of New York - Dr. Marvin Resnikoff - Comment 20

"The authors of the DES chose 22.2 LCF/million person-rem for lung cancer on the basis of the BEIR report (p. III-23). This number is smaller than that in a number of other reports. USEPA has assumed 50 LCF/million person rem. Dr. John Gofman reports that Cohen has used 39 LCF/million person-rem and assumed 762 LCF/million person-rem himself. From these data it can be clearly shown that the DES has understated the danger of plutonium inhalation by as much as 34 times."

State of New York - Dr. John Gofman - Comment 2

"In Table III-9 the DES estimates latent cancer fatalities as 22.2 deaths per 10^6 person-rems of exposure to the population. The data of reference 1 point to a more correct value of 762 deaths per 10^6 person-rems on the same calculation basis. Therefore, the DES estimate is some 34.3 times too low in its cancer estimate. If this underestimate of effect is combined

with the underestimates of dose, we arrive finally at the following error estimates for the DES evaluation:

> "For cigarette smokers, effects must be 3533 times larger than DES estimates,
>
> For non-smokers, the effects must be multiplied by 281.3 times to correct the DES estimates.

"The final result of such corrections is to make the DES estimates totally meaningless as they stand in the report."

Staff Response - Table III-9 was not copied from WASH-1400; it was assembled using data in WASH-1400. WASH-1400 is referenced as the source for the information. The correct interpretation of the table is that exposure of one million person-rem to any of the specified organs would be expected to result in the specified number of cancer fatalities. Table III-9 is a combination of Tables VI-9-4 and VI-9-5 from WASH-1400. The BEIR report, which was the source for those tables, did not distinguish between the irradiation of an organ from an internal or external source in its overall statistics. The important item is the total radiation received by the various organs. The thyroid value of 13.4 per million person-rem is a mortality value based on discussion in paragraph 1 of Section 9.3.5 on page 9-26 of Appendix VI to WASH-1400 and on the expected thyroid cancer figure of 134.1 per million person-rem given in Table VI-9-8 on page 9-37 of the same appendix.

The value chosen for LCF for lung cancer from accidental exposure is based on an age-cohort-corrected version of the 1.3 per million person-rem per year as discussed in WASH-1400. Gofman's value of 762 LCF per million person-rem has been disputed by many experts in the field. The value used by Cohen and EPA are not age-cohort corrected.

DES Chapter III: 21

ERDA - Comment 22

"This figure was taken from p. 9-7 of WASH-1400 Appendix VI. However, the referenced figure does not contain a curve for alpha emitters. Any subsequent argument pertaining to acute effects (death) of alpha emitter inhalation is unsupportable without these data and suggest that NRC might wish to include these data."

Staff Response - The curve for α-emitters in Figure III-2 has been replaced in FES Figure 3-3 with a new curve from Reference 3-20.

DES Chapter IV: 1

EPA - Comment 5

"It is stated that tiers 6, 7, and 8 in Figure IV-3 schematically illustrate the procedure that the FAA employed to arrive at the various dose estimates in their assessment, reference IV-2 in the statement. However, tiers 7 and 8 do not appear in Figure IV-3. They should be added in the final statement."

Staff Response - Figure IV-3 has been deleted.

DES Chapter IV: 2

ERDA - Comment 23

"Table IV-2 gives population dose to crew and passengers from packages. We suggest that it also include the differential received by same populations as a result of cosmic radiation at flight altitudes. Such a number would be several times the 1400 for Passengers-I* and many times the Crew-I* numbers."

Staff Response - Comparison of dose from cosmic radiation with that from radioactive material shipments has now been included.

DES Chapter IV: 3

ERDA - Comment 24

"There is inconsistency between PuO_2 shipping distance noted in this table and that noted in Table V-10 on p. V-37."

Staff Response - The inconsistency has been corrected.

DES Chapter IV: 4

ERDA - Comment 25

"Person-rem/yr are calculated on this and following pages. We think it appropriate that background exposure doses also be calculated and presented for comparison. For example, the 5042 person-rem/yr is a big number to the layman or the person taking data out of context. However, it becomes small when compared to the population background exposure of 22.5 million person-rem/yr."

Staff Response - Background population exposure has been added.

Department of the Interior - Comment 3

"Several statements suggest that the study is based on surprisingly incomplete information in some important areas pertinent to transport of radioactive materials. For example, it is stated: 'While no specific information is at hand to suggest that radioactive materials are not shipped on passenger trains, no evidence of such use was discovered in an informal survey of the industry' (Page IV-31, paragraph 1). This suggests that the facts now available to the staff provide no information on whether or not radioactive materials are shipped on passenger trains. It is also stated that 'it is suspected that barge may be a method for transport of new and spent fuel to reactors and reprocessors located on appropriate waterways' (page IV-34, paragraph D.4-1). This lack of certainty on the part of the Nuclear Regulatory Commission regarding even the basic mode of transport in use for such materials does not provide reassurance that transport of radioactive materials is being carefully regulated in all cases."

State of New York - Dr. Marvin Resnikoff - Comment 37

"The alternative of transporting materials by water is given only minimal consideration in Chapter IV, Section D.4, page IV-34. No information is given about the present volume of material shipped by water. It seems clear that in certain localities, water transport may indeed be an alternative to conventional inter-city ground transport modes, and might result in significant reductions in exposure in both normal and accident situations. Although plutonium is the major contributor to accident latent cancer fatalities, it has a long half-life. Thus the shipment of plutonium by water may be economically feasible as well."

EPA - Comment 6

"We feel that the water transport discussion was not thorough enough. The only reason cited for this treatment is a 'paucity of information' concerning water transport. However, the discussion in the draft statement on the manufacture of floating nuclear power plants (NUREG 75/113) provides a brief but much more adequate discussion of the subject. If it is believed that a projection to 1985 is too uncertain this is understandable and should be so stated, but a more thorough discussion would be more informative for the public and would not as likely appear to be a sidestepping of the issue. Therefore, further basic discussion of water transport and an explanation for its exclusion in the further analyses is warranted."

Staff Response - Shipments on passenger trains consist only of a few exempt postal shipments, and their contribution is negligible. Based on the results of the 1975 survey, water transportation is a very small portion of the total shipping industry. Water transportation is not practical for many materials (radiopharmaceuticals, etc.) because of the time required for the shipment. Water transport is also impractical for many other materials because of the lack of canals or waterways in the inland United States. To the extent that this mode is viable, it has been discussed in Chapter 4 and included as an alternative in Chapter 6.

DES Chapter IV: 6

ERDA - Comment 26

"It is assumed that there will be a two-hour 'storage' period associated with time spent in rail yards. Is this a realistic figure, particularly where interline transfer is required, or are these transfers taken into account in arriving at this figure?"

Staff Response - The rail yard storage time per trip has been changed to 24 hours based on testimony given at the Interstate Commerce Commission hearings regarding special trains for transport of irradiated nuclear fuel and wastes.

DES Chapter IV: 7

ERDA - Comment 27

"We feel that transport index system can be based on dosage from the package or the maximum number of packages considering criticality. Hence, the label does not inform as to which of two potential hazards exists. This could be important in accident recovery.

"Likewise, the terms Type A, Type B, or large quantity are meaningless to all but a very few persons. Some improvement might be obtained if the labels provided explicit relevant information. We suggest that NRC may wish to study this suggestion as an 'alternative' toward reducing mislabeling and mishandling occurrences."

Babcock and Wilcox - Comment 1

"The DES assumed that dose rates were proportional to the transport index. While this is true for non-fissile material, it is not so in the case of plutonium, where the transport index is derived from criticality considerations. It is felt that the exposure rate is the correct number to use, and it is not clear that this number was used in the DES. (See Page IV-42, for example.) Experience has shown the exposure to be about 1 mr/hr at one meter from a container of PuO_2. Thus, the transport index of 5 that was applied to shipments of PuO_2 in the DES is too large by a factor of five."

Staff Response - The use of fissile TI to predict normal radiation dose is clearly conservative (49 CFR 173.389(i)). Since actual radiation data were not available and since fissile materials are small contributors to normal dose even with fissile TI, that approach has been retained.

DES Chapter IV: 8

ERDA - Comment 28

"Since 10% of the incidents that involve release are in the Type A category and that these packagings are relatively inexpensive, it seems reasonable that requiring crush and puncture resistance characteristic of service conditions be explored as an alternative."

Staff Response - Not 10%, but virtually all incidents in which there are releases of radioactive material involve packages that are not designed against accidents. These are designed to provide protection against a reasonable level of crush and puncture conditions. To protect some two million packages against a very unlikely higher level of puncture and crush does not appear reasonable considering the limited consequences of incidents involving such packages.

DES Chapter IV: 9

EPA - Comment 7

"In the second paragraph of Section F.3, there is no factual basis cited for the statements leading to the 0.5 mrem/year 'expected' dose rate. This section needs to be more thoroughly documented to indicate which radionuclides were considered and in what proportions. Further, information on whether certain types of packages are damaged more frequently than others and, if so, which, is certainly of importance to the analysis of this section."

Staff Response - Section 4.5 of the FES has been rewritten, and exposures that were estimated using release data from actual shipping experience have been incorporated.

DES Chapter IV: 10

EPA - Comment 8

"The method of modifying equation 2 to arrive at the given equation is not clear, further elucidation is requested.

"If there are records indicating 'an average of 5 losses per year over the last 9 years,' it seems there might also be records indicating for how long these packages were lost. Such information would eliminate another estimate, i.e., the '7-days lost' figure, to allow a more precise appraisal of possible population doses."

Staff Response - The equation on page IV-42 used the integrated form of equation (2) where K takes the form of $K\, e^{-\lambda t}$ (λ = decay constant and t = time of exposure). Thus

$$\text{Dose} = 3.7 \times 10^{-7} \times P \times TI \times \int_0^T e^{-\lambda t} dt$$

where T = total time of package loss
λ = decay constant for material

This treatment has been modified to use the updated equations now provided in FES Appendix D. In addition, a loss-time figure of 14 days based on incidents reported since December 1975 has been used in the FES.

DES Chapter IV: 11

ERDA - Comment 30

"The subject of this section and that of Section D.4 (page IV-34) might well be considered in light of the prospect of using ferry barge shipments to circumnavigate cities or states which embargo nuclear shipments or areas where rail carriers are refusing to haul nuclear shipments. We do not feel that the regulations contemplated the casual public in such proximity to nuclear shipments, particularly spent fuel casks, for the typical time period involved. We feel that this situation lends itself to be analyzed in the draft."

Staff Response - Barge shipments are considered in more detail in the FES. It should be noted, however, that there are only a few current or potential sites that are serviceable by large-scale barge traffic. The rail carriers have not refused to carry nuclear-shipments; rather they have requested that some shipments be made by special trains. This restriction would not avoid casual public exposure.

DES Chapter IV: 12

HEW - Comment 11

"Page IV-43, item 7 indicates that a few individual transportation workers might possibly be exposed to radiation limits which exceed those established for the public. The draft document devotes little attention to the problems of identifying, monitoring, and controlling the exposure to 'truckers', 'handlers' and others."

State of Georgia - Comment 2

"Throughout the document, the dose estimates are related to the average exposure to population in man-rems. The NRC should also include dose values based on the maximum exposure to individuals."

EPA - General Comment 1

"There is a lack of analysis pertaining to individual doses to passengers from normal shipments on aircraft. The only mention of the problem is in Table IV-2 where an unacceptably high maximum dose of 340 mrem/year and an average dose of 60 mrem/year are given. Doses of this magnitude to individuals, which are large fractions of the FRC guidance, are the most significant impact from normal air shipments. As EPA recommended to the FAA and pointed out in its document, 'Considerations for Control of Radiation Exposures to Personnel from Shipments of Radioactive Materials on Passenger Aircraft' (December 1974), the population doses are small and can probably be considered insignificant. However, the exposures to individual passengers are unacceptably high considering there are cost-effective measures which can be taken to reduce them. Several alternatives were addressed in the report and it was found that at least one cost-effective method is readily available. EPA recommended to FAA that a dose limit of 0.5 mrem per hour at seat level be established to provide protection of aircraft passengers.

EPA believes, therefore, that this subject must be addressed by NRC in much greater detail in the final statement and that EPA's recommendations must be considered."

EPA - Comment 9

"The discussion shows that it is currently possible for workers to exceed 500 mrem/year simply handling shipments. It is clear that if the number of shipments increase as they are projected to do that these workers will routinely exceed 500 mrem/year. Any provisions which have been made to prevent this from occurring should be indicated. Furthermore, if the doses mentioned on p. IV-44 do not include unnecessary doses (e.g., sitting on or standing near radioactive cargo), which they apparently do not, the problem becomes worse than estimated on p. IV-44. We believe that if unnecessary exposures are indeed a fact of life, they should be included in the environmental impact assessment. Any plans underway to mitigate or eliminate these unnecessary exposures would be of interest also."

Staff Response - The question of maximum individual doses from normal transport is now addressed in FES Chapter 4, and EPA's recommendation is considered in FES Chapter 6.

DES Chapter IV: 13

EPA - Comment 16

"In the 'Dose to Crew' equation the 'D_c' factor is unnecessary. Its inclusion squares the dose rate."

Staff Response - This typographical error has been corrected.

DES Chapter IV: 14

HEW - Comment 12

"The average individual dose from transportation is stated as 0.5 mrem/year. This is a factor of 2, not 20 less than the average per capita dose from radiopharmaceuticals (Table III-3)."

Staff Response - This typographical error has been corrected.

DES Chapter IV: 15

Dr. K. Z. Morgan - Comment 10

"The man-rem dose for normal and accident operations should be integrated over the entire population for all age groups and for all dose rates. Arbitrary cut-offs, and boundary assumptions lead to serious underestimates of the risk."

Staff Response - The dose for accidental or normal transport is integrated over all age groups. The only dose-rate restrictions are those imposed in line-of-sight distance for direct exposure

and the finite distance of debris cloud travel (100 km) in the accident case. This procedure results in an accumulated 50-year lung dose of less than 200 person-rem (for a plutonium release) which is negligible.

DES Chapter IV: 16

ERDA - Comment 29b

"However, some of the more notable incidents have derived from packaging errors. We do not feel that this section discusses this matter in proportion to its importance -- either as to requirements or as to cost-benefit or corrective action. It is implied elsewhere that a preconsignment survey of the package would be beneficial in reducing labeling errors. However, the benefit of a quality assurance over-check as to labeling and proper packaging and closure should be considered as an alternate."

State of New York - Skinner/Willen - Comment 51

"Many accident modes within each transportation pathway have been overlooked. Such likely occurrences as fork lift puncture and container leakage are not treated in each pathway."

State of New York - Skinner/Willen - Comment 52

"No discussion in the Draft Impact Statement can be found relating to errors in record-keeping, radiation monitor errors, container maintenance hazards, and other miscellaneous causes of inadvertant over exposure to the public during transportation."

Staff Response - The subject of packaging errors is addressed in more detail in this revised version.

DES Chapter V: 1

Friends of the Earth - Comment 8

"We dissent from the statement that 'The most severe accidents are generally the least likely to occur' as yet another departure from logic and from knowledge of stochastic events. If the NRC wishes to persist in this type of argument, they should provide us with the mathematical model supporting this position. Similarly, they refer to 'The complete logic model' of accident sequences leading to an environmental impact. A complete logic model is by definition impossible, since if all accident causes and sequences could be articulated, in theory all accidents could be foreseen and avoided. What disturbs us are those sequences that will be left out of the logic model and therefore are unknown."

State of New York - Dept. of Environmental Conservation - General Comment 16

"While the use of average exposure is reasonable to predict the effects resulting from normal transportation, the use of the estimated average accident risks can be misleading. The low average accident risk results from taking the very low accident risks associated with the large number (some 70% of total shipment) of radiopharmaceutical shipments and distorts the risks associated with the transportation of plutonium."

Staff Response - Regarding the commenter's objection to the statement "The most severe accidents are generally the least likely to occur," accident statistics show that this is, in fact, the case. Although the average annual risk could be misleading if dealt with in isolation, consequences of severe accidents are also considered in that "worst case" results are listed with their respective occurrence probabilities.

DES Chapter V: 2

ERDA - Comment 31-1

"We assume this equation was used to calculate accident risks. We have several questions on the methods used to develop numerical values for input into the equation. A primary concern is the term D_{ij} (estimated release fraction for the type of shipment being considered and for the accident severity class). The method of development of D_{ij} appears to be oversimplified. Release fractions used for each accident severity class are presented in Table V-6 (page V-25). Questions are raised for both the values used and the use of the release fraction in the analysis. The statement is made (page V-24) that 'Model 1 would be an accurate model if packaging were not better than required by present standards.' We disagree that it would be accurate; experience indicates that not all material will get out and become dispersed when a package is breached. We are not sure of the basis for Model II. It was our understanding that the reference testing was under impact conditions. If so, how does one apply the results to, e.g., puncture conditions?"

Staff Response - The release fraction model has been revised to incorporate more recent Sandia Laboratory container test data.

The reviewer is correct in noting that the referenced Sandia tests were impact tests. However, since the initial report, further tests involving fire, crush, puncture, impact, and immersion have been conducted, and these results have been taken into account in the FES.

DES Chapter V: 3

ERDA - Comment 31-2

"Does a category VII accident in air transport involve the same forces as a category VII accident in truck transport? If not, we would expect different release fractions for different modes (since the same container could be used in any mode).

"We would not, in general, expect the same release fraction from an accident involving a category VII impact and one involving a category V impact and a category III fire. According to Figure V-6 (Page V-9) the latter is also a category VII accident. Whether or not a category III fire will contribute to a release depends on specific package characteristics and specific contents characteristics."

Staff Response - The severity categories were assigned based on the forces estimated to produce a given release. Thus, a category VII truck accident is equivalent to a category VII plane accident in terms of amount of material released.

The model does not consider category V impacts or category III fires separately. It does consider category V, etc., accidents that can involve various combinations of impact force and fire duration. Thus, as discussed above, the severity classification scheme does postulate a given release fraction for a given severity accident, regardless of the combination of forces that cause the accident of that severity to occur. The use of a simple set of accident severity categories for several different transport modes is not new (see W. A. Brobst, Nuclear News, May 1973).

DES Chapter V: 4

Dr. K. Z. Morgan - Comment 6

"I believe the severity of aircrash assumed in this report comes far short of the worst case."

Staff Response - The minimum accident impact velocity on an unyielding surface for a class VIII accident in which any accompanying fire lasts no longer than 30 minutes is 256 feet/sec (375 mi/hr). This is a factor of 3 greater than the impact velocity required for flight recorder design (80-90 feet/sec). Thus, the minimum impact energy for a package involved in a class VIII aircraft accident is a factor of 10 greater than that for flight recorders that are designed to survive intact in all but the worst air crashes.

DES Chapter V: 5

ERDA - Comment 31-3

"It is also not clear how the normalized population dose (K_i in Equation (1)) is obtained. We know it involves figure V-11 but there is no reference as to source of figure V-11 nor how the curve was developed."

Staff Response - Figure V-11 has been simplified for the FES (Figure 5-7). The function represented by the curve is curies inhaled per curie released versus area. When it is integrated over an area containing a uniform population density and combined with a rem/curie inhaled value for a particular isotope, a value of person-rem/curie released is obtained. This is the K_{ij} in Equation 1. This explanation has been clarified and Appendix G has been added to further explain Equation (1).

DES Chapter V: 6

ERDA - Comment 69B

"There is a VII just above II and a III next to II. Should they not both be III?"

EPA - Comment 17

"The squares listed for the following figures are apparently mislabeled: Figure V-6; 0-0.5 hour fire, 30-55 mph and, 0.5-1 hour fire, 11-30 mph; Figure V-20: 1-1.5 hour fire, 40-60 mph."

Staff Response - The typographical errors have been corrected.

DES Chapter V: 7

State of New York - Dept. of Environmental Conservation - Comment 16

"The basis is not provided for the distribution of accidents among the various population densities for each of the transportation modes considered. Although some description of the basis for the fractions used for aircraft accidents is provided, almost no basis is provided for expecting the low severity truck accidents to occur mainly in urban areas. If these assumptions are based on a statistical analysis, that analysis should be identified."

Staff Response - The subsections on each of the transport modes describe the fractional breakdown for accidents in various population zones and the rationale behind the values assigned. No statistical analysis was performed to arrive at those values.

DES Chapter V: 8

ERDA - Comment 32

"A fire temperature of 1875 F is referenced. We wonder if it would not be appropriate to discuss the 1475 F used in container (MC 0529, 10 CFR 71, etc.) and the impact of the difference."

Staff Response - The 1875 F fire temperature should be 1850 F; this correction has been made. The 1850 F value was used to facilitate comparison with the data of Clarke et al. Since the fire damage is usually taken to be proportional to the temperature-time product, the fire duration may be scaled accordingly. This correction is now included in FES Chapter 5.

DES Chapter V: 9

State of New York - Dr. Marvin Resnikoff - Comment 9

"Nothing in the text of the DES indicates how the authors established accident type classifications on the basis of papers by 'Clarke et al.' (p. V-60). Since the NRC has made the work of Clarke et al. central to the determination of these 'type classes', specific discussion of all relevant portions of that material must be provided if this part of the DES is to have any validity."

City of New York - Comment VI

"At pages V-8 through V-15, there, the probability of spillage model which purports to calculate accident statistics, takes accident data not from actual aircraft accidents but from Clarke's model, based upon laboratory simulations of crashes on unyielding surfaces. Clarke's results are then modified by an unexplained process of 'engineering judgment' (at page V-13 an explanation is included which provides no proofs nor any basis for the assumptions made). No attempt is made in this analysis to use actual aircraft collision data in a study similar to that performed by Bovet, 'Preliminary Analysis of Tanker Collisions' D. M. Bovet. Reported by U.S. Coast Guard Office of Research and Development, November 30, 1970, or Monorksy, 'An Analysis of Ship Collisions with Reference to Protection of Nuclear Power Plants,' Journal of Ship Research, October 1959."

Staff Response - Clarke et al. use a method of accident classification based on five categories that used actual data where available. The authors of the Clarke document were asked to provide similar probabilities for an eight-category analysis. This rationale is specified in Section B.1 of the DES.

DES Chapter V: 10

City of New York - Comment 6-3

"The accident classification scheme improperly relates severity of an accident to fire duration and speed of impact. It fails to evaluate crush and puncture damage."

State of New York - Dr. Marvin Resnikoff - Comment 8

"The DES presents an abbreviated analysis for the complex and controversial area of accident environments. The authors of the DES consider only that damage inflicted on the containers by assumed fire and speed of impact factors and do not consider crush and puncture damage, the very damage mechanisms deemed to be so significant in the earlier Sandia report which was placed on the record of the State's case by the defendants themselves (Def. Aff. Nussbaumer, Exh. C, D and F)."

Staff Response - The categorization of aircraft accident severity by fire duration and impact force is an accepted technique. Crush and puncture were not included in the aircraft analysis because the results of Clarke et al. showed that, for aircraft accidents, the effects of impact and fire are much more significant than crush and puncture. Crush and puncture were considered in the evaluation of truck and rail accidents in Sections B.2 and B.4 of Chapter V (FES Sections 5.2.2.2 and 5.2.2.4).

DES Chapter V: 11

EPA - Comment 10

"The scheme of the de-rating of aircraft accidents seems somewhat unrealistic in one sense and quite arbitrary in another. First, airline routes do not blanket the entire country uniformly, especially flights carrying radioactive materials. It would seem much more realistic to determine the proportion of flights carrying radioactive cargo over the various land surfaces and then de-rate the accidents. Second, the reasons for choosing the number of accident severity classes by which accidents are de-rated are not apparent. The arbitrary nature of the statements brings them into immediate question."

Friends of the Earth - Comment 9

"Paragraph one states that 'only 10 percent of the land area of the United States could be considered as "unyielding surfaces" such as rock, concrete, or rock covered by soil. However, it should be pointed out that if air transportation is utilized to any great degree in the future (something we strongly oppose), this will mean a larger number of shipments departing from and arriving by air over concrete air strips. Thus, a large percent of shipments would be at risk."

Staff Response - The explanation of the derating scheme has been expanded and included as FES Appendix H. The data used for surface occurrence probability are based on actual air carrier flight paths. It should be pointed out that a concrete runway is not an unyielding surface, and very few air crashes at a velocity at which derating is important occur on runways.

DES Chapter V: 12

Friends of the Earth - Comment 10

"Paragraph three states that accidents of severity VII or VIII are expected to occur randomly. If so, then how does the NRC justify its statement (see above, Chapter V, pp. V-2, 3) that the most severe accidents are the least likely to occur? And how does the NRC justify non-random dispersal of radioactive materials?"

Staff Response - Aircraft speeds in takeoff and landing accidents are considerably smaller and altitudes are considerably lower than in inflight accidents. Category VII and VIII accidents, being inflight accidents, occur at random locations, in contrast to the less severe accidents, which would be expected to occur near airports.

DES Chapter V: 13

State of New York - Skinner/Willen - Comment 50

"No discussion appears in the alternatives section concerning the impact of facility location on the severity of accidents and the probability of their occurrence."

City of New York - Comment 6(3)(b)

"The accident classification scheme fails to consider population density as a contributing factor to accident severity."

Staff Response - Accident consequence, not severity, is a function of accident location (i.e., population density). It is not clear that the specific location of facilities would have any effect on accident severity.

DES Chapter V: 14

ERDA - Comment 33

"Crush forces are load dependent. Therefore, if, for example, a shipment is made in a sole use vehicle which contains only a few small radioactive material packages the crush force severity categories (e.g., category VIII, 5% of accidents involve a crush force greater than 500,000 pounds) are likely to be incorrect.

"Also it would be appropriate to define the phrase 'crush force.'"

Staff Response - The reviewer has misquoted the percentage of category VIII truck accidents. Table V-2 (FES Table 5-3) states it is 0.0015 percent, not 5 percent. We agree that the number of packages and package loading configurations is important. However, this effect is very difficult to treat quantitatively because of the wide variation in loading schemes. This problem is discussed in the text.

DES Chapter V: 15

State of New York - Dept. of Environmental Conservation - Comment 17

"This section indicates that in the case of accidents involving motor carriers the dominant factors in the determination of accident severity are crush and fire. Currently, packaging standards do not include crush specifications. It is recommended that the responsible regulatory agencies consider implementation of a crush standard."

Staff Response - Crush force standards designed to simulate the normal transport environment for Type A packages are specified in Appendix A to 10 CFR Part 71. Regulatory agencies are currently considering the introduction of crush standards for Type B packages.

DES Chapter V: 16

State of New York - Dept. of Environmental Conservation - Comment 20

"The first sentence of the last paragraph refers to 'Table V-2.' It appears that it should refer to 'Table V-6.'"

ERDA - Comment 69C

"Should it not be Table V-6?"

Staff Response - The typographical error has been corrected.

DES Chapter V: 17

EPA - Comment 2

"With regard to transportation accident analysis, the relationship of the shipping package test requirements and the performance of the packaging under various accident categories has not been established to our knowledge. Thus, the information on failure rates and release fractions are presented in Table V and the conclusions drawn are based solely on engineering judgment. This fact should be indicated in the final statement."

EPA - Comment 11

"EPA previously stated and still believes that a technical analysis should be performed relating packaging test requirements to the forces a package may experience in an actual accident environment since primary protection in transportation is currently provided by the packaging itself. Special attention would be given to the probable extent of damage expected to be suffered by the package and the resulting quantity of radioactive materials which may be released to the environment under the various accident conditions. In developing this analysis, it is important to use as much test data as possible rather than relying on unverified engineering models. EPA is encouraged that data is now being gathered from actual tests, however, it

appears that insufficient data makes it too early to use 'Model II' in Table V-6. In our opinion, Model I should be used as the basis for the risk assessment at this time, with Model II used only as a comparison."

Staff Response - The release fraction model has been revised to incorporate the recently available Sandia Laboratories' data. This model is discussed in Section B.6 of DES Chapter V (FES Section 5.2.6).

DES Chapter V: 18

Friends of the Earth - Comment 11

"NRC states that present shipping containers exceed required standards, apparently in reference to the Sandia Laboratories tests comparing severity of the thirty-foot drop onto an unyielding surface to a 2,000-foot drop onto hard prairie. The parameter excluded here is the 2,000-foot drop onto a hard surface, e.g., the surface of airports, which by the NRC's own standards, would therefore exceed both of the aforementioned tests."

Staff Response - There have been more recent impact tests on plutonium shipping containers performed at Sandia onto unyielding surfaces (steel over reinforced concrete). The implication that all aircraft accidents occur on runway surfaces and that all runways are unyielding surfaces is incorrect. The Sandia container tests involved impacts at speeds much greater than would be achieved in a 2000-foot drop.

DES Chapter V: 19

State of New York - Dr. Marvin Resnikoff - Comment 4

"Whether or not plutonium powder will escape its container during an air accident is dependent on two factors, the strength of the container and the severity of the accident environment. Considering the first of these, the DES makes only a passing reference to the wealth of material available as a result of the work done by Sandia Laboratories, and others, as well as a great deal of data supplied by the many experts appearing in the case of State of New York v. Nuclear Regulatory Commission, et al., United States District Court for the Southern District of New York (75 Civ. 2121 [WCC]). No data whatsoever can be found in the DES to dispute the criticism in the affidavits previously filed by the State in that case and in the Nuclear Regulatory Commission ('NRC') proceeding on transportation noticed at 40 Fed Reg. 23768."

State of New York - Dr. Marvin Resnikoff - Comment 5

"It has been determined under performance test conditions that the integrity of these containers are breached by levels of test crash environment intensity which are significantly less severe than actual air crash environments (Def. Aff., Nussbaumer, Exh. D; Pl. Aff., Pinkel, p. 6; Resnikoff, [6/12/75], p. 3). In fact, during test drops done for NRC at speeds of only 130 feet per second, even the inner pressure vessels were caused to leak (P. Aff., Resnikoff [6/12/75], p. 3; Def. Aff., Nussbaumer, Exh. D.). The Sandia Laboratory Report, 'Special Tests

for Plutonium Shipping Containers,' annexed to the Nussbaumer affidavit as Exhibit D, candidly admits that, if impact speeds were raised to 150 feet per second, spillage of nuclear material is likely (Pl. Aff., Pinkel, p. 6; Def. Aff., Nussbaumer, Exh. D). Yet the DES classification scheme for accident severity categories assumes that no material will leak from cannisters in such accidents. Hence, these assumptions in the DES directly contradict the earlier affidavits of defendants submitted to the Federal District Court and the NRC."

State of New York - Dr. Marvin Resnikoff - Comment 7

"Cannister strength is lightly treated by the DES on pages V-24, 25, and 26 and VI-48 and 49. At this late date the NRC admits that 'only a limited number of containers [have been] tested.' The DES assumes that 'Model I' packaging (that is cannisters meeting current regulations) would fail (p. V-12). As to cannister 'Model II', which is deemed by the NRC to be a conservative approximation of 'real containers in an accident environment' (VI-26), and hence the critical link for NRC's allegations as to safety of containerization, the authors rely on unspecified 'personal communications' for substantiation of their various assumptions. This totally undermines the validity of this analysis for the purposes of this DES. The authors arbitrarily define fractions of plutonium powder shipments which will be released in the event of an air accident of a given severity class. Of the two references presented to support these arbitrary assumptions, one (9) (p. V-24) is a private communication. A 'private communication' is also referred to earlier on page V-14 in regard to population densities across the country. 'Private communications' are a highly suspect source for a very important parameter for study of this area. No specific data is ever identified as stemming from this 'personal communication'; and hence, no basis is given for the authors assumptions as to accident severity classes and release model fractions. These models are unverifiable and, as a result, highly questionable, to say the least."

Staff Response - The most recently available shipping container data have been used in the FES. It should also be pointed out that the breach of a container does not necessarily result in release of all or part of the contents and that release of contents does not necessarily imply aerosolization of all or part of the released materials. Since no data base ever includes all possible data, some degree of engineering judgment is required. The Sandia Laboratory report, "Special Tests for Plutonium Shipping Containers," was seriously misquoted by Dr. Resnikoff. It does not say "if impact speeds were raised to 150 feet per sec, spillage of nuclear material is likely." What it did conclude was: "It appears that any increase in impact velocity for the SP 5795 and L-10 containers would seriously damage the vent valves in the top of the pressure vessels and might permit loss of contained liquid." And in the fire tests, "The 6M container failed to retain the solution which leaked from the bottle inside the pressure vessel. The leakage referred in both cases to liquid contents. Referring to the 6M, the report went on to say "Had there been a metal or oxide contained within the pressure vessel, it appears that there would have been no leakage from the pressure vessel." The 1975 Survey data indicated that virtually all plutonium shipments in 1975 were in metal or oxide form. Furthermore,, 10 CFR § 71.42 requires that, after June 17, 1978, all plutonium in excess of 20 curies per package must be shipped as a solid.

DES Chapter V: 20

State of New York - Dr. Marvin Resnikoff - Comment 6

"No thought has been given to the potential of penetration damage due to shrapnel-like fragments of disintegrating airplane components resulting from an air accident (Pl. Aff., Pinkel, p. 7). Dr. Chapman, formerly of the Cornell Aeronautical Laboratory, is in agreement with Mr. Pinkel and Dr. Resnikoff when he concludes that, given the present containers, there is little assurance of containment of materials in air crash environments, which are clearly more severe, more complex and of greater impact than accidents in other modes of transport (Pl. Aff., Chapman, pp. 2-3; see also Pinkel, Resnikoff). The containers now in use by the NRC, their agents and licensees are clearly not designed from a complete knowledge of the air crash environment and continued use of such containers in air transport jeopardizes human life (Pl. Aff., Pinkel, p. 10)."

Staff Response - The analysis of air crash environments by Clarke et al. (SAND 74-0001) concluded that damage by shrapnel impacts that might puncture the container was an order of magnitude less likely than damage by the overall container impact.

DES Chapter V: 21

ERDA - Comment 34

"From this statement and the discussion near the top of page III-17, the reader is left with a confused picture. Is the calculation for ^{131}I and ^{137}Cs release consequences based on the milk path or on the inhalation path only? The statements in Chapter III imply that only the inhalation was included in which case the consequences for ^{131}I and ^{137}Cs releases are underestimated. This should be clarified in the final statement."

Staff Response - The part of Section C that conflicts with Chapter III has been deleted. The current model does consider only inhalation doses for I-131 and Cs-137. This is justified in the case of I-131 by assuming that affected milk or crops will be impounded for 60-80 days to permit decay (for I-131) or destroyed (for Cs-137). Hence, minimal ingestion would occur. This assumption is reasonable because of the relatively small quantities of material released.

DES Chapter V: 22

HEW - Comment 13

"This represents two cycles incorporated into one and is usually referred to as 'grass-cow-milk-man' and 'grass-cow-man' cycles."

Staff Response - The phrase in question has been deleted.

DES Chapter V: 23

Friends of the Earth - Comment 12

"We disagree with the statement that 'Consequences to the aquatic environment are less well understood than for the land.' At least one thing is known about living organisms in aquatic environments, namely that they concentrate radionuclides in their flesh (and bones, if they are bony fish), and that these concentrations can easily end up in the food chain that terminates with man. It is also quite obvious that radioactive spills in water are irreversible and cannot be cleaned up, unlike contamination of buildings, solid materials, etc. Consequently, radioactive contamination of bodies of water and of aquatic organisms is likely to be highly detrimental to non-human species of plants and animals, whereas radioactivity released into air can be more injurious to human beings through ingestion or high whole-body doses from gamma radiation."

Department Of The Interior - Comment 5

"The report does not specifically analyze consequences of accidents resulting in significant quantities of radioactive materials entering surface waters. While the probability of such occurrences would no doubt be very low, such an analysis might still be desirable to determine if conditions could arise requiring emergency measures to protect public water supplies."

Staff Response - The commenter disagrees with a statement that "consequences to the aquatic environment are less well understood . . ." because it is known that fish concentrate radioactivity in their flesh and bones. In order for them to do so they have to ingest some radioactivity either through water or food. Many radioactive materials, including plutonium dioxide, are comparatively insoluble in water. It is difficult to imagine an accident of such severity that the entire contents of the container would be spilled into the water except possibly for Type A packages. These are primarily radiopharmaceuticals that have very short half-lives. For Type B package incidents, packages would normally be recovered. A single radioactive spill in the ocean depths would soon be diluted to safe levels. In the interim, restrictions requiring monitoring of fish taken from the contaminated water, in much the same way as was done for deer taken by hunters from the grounds of the Savannah River Plant, would minimize the direct impact to man. The low frequency of transportation accidents involving radioactive material shipments and the very small probability that such an accident would occur over water reduces any danger of significant contamination of water and the associated aquatic food chain to a very low level.

DES Chapter V: 24

State of New York - Dr. Marvin Resnikoff - Comment 16

"The DES assumes 10,000 people/square mile to be a 'High Population Density' (P. V-30). Examination, however, of the Tri-State Regional Planning Commission 1970 Census population distribution shows that there are only a few square miles within a zone of maximum impact in

New York City with 10,000 persons or less (Pl. Aff. Skinner-Wang sworn June 13, 1975, exhibit 7). The Skinner-Wang affidavit utilizes 40,000 persons/square mile as a more representative value for a 'worst case' accident at JFK. According to that affidavit a four-fold increase in the population density would result in a four-fold increase in the impact presented in figure V-12 and V-13 of the DES."

State of New York - Dr. Marvin Resnikoff - Comment 25

"Although many variables have been mentioned herein as being underestimates, only one of these, population density, is analyzed in the DES for sensitivity in the accident scenarios. As mentioned before (Pl. Aff. Skinner-Wang, sworn June 13, 1975, Table A) we maintain that 40,000 people/square mile is a more representative population density for the New York City region imperiled by plutonium air shipments. This represents a 400% increase over the baseline population density (10,000/mile) NOT 10% as the DES assumes."

Staff Response - In terms of population density in the United States, New York City is a singularity. The assumed urban density of $10,000/mi^2$ includes 90 percent of the "cities" in the U.S. with populations greater than 100,000. The worst-case analysis in the final environmental statement includes an analysis of an area with a population density of 40,000 people per square mile.

DES Chapter V: 25

ERDA - Comment 35

"There is no discussion or reference to explain the model used to calculate the area enclosed by isopleths. When area as large $10^4 km^2$ is involved (see figure VII), the model used for this calculation is very much of interest since this area exceeds by more than four orders of magnitude the areas plotted in Meteorology and Atomic Energy. Also, such a large area would depend more on regional than on local meteorology. The atmospheric stability and wind speed should be mentioned as well as the method by which values of the dispersion parameters σ_y and σ_z are determined."

State of New York - Dr. Marvin Resnikoff - Comment 12

"Both Robert Barker of the NRC (Def. Aff. sworn May 30, 1975) and Dr. Marvin Resnikoff (Pl. Aff. sworn April 25, 1975 and June 2, 1975) (one of the deponents herein) utilized Gaussian models with full explanation of the input parameters and sensitivity thereto. The DES, inconsistent with the analysis of the NRC's own expert, Barker, does not even explain these differences in approach between the DES and the Gaussian analyses. The discussion of contradictions later in these comments shows that the DES predicts 617 Latent Cancer Fatalities, Barker 15,000, and Resnikoff 107,000. Since the DES arrives at conclusions different than either of those models, some explanation is required before the DES can possibly be relied on as having any validity."

State of New York - Dr. Marvin Resnikoff - Comment 13

"Dispersion is also dependent on the meteorological conditions assumed. Calm weather increases the amount of individual dosages and turbulent conditions decrease dosages. In the DES the authors state: 'A year or more of data record (sic) for these parameters is used in the model, which was obtained at two different locations' (p. V-29-30). Neither the data recorded nor the locations studied were presented; yet these factors quite obviously have tremendous impact on the conclusions presented in Figure V-10. Such data were presented by Barker (Def. Aff. p. 17 and exhibits) and Resnikoff (Pl. Aff. April 25, 1975 Table 2). Once again this omission precludes reproduction of the DES's conclusions by the reader. The DES's use of only average conditions from the 'year or more of data' recorded does not present scenarios capable of producing 'worst-case accident consequences' found in figures V-11 and V-12."

Staff Response - The dispersion analysis that was used in the DES is explained in Section C of Chapter V. Contrary to the allegations of the commenter, atmospheric dispersion is calculated using a Gaussian plume model and a substantial set of actually measured meteorological data; the 95th percentile values were chosen for use in the dose calculation rather than the average. Using 95th percentile data provides a good approximation to worst-case meteorology. The meteorological data were gathered at meteorological stations in Savannah River, Georgia, and White Sands, New Mexico. The authors acknowledge that diffusion models are not as accurate at large distances such as 100 km as they are at smaller distances from the release site. The discussion of the atmospheric dispersion model used in the DES has been expanded in the FES.

DES Chapter V: 26

Friends of the Earth - Comment 13

"In paragraph three, the NRC states certain population densities as their method of calculating person-rems from accidents involving radioactive materials, and then states that 98% of the U.S. area has a population density lower than any of these densities. However, they have overlooked the fact that insofar as air transportation is involved, most airports are located in metropolitan areas, particularly those of the heavily populated northeast where a good proportion of existing nuclear facilities are now located. Since only 25 states have no commercial nuclear reactors, it hardly matters what their population densities are. It is the population density in the areas near nuclear facilities that count."

Staff Response - The population densities of 90 percent of all U.S. cities with populations greater than 100,000 are less than that value used to represent urban areas in the DES. In addition, most airports are located near, not in metropolitan areas. If nuclear power reactors are meant to be "existing nuclear facilities," the criticism has little validity since no shipments to and from nuclear reactors are made by aircraft. Not all shipments considered by the DES use the air mode, but any shipment between two locations must pass over the intervening territory where accidents can and do occur. This is the reason that lower population densities areas were considered in the DES.

DES Chapter V: 27

ERDA - Comment 36

"Figure V-10 is self-explanatory although the normalization dose value of 0.8 rem seems odd and there is no explanation of it in the text. This figure, however, and figure V-11 on page V-38 are inconsistent. From figure V-10 the 10-meter release height curve yields a value of 4×10^6 m^2 at the 95 percentile. Thus, the area enclosed by the 8×10^{-4} rem per gm of ^{239}Pu released is 4×10^6 m^2. In figure V-11, however, the ordinate corresponding to 4×10^6 m^2 is 9×10^{-3} rem/gm of ^{239}Pu released. This discrepancy should be corrected."

Staff Response - Figure V-10 has been deleted, and Figure V-11 has been redrawn (FES Figure 5-7) to accommodate changes in the atmospheric dispersion model.

DES Chapter V: 28

State of New York - Dr. Marvin Resnikoff - Comment 3

"For the purposes of the DES the authors assumed an air shipment of plutonium with a size of four packages containing five kilograms each for a total of 20 kgs. (Tables V-13, V-12, V-7.). Actual practice seems to indicate that larger sized shipments are more realistic. For instance, two JFK PuO_2 shipments on July 29, 1974 and February 24, 1975 weighed 48.3 kilograms and 45.1 kilograms respectively, each more than twice the size assumed by the DES. This assumption undercuts the credibility of the 'worst-case' scenario."

Dr. K. Z. Morgan - Comment 2

"Table V-7, V-12, and V-13 are good examples of an attempt to give the impression of a very conservative consideration of the problem and an evaluation of the 'worst case accident' and yet your worst case assumes a shipment of only 20 kg of Pu when it is an established fact that larger Pu shipments have passed through some of our airports. When the reader notes such tactics used to depreciate the risks, he is inclined to question the credibility of the rest of report."

Staff Response - The revised standard shipment model includes explicitly a 100 kg (6000 Ci) shipment of $Pu^{239}O_2$, which passed through New York City during late 1974.

DES Chapter V: 29

ERDA - Comment 37

"In the last sentence a cloud height of 10 meters was assumed; however, we feel that atmospheric stability and wind speed assumption should be made and stated."

State of New York - Dr. Marvin Resnikoff - Comment 43

"For a diffusion model used to assess the consequences of release of radioactive materials, figure V-10, page V-31, what release height figures are used; and why are these chosen for each mode?"

State of New York - Dr. Marvin Resnikoff - Comment 46

"In the release consequences analysis (Chapter V, section E, page V-43), how do worst-case release heights vary from one mode of transportation to another (e.g., truck or helicopter accidents)?"

Staff Response - The weather conditions used in the analysis were 95th percentile values as discussed in the expanded section on the meteorological model. The 10-m release height was chosen for the reasons discussed in Section 5.3 and was used for all modes of transport and all releases.

DES Chapter V: 30

State of New York - Dr. Marvin Resnikoff - Comment 11

"The degree to which the public would become exposed to plutonium powder in the event of an air accident is dependent on the parameters discussed earlier and on several others as well; dispersion is one of them. The DES presents an almost incomprehensible complex of figures and explanations on this topic. A number of factors necessary for the reader's reproduction of the conclusions as to dispersion are omitted or inadequately described. The basic input term of deposition velocity, necessary for standard Gaussian analyses, is completely missing. Apparently Figure V-11, 'Specific Dose vs. Area,' is important to the DES's determination of areas which would be covered by plutonium powder after an accident. The term, Specific Dose (rem/gm), is depicted as varying with the area enclosing such a dose. This is an internally inconsistent concept (rems/gram of plutonium does not vary – it is a constant). Yet the concept becomes, by the use of other vague factors, the basis for figures V-12 and V-13, which set forth the number of people affected. Because of the inconsistencies and lack of descriptive information contained in the DES on this issue, we have been precluded from further comment on this analysis."

State of New York - Dr. Marvin Resnikoff - Comment 14

"Resuspension of the powder once it has settled out of the atmosphere onto buildings, vehicles, roads, etc., will plague decontamination and evacuation efforts and increase exposures to the public. The DES states only that 'the contribution to the total dose from cloud shine, ground shine, and resuspension can be obtained by the application of established factors to the results shown in figure V-11 . . .' (p. V-39). No use or actual application of these highly important 'factors is to be found in the DES."

Dr. K. Z. Morgan - Comment 1

"Here I read 'The Contribution to the Total Dose from Cloudshine, Groundshine, and Resuspension can be obtained by the application of established factors to the results shown in Fig. V-11. For ^{239}Pu and other isotopes of interest, these radiation effects are negligible . . .'

"I believe one has to be a bit naive to assume resuspension makes a negligible contribution to the human Pu dose. For example, several papers at the IAEA San Francisco meeting (November 1975), indicated the importance of resuspension. Here Romney (University of California) indicated that small particles of Pu are rapidly blown away from the source, and when resuspended they are deposited on plants that are eaten by animals and man. Most of the Pu found in vegetation got there by resuspension of dust. Jakublick (of Germany) indicated this PuO_2 on the soil migrates 100 times faster than soluble Pu (e.g. nitrate). Bondietti (of ORNL) indicated the Pu in soil forms complexes that are much more available for uptake by plants and animals. Becker (of EPA) suggested that the action of microorganisms in the soil may render this Pu available for uptake. McLendon (Savannah River Plant) found a high concentration of Pu in plants (1/10 that of core samples). This all suggests we cannot disregard the Pu in the soil where, in time, it may be transformed such that its fractional uptake by the human body may increase from 10^{-6} to 10^{-2}."

Staff Response - Deposition velocity and resuspension have been included in the dosimetric model both from a surface contamination and inhalation dose point of view. The typographical error on Figure V-11 has been corrected.

The commenter has significantly overstated the ingestion hazard for plutonium. The ingestion hazard is low because of several factors: GI tract absorption factors vary from 10^{-2} to 10^{-6}; resuspension factors are on the order of 10^{-4} m^{-1}; soil transport and plant uptake of insoluble plutonium are very low. The dose commitment from ingested plutonium is several orders of magnitude lower than that due to inhaled plutonium, if a single accidental release is postulated.

DES Chapter V: 31

ERDA - Comment 38

"We do not understand the shape of this curve. The dose should be proportional to the atmospheric dilution factor, E/Q or x/Q' and the area as a function of x/Q' as plotted in Meteorology and Atomic Energy has a concave shape to it, whereas this one (figure V-11) is convex. Since no model is described or referenced, it is impossible to check. As previously noted, we suggest that the source of this figure and how the curve was developed be referenced."

Staff Response - Several items are germane to this comment: (1) The reference is apparently to Figure A-8 on page 414 in Meteorology and Atomic Energy. This is function $\chi\bar{U}/Q'$ not χ/Q'. (2) Figure A-8 assumes a ground-level release; Figure V-11 in the DES assumes a 10-m release

height. (3) Figure A-8 assumes no initial dilution; Figure V-11 assumes the initial dilution in the 10-m cloud. (4) The curves in Figure A-8 are specific to wind speed and Pasquill stability category; Figure V-11 results from a Monte Carlo compilation of many combinations of wind speed and Pasquill category. The net result of these differences, especially the initial cloud height and initial source dilution makes Figure V-11 compatible with Figure A-8.

DES Chapter V: 32

ERDA - Comment 39

"A computer code is mentioned. Which code is it? Is it documented? There is an ANSI Standard for computer codes which if followed gives the reader some assurance that the code has been reviewed and checked for accuracy. Has this been done for the codes used in this document?"

Staff Response - The computer code referred to is the one that performs the Monte Carlo Gaussian calculations. The code is not adequately documented in unclassified literature, so the explanation of the calculation in Section C (FES Section 5.3) has been expanded to describe the calculations.

The ANSI standards review is strictly devoted to computer format, not theoretical basis. Hence, a review of that sort carries no implication of calculational accuracy.

DES Chapter V: 33

State of New York - Dr. Marvin Resnikoff - Comment 15

"Plutonium powder comes in various size gradations, depending on the source, some being more likely to settle in the lung than others. The more plutonium which settles in the lung, the greater the degree of risk of lung cancer. The authors of the DES assume 20% will be a candidate for deposition on the basis of particle size gradation of Fast Flux Test Facility ('FFTF') feed material (p. V-40) stated by the DES to be 20% respirable. However, plutonium oxide shipments through JFK in 1974 and 1975 (p. V-43) were admitted by the NRC to be 40% respirable. Indeed even the DES assumption of 40% respirability for JFK shipments is far too low as the authors have based that figure on a statistical construct of a 3.3 micron mean size of particles in those shipments. However, uncontested information in the record of the State's case against the NRC indicates that the range of particle size (.92 - 1.12 microns) did not include 3.3 micron particles at all, much less a mean particle size of 3.3 microns (Pl. Aff. Skinner, Appendix B). Since particles below 3.3 microns are '. . .considered to be respirable and candidates for deposition in the pulmonary tissue. . .' (p. V-40), it is accurate to say that 100% of the JFK shipments were candidates for lung deposition. Use of a 20% respirability figure represents a significant underestimate of plutonium's dangers. Again the DES proves to be a document replete with invalid assumptions."

ERDA - Comment 40

"We do not feel that taking 20% respirable as a median for 10% and 40% is conservative."

Staff Response - The value of 0.92 to 1.12 μm size is a mean value obtained by a measurement technique that examines the bulk surface characteristics of the particles. For biological response studies the characteristics of the mass distribution of plutonium with size was required. The information was inferred from the surface-related data using standard techniques. To assert that there were no particles larger than 1.12 μm or that biological data related to that diameter are those to be used is incorrect.

According to the ICRP Lung Dynamic Task Group analysis, particles of mean size 0.92 to 1.12 microns would be deposited between 20 percent and 30 percent in the pulmonary region, not 100 percent as alleged by the commenter.

The 20 percent respirable assumption is considered to be a conservative mean value because it is at the upper end of the data representing PuO_2 of U.S. manufacture, even though the value is below that of shipments that arrived at JFK in 1974 and 1975.

DES Chapter V: 34

Dr. K. Z. Morgan - Comment 10

"The ICRP lung model is used improperly. If the 750 ml lung tidal volume curve had been used (for the child) instead of the 2150 ml curve, it would be noted that about 28% and not 14% of the particles of 3 microns mean size distribution are retained in the lower pulmonary compartment of the lungs, and in either case (for the child or the adult) the larger Pu dust particles should not be neglected in the calculations of risk."

Staff Response - We believe the ICRP lung model is used properly for a 1-micron AMAD particle. The pulmonary deposition increase from a tidal volume of 750 ml to one of 2150 ml is small at this diameter (0.25 at 750 ml versus 0.23 at 2150 ml). If a 3.0-micron AMAD particle is assumed, the change is more significant (0.30 at 750 ml versus 0.20 at 2150 ml). Numbers are cited from Table 1 of "Deposition and Retention Models for Internal Dosimetry of the Human Respiratory Tract" (ICRP Task Group II report).

The effect of larger Pu particles, which settle principally in the nasopharyngeal and tracheobronchial regions, is negligible because of their rapid mucociliary clearance to the GI tract (biological half-times on the order of a few minutes to a few hours).

DES Chapter V: 35

ERDA - Comment 41

"No support or descriptions are given for either of the two components in the 'third factor.' The statement 'For plutonium this fraction is approximately 11/24' is unsupported as

is the statement 'ratios of irradiation rates and clearance rates. . .this factor is approximately unity for plutonium.' A geometric standard deviation of 3 (footnote) signifies a very wide range of particle sizes, and a most difficult aerosol from which to derive 'irradiation rates.' This lack of information renders the entire remainder of this section unsubstantiated and therefore of little value. We strongly suggest that additional information be supplied.

"Also, we would like to know what is the significance of 11 and 24 in the fraction 11/24 and is there any reference for these figures."

Staff Response - The "third factor" is the particle size distribution factor, which accounts for the fact that the actual plutonium particle size encountered is larger than the size used in the dosimetric calculations. This value, 11/24, is derived using the upper curve on Figure V-12 as a probable "realistic value" for respirability (11%) and comparing this value with the maximum value (24%) used in the dosimetric model. The section has been rewritten to clarify this point.

The geometric standard deviation of 3 was taken as a likely upper limit value for a JFK shipment in order to estimate its respirable fraction. This shipment was not used in the calculations in Chapter V.

DES Chapter V: 36

ERDA - Comment 42

"Radionuclide name is missing on first line. We assume this should be ^{239}Pu."

State of New York - Dept. of Environmental Conservation - Comment 21

"Table V-11 does not identify the first radionuclide on the list. It appears that it should specify Plutonium."

Staff Response - Table V-11 has been completely rewritten to reflect the revised standard shipment model. It now appears in FES Appendix A as Table A-6.

DES Chapter V: 37

State of New York - Dept. of Environmental Conservation - Comment 18

"These tables should include the consequences of accidents involving spent fuel."

Staff Response - Spent fuel has been added because of the large amount of interest in the consequences of transportation of that material.

DES Chapter V: 38

State of New York - Dr. Marvin Resnikoff - Comment 23

"Another significant underestimate in impact consequences can be found in Table V-13's use of the 'Integrated 1 year dose' factor. Instead of presenting the number of people who would have suffered irradiation over their 50-year adult lifetime, the DES presents a smaller number on the basis of only a 1 year dose. The text of the DES does not describe how this integration was done, which precludes adequate analysis by ourselves at this time."

Staff Response - The 50-year doses were omitted from Table V-13 because the emphasis in that table is on the early effects from the irradiation; 50-year dose commitments (in terms of integrated population dose) may be found in Table V-12.

DES Chapter V: 39

State of New York - Dr. Marvin Resnikoff - Comment 21

"Of interest as well is the DES's use of cutoff points for the production of LCF's from population exposure. Standard epidemiological analysis utilizes the formulas described above (LCFs/10^6 person-rems) based on the whole population exposed. This method is necessary to integrate the natural variability of people's response to carcinogens. Although the DES uses the above epidemiological tool, it applies that tool only to a part of the population, that part which has sustained more than a given dose, thereby eliminating a significant number of exposed persons (or person-rems) from consideration. Table V-13 employs a cutoff of 15 rem. That part of the exposed population, perhaps millions of people who, receiving less than 15 rem, are excluded from epidemiological consideration i.e., they are deemed by the DES as not being potential cancer victims. Such a method is contrary to standard epidemiological practice (as utilized in the Skinner-Wang affidavit of June 13, 1975, Exhibit 1). The method employed by the DES significantly reduces the impact of a dispersion accident."

State of New York - Dr. Marvin Resnikoff - Comment 22

"A similar cutoff or threshold was applied to calculations underlying figure V-10. The cutoff of .8 rem was used for depicting the area enclosing populations dosed at that level. Since this figure is based on a one kilogram release and the DES worst case scenario was based on a 20 kg release, one can readily see that the actual cutoff is not .8 but actually (1) 20 x (0.8) or 16 rems or (.5) (20) x (.8) or 8 rems depending on the fraction of a shipment released (p. V-25)."

Staff Response - The only "cutoff" used in Table V-13 was the restriction of plume propagation to a maximum area of 10^9 m^2. This allows doses of order hundredths of millirem. Table V-13 merely lists 15 rem as a benchmark point since it is an NCRP recommended limit. The same misinterpretation was apparently used on Figure V-10. This figure was merely presented as being illustrative, not as one end or the other of the dose spectrum analyzed. It has been deleted from the final report.

DES Chapter V: 40

State of New York - Dept. of Environmental Conservation - Comment 19

"For the 20 kg Pu Case, the number of persons receiving doses greater than 15 rem, 10^4 rem, and 10^5 rem are listed. Since the number of persons receiving a dose greater than 15 rem is several orders of magnitude greater than those receiving a dose greater than 10^4 rem, the number of persons receiving doses at intermediate levels should be provided."

Staff Response - Table V-13 is not meant to show the entire dose spectrum; 15 rem was selected because it is a regulatory organ dose guideline, and 10,000 and 100,000 rem were chosen because of their particular health effect implications as discussed in Chapter V.

DES Chapter V: 41

State of New York - Dr. Marvin Resnikoff - Comment 17

"Radioactive material has a normal decay half-life of the material itself. In addition, when a radioactive material is taken up by the body, natural biological processes can expel a part of that uptake. The rate at which the expulsion takes place is known as the biological half-life. For the purposes of the DES the authors chose 500 days (page III-16). This assumption appears to be a significant underestimate. In the appendix to the DES (page B-7), the authors admit the '. . .lung clearance half-time' is 200-1,000 days. In order to obtain the worst-case scenario as described in figures V-12 and V-13, the authors should have used 1,000 days, not 500. There is significant authority for the use of such a value. The U.S. Environmental Protection Agency ('EPA') reports in its publication, 'Environmental Analysis of the Uranium Fuel Cycle, Part III - Nuclear Fuel Reprocessing,' 520/19-73003-D, that the new International Commission on Radiation Protection ('ICRP') lung model assumes a 1,000 day half-life as does the NRC's WASH-1535 'LMFBR Program Environmental Statement' in that document's Table II.G-9."

Staff Response - The actual value used for PuO_2 lung clearance half-time was 1,000 days as per WASH-1400 for category Y pulmonary clearance. This value is used to generate the value of 2×10^8 rem/curie; hence, it does in fact represent the "worst-case" clearance time.

DES Chapter V: 42

State of New York - Dr. Marvin Resnikoff - Comment 10

"It is significant that the earlier analysis by Resnikoff (Pl. Aff. April 25 and June 12, 1975), which only assumed 1/16 of the DES 'worst-case' release, resulted in the tens of thousands of Latent Cancer Fatalities ('LCF's'). Had he used a 20 kilogram release instead, hundreds of thousands of people would have become LCF's in all three cases of meteorological stability. (See Pl. Aff. Resnikoff, April 25, 1975, Appendix B.)"

State of New York - Dr. Marvin Resnikoff - Comment 29

"The DES presents accident impact conclusions which, in part because of the nature of the assumptions used, were smaller than those previously claimed by the NRC in the NRC affidavit by Barker (p. 5-12). Unfortunately lack of clarity and documentation in the DES precludes complete comprehension of all the origins of these discrepancies. Therefore preliminary analyses were made using known dispersion models with the major known impact assumptions used in the DES."

State of New York - Dr. Marvin Resnikoff - Comment 32

"Because of the lack of clarity and specifics in the DES model, we were unable to use that model and we utilized the Barker model instead, changing only the amount of plutonium oxide released. The Barker model originally used a release of approximately 1.25 kgs (page 1 BNL memo). We changed this amount to the amount utilized in the DES, 10 kgs. All other inputs were kept the same. This changed the value of latent cancer fatalities of 15,000 people which the Barker model predicted in Table No. 6 of the BNL memo (Pl. Aff. Skinner-Wang, sworn to June 13, 1975, Table A) to an astounding total of 53,000 people. The DES on the other hand, on page ii, predicted only 617 fatalities. The only possible explanation for this conflict lies in the many assumptions used by the DES which remain secret and unavailable for scrutiny by Congress or the public."

State of New York - Dr. Marvin Resnikoff - Comment 36

"Assuming GESMO utilized the worst-case conditions, stability Class F (Case B in Pl. Aff. Resnikoff, Table 2), over 1.4 million people would be exposed in the dispersion arc to 54 rems or more. On the other hand, the DES states in table V-13 that only 280,600 persons are being exposed to 15 rems or more. This massive inconsistency between the DES and other NRC documents totally undercuts the validity of the health effects model of the DES for air transport of plutonium."

Staff Response - The alleged massive inconsistencies between computation using other dispersion and dosimetric computational schemes are largely a function of varying input data such as assumed population density, assumed respirability, assumed Pasquill stability category, assumed material toxicity. The factor of 5 between the DES and GESMO models could be accounted for by any of these and may not be inconsistent when taken in context. In other words, the GESMO assumption may be for different circumstances than the DES assumption. If the Resnikoff assumptions are used in the DES model, a value of 4.0×10^6 is obtained. It is believed that the assumptions used in the DES analysis are more valid, and hence they are employed.

DES Chapter V: 43

ERDA - Comment 43

"Delete the word 'physiological' since it is meaningless as used here."

Staff Response - The phrase in question has been deleted.

DES Chapter V: 44

ERDA - Comment 44

"We suggest that Equation (1) should be given or referenced."

Staff Response - Equation (1) is given on DES page V-1. The FES refers the reader to Appendix G for more detailed equations and the method by which risk is calculated.

DES Chapter V: 45

ERDA - Comment 46

"The risk reported in this table of accidents in the shipment of PuO_2 is (for the same annual shipment quantity) at least four orders of magnitude greater than that found in a detailed assessment of the risk of shipping plutonium by truck. (T. I. McSweeney, R. J. Hall, et al., 'An Assessment of the Risk of Transporting Plutonium Oxide and Liquid Plutonium Nitrate by Truck,' BNWL-1846, Battelle Pacific Northwest Laboratories, Richland, Washington, August 1975).

"We feel that this is extreme conservatism in the accident risk analysis."

Staff Response - There are numerous differences in analytical methodology between BNWL-1846 and NUREG-0034. The area of principal difference appears to be in the release fraction model and in the aerosolization model. In both of these cases, the BNWL values are orders of magnitude lower than those used for NUREG-0034. Available data should be used to predict release fractions. That data base forms the basis for the DES release model.

DES Chapter V: 46

Friends of the Earth - Comment 14

"NRC inexplicably says that the risk of plutonium accidents goes down in the 1985 projections. We would like to inquire: why? How can this statement be justified, in view of the government's determination to proceed with experimental, and later commercial, plutonium recycle and the fast breeder plutonium economy? It is not unreasonable to assume that greater use and transport of plutonium increases the risk of accidents due to plutonium release (or diversion)."

Staff Response - The statement was that the percentage of the risk due to plutonium accidents decreased slightly; the actual risk increased, but the percentage of the total risk caused by plutonium shipments actually decreased. The question is now academic, however, because the standard shipment model has been revised using the 1975 survey data.

DES Chapter V: 47

State of New York - Dr. Marvin. Resnikoff - Comment 19

"Recycle of plutonium in today's light water reactor fuels will increase the concentrations of certain isotopes of plutonium in any shipments by air as shown below:

Plutonium Constituents

Constituent	DES (B-5)	JFK*	WASH-1327**
Pu-238	1.9%	0.6%	4%
Pu-239	63.0%	72.0%	43%
Pu-240	19.0%	18.7%	26%
Pu-241	12.0%	7.0%	15%
Pu-242	3.8%	1.6%	11%
Am-241	0.6%		1%
Rems/curie	10.6×10^6	39×10^6	83×10^6

(See April 25, 1976 Resnikoff affidavit - table 2 for calculations of Rems/curie)

"These increases mean that the latent cancer danger of plutonium powder will increase by about 100% when plutonium recycle matures. This effect has not been taken into account in tables V-16 and V-17 of the DES."

Staff Response - The effect of isotopes other than Pu-239 in recycle fuel or discharged LWR fuel is discussed in DES Appendix B (FES Appendix C). The numbers derived there are used for the 1985 plutonium toxicity values.

DES Chapter V: 48

HEW - Comment 14

"The statement does not project the latent cancer fatalities (LCF) or early fatalities (EF) to the year 1985. Although exposure is projected to increase by a factor of approximately 3 from 9589 (1975) to 28,590 (1985), this suggests the LCF could increase from 1.2 in 1975 to 3.6 in 1985 as a result of normal transport only. Assuming the increase of a factor of 3 and an essentially equivalent population exposure, one may project the fatality data on pg. xx to be as follows:

	1975	1985
Early Fatality	1	3
Other deaths	16	48
Latent cancer deaths (30 yr. period)	600	1800"

Staff Response - LCFs due to accidents for 1985 are predicted in Tables V-16 and V-17 and EFs for 1985 are predicted in Table V-18. The LCFs due to normal transportation are (as inferred) 3.6 in 1985. The early fatality and LCF predictions from page xx should not be scaled as suggested in the comment. These values are based on a single "worst-case" analysis. The parameters for that analysis are shipment size, population density, material characteristics, and meteorology. None of these parameters will change with the number of shipments, which is the basis for the cited scale factor (3). The aspect of the "worst-case" accident that will change is the annual probability of occurrence, since this is a function of number of shipments. The observation that the alternatives in the DES were not projected to 1985 is correct, but the alternatives in the FES are based on 1985 risk.

DES Chapter V: 49

ERDA - Comment 69D

"Should it not be 0.2 fatalities per year? (Page V-54 of DES)."

State of New York - Dept. of Environmental Conservation - Comment 22

"The last sentence of the first paragraph refers to a number of injuries and fatalities 'per reactor year.' It appears from what is presented previously in the paragraph that it should refer to the number of these events 'per year.'"

Staff Response - The data from WASH-1238 is on a reactor-year basis. Hence the text was correct as written.

DES Chapter V: 50

State of New York - Dept. of Environmental Conservation - Comment 23

"Justification should be given for assuming that the population at risk is 75 million persons."

Staff Response - The selection of 75×10^6 persons at risk has been explained in more detail.

DES Chapter V: 51

State of New York - Skinner/Willen - Comment 48

"Your analyses have considered impacts of transportation accidents in terms of population dose only. Careful consideration must be in the final document of the clean-up costs of all postulated accidents as well as a qualitative description of the inconveniences suffered by residents adjacent to and within accident contamination zones."

State of New York - Skinner/Willen - Comment 49

"Your analyses should contain reviews of typical accidents which have already occurred and the costs and difficulties of clean-up at each. These reviews should include plutonium clean-up operations at Thule, Greenland and Palomares, Spain."

Staff Response - A section on contamination/decontamination has been added to FES Chapter 5. This section includes a discussion of cleanup costs, etc., based on WASH-1400, Appendix VI, data. The authors feel that source is the most current and applicable material on that subject.

DES Chapter V: 52

State of New York - Dept. of Environmental Conservation

"The draft statement should also discuss indemnification for any damages that may result from transportation of radioactive shipments made under Federal regulations including human exposure, contamination limits, etc."

Staff Response - Although the extent of the insurance coverage may have an effect on the way people respond to an environmental impact, insurance does not appear to directly affect the impact itself. An analysis of insurance coverage is therefore not included in this statement. Information on insurance coverage can be obtained from the following reference:

> Joint Committee on Atomic Energy - HR-8631, "NRC Staff Study Concerning Financial Protection Against Potential Hazards Caused by Sabotage or Theft of Nuclear Materials," Appendix D, "To Amend and Extend the Price Anderson Act," Part IIB, "Geographic Limitation on Coverage."

DES Chapter VI: 1

EPA - Comment 18

"The act referred to as the National Environmental Protection Act is correctly cited as the National Environmental Policy Act of 1969."

Staff Response - The error has been corrected.

DES Chapter IV: 2

ERDA - Comment 47

"One section noticeably missing is a detailed history or 'Track Record' of fissile and other radioactive materials during the past 15-20 years and the analysis of that data utilizing the parameters used in this study. This omission is not understood since the first sentence in paragraph 2 on page VI-1 states, 'The environmental impact of an alternative in radioactive materials shipments is meaningful only when compared to the impact of the current shipping practice.' The evaluation of low consequence events of the past could then be compared to projected consequences of future shipments to assess the method used.

"No assessment is made of risks resulting from human error or faulty equipment which could result in dropping or puncturing containers during handling (fork-lifting) operations.

"In addition, no mention is made of specialized training for personnel involved in the various facets of fissile and radioactive materials shipments and the impact it might have in precluding incidents and accidents."

Staff Response - A "track record" section has been added to Chapter 1. The human error problem is addressed in Chapter 4 (in context with Appendix C).

DES Chapter IV: 3

HEW - Comment 14b

"The alternative analysis is based on current shipment impact, pg. VI-1, and does not appear to be projected in terms of conditions which might be expected in 1985. Essentially, the alternatives are compared on a basis of cost benefit versus radiological effect(s), pgs. VI-1 and VI-3. If one accepts the figure of $\$8.22 \times 10^6$ per LCF or any other death, an investment benefit in terms of citizen protection may be calculated."

Staff Response - The alternatives were all discussed relative to the baseline 1975 data in the DES but are based on 1985 data in the Final Environmental Statement. The cost-benefit is assessed by using the value $\$8.22 \times 10^6$ per LCF and comparing the equivalent dollar value for a reduction in LCF with additional costs to provide this reduction.

DES Chapter VI: 4

ERDA - Comment 48

"We suggest that the annual population dose due to accidents be included."

Staff Response - Population dose (in person-rem) has been added to Table VI-1.

DES Chapter VI: 5

State of New York - Dr. Marvin Resnikoff - Comment 40

"How are cancer fatality figures for normal and accident transport situations calculated? (Table VI-1, pg. VI-2)."

State of New York - Dr. Marvin Resnikoff - Comment 41

"What is the basis for figures in Table VI-1 on annual person-rems in normal transport for each type of radionuclide? How are the annual person-rem figures calculated in the alternative section (e.g. Table VI-4, pg. VI-10)?"

State of New York - Dr. Marvin Resnikoff - Comment 38

"There is a major difficulty in determining the areas of sensitivity when the various parameters in the risk equation for accident scenarios, pg. V-8 are changed in alternative situations. We are provided with a set of figures for the baseline and alternative situations, but nowhere are there any intermediate or exemplary calculations which would show what, specifically, contributed to the change between the baseline and alternative figures. For example, in Table VI-3, page 41-7, we are given the set of figures for all air shipments being instead transported by truck. But it is impossible to tell from these new figures alone, just what contributed to the alternative results -- a difference in vehicle miles/year, probability of accidents, accidents of different severity classes, etc. Without the benefit of intermediate calculations, it is impossible to determine why the proposed alternatives result in the changes given in the summaries."

State of New York - Dr. Marvin Resnikoff - Comment 44

"In the summaries of results for each transport mode, how are figures for "probabilities of $\geq$ 1 early fatalities/year" derived, e.g., Table VI-4, page VI-10?"

Staff Response - The calculation methods specified in FES Chapters 4 and 5 and Appendices D and G are used for all baseline and alternative analysis. The alternative section has been expanded to specify the reasons for changes in radiological consequences in more detail.

DES Chapter VI: 6

ERDA - Comment 49

"Table VI-4 and following give baseline and alternative calculated values then a change, usually in percent. Giving this change in percent rather than in absolute value tends to be misleading. This is particularly true when evaluating the sum of LCF for normal and accident. For example, on page VI-22 we find a normal transport LCF increase from 1.166 to 1.195 or 0.029 or 2% while accident LCF decreases 21%. Stopping there it sounds like a substantial overall LCF decrease. But looking farther we see the 21% decrease is from 0.000529 to 0.00044 or 0.000089 decrease off-setting 0.029 increase or a net 0.0289 increase. We recommend showing the change in absolute values throughout this section.

"Furthermore, we feel that the text could be strengthened by the addition of narrative which place the differentials between alternative modes in perspective relative to the probable accuracy of the result (i.e., relative to the confidence limits in the data). For example, what is the confidence in, or significance of, the computed 21 percent decrease in latent cancer fatalities due to accidents?"

City of New York - Comment 6a

"Computed estimates of alleged risk are singularly deficient in statistical confidence limits. For example, the risk assessment relies upon a progression of modelling stages; the cumulative effect of the degree of precision lost at each stage makes the study of little or no value."

Staff Response - The percentage changes in LCF have been deleted; only the absolute values are given. It is very difficult to present confidence limits in a calculation of this type. For example, it is doubtful whether confidence limits could be applied to the package response model because of the paucity of the package test data. However, throughout the calculation, a conservative approach has been taken in those stages of the model where the degree of confidence is unknown. Therefore, the computed values for risk are not statistical averages about which one would place confidence limits but more like a conservative upper bound.

DES Chapter VI: 7

ERDA - Comment 50

"The annual air cost minus truck cost in dollars for plutonium shipments should be 2.8×10^3, not 3.4×10^3, based on the information in this table. Also, the footnote for this table is confusing since it is indicated that the plutonium shipping distance is 1200 miles but the cost is given for a 2000 mile trip."

Staff Response - The two errors in Table VI-6 have been corrected.

DES Chapter VI: 8

State of New York - Dr. Marvin Resnikoff - Comment 42

"How are mileage, exposure time, and population dose figures determined for alternative transportation modes? (e.g., switching from all passenger to all cargo aircraft, paragraphs 1 and 2, pg. VI-16)."

Staff Response - Any changes in parameters used in the baseline 1985 study derived for the alternative calculation were based on data for the mode established earlier and on estimates of increased (or decreased) mileages necessary for performing specific mode shifts or service pattern changes. Wherever possible supporting reference material was cited.

DES Chapter VI: 9

ERDA - Comment 51

". . .States, 'additional secondary mode mileage. . .' This is in conflict with statement on page VI-17, B.1-3 which says, 'shorter distance in secondary mode.'"

Staff Response - There is an error in the assignment of additional secondary mode costs in the shift from cargo air to passenger air, and this error has been corrected. Because of the greater number of airports providing passenger air service, the average secondary mode mileage would be shorter for transport by passenger aircraft.

DES Chapter VI: 10

Friends of the Earth - Comment 15

"In discussing the alternative of shifting all radioactive cargo to passenger aircraft, the report states that although this would increase passenger exposure, it would decrease the exposure (presumably to the public at large) by reducing the total miles travelled in secondary modes. We take issue with the practice of separating passengers - or cargo handlers - or nuclear industry workers - from the public at large, specifically as it relates to the genetic effects of radiation. NRC can hardly take issue with the fact that there is gene flow via reproduction between workers and non-workers, or between passengers and non-passengers. This indefensible distinction becomes particularly odious when one becomes aware of recent studies indicating that ingested plutonium may concentrate in the gonads."

Staff Response - This alternative decreases the total amount of exposure to the public, which is a net positive effect. It is not essential to discuss the exposure to various groups such as cargo handlers in order to assess the risk. As for genetic effects, the discussion in WASH-1400, Appendix VI, indicates that these are negligible compared to somatic effects. The comment about ingested plutonium being concentrated in the gonads is irrelevant to discussions of normal transport.

DES Chapter VI: 11

Transnuclear, Inc. - Comment 2

"In Chapter VI the discussion in Section B.1-6 indicates that seven times as many shipments will be required by truck as compared to rail. However, in Table VI-17, there are 380 shipments per year by truck and none by rail. This value should be 54 + 7(326) = 2336 if all 326 rail shipments are to be transferred to truck. If the radiological impacts as reported in Table VI-18 are based on Table VI-17, there may be significant errors in the results."

Staff Response - The FES includes more accurate treatment of spent fuel shipments, including capacities of truck and rail cars.

DES Chapter VI: 12

ERDA - Comment 52

"The discussion fails to acknowledge the aggravated logistics and increase in facilities and labor required at a reprocessing plant receiving about 5 metric tons of fuel per day by truck relative to rail. This is important also in light of the added potential for operator error, and dosage to plant operating personnel.

"Some mention of the efficient utilization of transport fuels is probaly appropriate A 1000 MWe light water reactor might originate 60 spent fuel cask shipments per year by truck or 10 cask loads by rail. Fuel consumption is typically 670 BTU per ton mile by rail; 2400 BTU per ton mile by truck. Assuming a 1000 mile trip (each way), rail shipments would save over 64,000 gallons of diesel fuel per reactor year."

Staff Response - This information has been incorporated in the FES.

DES Chapter VI: 13

Transnuclear, Inc. - Comment 3

"We also question the economics of spent fuel transport as reported in Section B.1-6.2. A recent study by the Edison Electric Institute on Nuclear Fuels Supply reported in Appendix V:

"'The cost of transporting a normal spent fuel annual discharge for a 1200-1300 MWe reactor over a distance of 1000 miles to a reprocessing plant is about $680,000 using a legal weight truck, $275,000 using an overweight truck, $460,000-$530,000 for a non unit train, and $750,000-$860,000 for a unit train.'

"We suggest that the alternative for spent fuel transport be presented as follows:

	Legal weight truck	Special permit truck	Rail
PWR elements/cask	1	3	7
Trip distance miles	1,000	1,000	1,000
Trips per year (1975)	2,336	780	334
Cost per assembly	11,300	4,600	7,600-14,300

"The radiological impacts should be calculated using the above values."

Staff Response - The EEI information has been incorporated into the discussion of the alternative in the FES.

DES Chapter VI: 14

United Airlines - Comment 2

"To prohibit shipments of radioactive material during adverse weather would be impractical because it changes so quickly in widely separated geographic areas."

Staff Response - A statement concerning the impracticability of this alternative has been incorporated into the FES.

DES Chapter VI: 15

United Airlines - Comment 3

"To restrict movement to daytime flights would eliminate most freighter flights. This would be very undesirable."

Staff Response - Restriction of flights to daytime hours has been eliminated as an alternative.

DES Chapter VI: 16

United Airlines - Comment 4

"It would not be practical to restrict movement by air to airports in low population areas, since service by air is so limited at such locations. A better alternative, if this is a valid concern, would be to prohibit transport by air."

Staff Response - Qualification "a" in Section B.2-2.3 (Qualification 1 in FES Section 6.3.1.2) discusses the limited air cargo service to suburban airports.

DES Chapter VI: 17

City of New York - Comment 3c

"Not only is there a failure to adequately analyze alternative modes of transportation, there is a virtually total lack of discussion of the impact of alternative routing of nuclear transportation shipments. The DES acknowledges the importance of population density in determining the significance of an accident (V48), but nonetheless fails to discuss routing alternatives which would take difference in population density into account."

Staff Response - Routing alternatives for aircraft are discussed in paragraph B.2-2.3 of Chapter VI. Routing alternatives for truck/van are discussed (qualitatively) in paragraph B.2-3.1 of Chapter VI.

DES Chapter VI: 18

EPA - Comment 12

"The discussion on the mitigation of accident consequences which precedes this table [Table VI-25] in this section indicates a decrease in the 'Accident L.C.F.' rather than an increase as given in Table VI-25. The reason for this seeming inconsistency should be explained."

Staff Response - In the discussion preceding the table, it was stated that, by requiring radioactive material flights to avoid zones of high population density, the risk to the population from flight accidents would be lower. However, these restrictions would severely limit the number of available airports, thereby increasing the average secondary mode mileage. The increased number of secondary mode accidents would produce the overall increase in accident LCF.

DES Chapter VI: 19

State of New York - Dr. Marvin Resnikoff - Comment 47

"On page VI-41, Section B.2-3.1, what procedure is used to determine reduction in truck accident rates due to the 3 alternatives given?"

Staff Response - The accident rate reductions for these alternatives are discussed in the cited reference.

DES Chapter VI: 20

ERDA - Comment 53

"States 'Restricting trucks to good weather driving. . .'A restriction of this type would precipitate confusion as to the definition of 'good weather driving' and would prevent the

driver from exercising discretion as to whether road conditions are safe or unsafe (he should be in the best position to make that determination)."

ERDA - Comment 54

"This section discusses restriction on truck travel on weekends. Since truck costs are based on miles covered, denial of weekend travel would severely escalate costs of shipments by this restriction. Long-haul operations that are currently on the road for greater than five days would be severely affected."

Staff Response - These observations have been incorporated into the discussion of the alternative in the FES.

DES Chapter VI: 21

State of New York - Dr. Marvin Resnikoff - Comment 45

"Why are certain alternatives evaluated only with regard to cost, while discounting seemingly significant decreases in accident latent cancer fatality figures, e.g., Table VI-28, page VI-44."

Staff Response - A dollar value was assigned to LCF values in an attempt to put accidents, normal transport, and overall cost into perspective.

DES Chapter VI: 22

ERDA - Comment 55

"In view of recent railroad actions, we feel this section deserves more emphasis and perhaps some expansion. Specifically, is there any basis in statistical data to suggest that the addition of special train units (extra's) operating over trackage otherwise scheduled, but at less than normal freight train speed would increase accident frequency or consequences relative to normal freight service?"

Association of American Railroads - Comment 1

"The conclusions on pages VI-44-45 were predicated on regular train service and a number of accidents (most of which were assumed not to be of a serious nature), but should have been predicated upon special train service with no accidents."

Staff Response - The section on special trains has been revised to include safety and economic data from several sources. These sources (notably, an analysis of AEC weapon transportation) indicate that a reduction in accident rate occurs, perhaps by as much as a factor of 7; however, special trains are certainly not immune to accident as suggested.

DES Chapter VI: 23

EPA - Comment 13

"Correction of the term 'ny' is necessary to clarify the sentence's meaning.

Staff Response - The typographical error has been corrected.

DES Chapter VI: 24

Friends of the Earth - Comment 16

"In this table of alternative transportation modes, two modes that could reduce radioactive exposure are inexplicably left out: avoiding cities (by barging materials where possible, as with Brookhaven National Laboratories, and the Shoreham and Jamesport reactors on Long Island); and barges themselves as an alternate or for part of a trip. Cities could be avoided by the use of not only barge but of trucks and railroads; surely the avoidance of populated areas - a general government policy where hazardous materials are involved - could substantially reduce potential effects from accidents or releases. Why is this not considered? Why were barges not considered?"

City of New York - Comment 3a

"There is a failure to make a rigorous and objective evaluation of all reasonably available alternatives. To take but one egregious example, barging is described as creating a "negligible" population exposure (IV-34), and barging has been recognized by USEPA as a desirable alternative to land transportation, yet no assessment of it is made in 'Chapter VI - Alternatives' or in the 'risk assessment section of Chapter IV.'"

Staff Response - The use of barges has been more adequately discussed in the Final Environmental Statement.

DES Chapter VI: 25

State of New York - Dr. Marvin Resnikoff - Comment 39

"The methods of obtaining figures for normal and accident L.C.F. in both baseline and alternative transport situations are quite unclear. There is no derivation given for the equation from which the baseline risk figures are obtained. (The equation itself is very difficult to find, especially in light of its exclusive use in determining the final figures). The variables used in this general equation are also hard to locate and several of them (e.g., vehicle miles/year for each type of shipment, probability/vehicle mile of a specific severity class accident) can only be obtained through a series of separate calculations. Calculations of the alternative results are made by changing a specific parameter in the original equation and following this through; this is obviously done with a computer program, but no program is provided, making it very difficult to reproduce these results. In addition, inconsistencies

with the language used to show the changes between baseline and alternative situations make the results confusing and occasionally misleading. While most of the changes are represented in percentages, the very large reductions are not, e.g., a 'factor of 16 decrease', which seems fairly small, actually represents a 94% decrease in the baseline figure, a very significant change. Particularly puzzling are the rankings of truck, rail, and passenger air transport (VI 53-55)."

ERDA - Comment 56

"This table [Table VI-29] shows a factor of 16 increase for one item and 100% decrease for another. We suggest consistency in these tables. Same comment applies to table VI-30, page VI-49."

Staff Response - The calculational scheme is now specified in greater detail in FES Appendices D and G, and the language inconsistencies mentioned have been removed.

DES Chapter VI: 26

ERDA - Comment 45

"Accident LCF reduction in table [Table VI-30] is by a factor of 23, but the text refers to a 23% LCF reduction. This discrepancy should be corrected."

Staff Response - The text has been corrected.

DES Chapter VI: 27

ERDA - Comment 57

"States '. . .Since accidents involving plutonium shipments are expected to produce 98.6% of the total risk. . .' If this statement is true, then the packaging requirements for all quantities of plutonium shipments should be upgraded. Perhaps consideration should be given to require all transuranics to have a super classification of containers to be used for all modes of transport."

Staff Response - NRC is currently evaluating standards for packagings for plutonium.

DES Chapter VII: 1

Friends of the Earth - Comment 1

"The draft environmental statement refers here to air transport as an "effective means of protection" against theft and sabotage of radioactive materials. We strongly disagree. Sabotage of aircraft could lead to a crash and fire and possible dispersal of radioactive materials. Air transport is therefore not an alternative to ground modes of transport since it offers additional potential for such dispersal, in fact triple potential, through aircraft malfunction, pilot error, or sabotage. In our opinion, air transport is the least acceptable and by far the most risky of all transportation modes. Rather than offering an "effective means of protection," it offers instead a wider variety of possible events that could result in dispersal of radioactive materials."

Staff Response - The FES reflects the NRC conclusion that, regardless of the mode of transportation, adequate protection can be provided against theft and acts of sabotage that would result in a significant radiological hazard.

DES Chapter VII: 2

Friends of the Earth - Comment 15

"The report goes to great lengths to assert its desire to protect civil liberties while maximizing safeguards. Yet the Special Safeguards Study has already suggested considering such anti-civil liberties measures as wiretapping, surveillance, and infiltration of groups that the government considers potentially subversive or violent."

Staff Response - The Special Safeguards Study (authored by D. Rosenbaum, et al.) discussed the cited measures in the context of domestic intelligence-gathering activities that are not among the responsibilities of the NRC. Domestic intelligence activities would contribute but marginally to the protective capabilities possessed by NRC licensees. NRC programs for the security of fixed sites and transportation links are designed to benefit from, but not depend upon, any intelligence indicators that may be generated. The NRC attempts to minimize the societal impacts of a nuclear industry by ensuring that each facility and each transportation link is sufficiently secure within itself to minimize the risk of theft or sabotage.

DES Chapter VII: 3

Friends of the Earth - Comment 16

"The footnote referring to an NRC ban against plutonium air shipments is in error. NRC should be reminded that they refused to implement such a ban, and that only a Congressional amendment introduced by Congressman James Scheuer put such a ban into effect. The ban unfortunately does not apply to ERDA shipments."

Staff Response - The NRC ban on air transport of plutonium referred to in this comment implemented legislation passed by Congress. The text of the FES has been revised to reflect this fact.

DES Chapter VII: 4

United Airlines - Comment 5

"Air transport should not be required for the movement of radioactive shipments based on security considerations. The much more important consideration relates to the exposure of people, equipment and facilities to radiation and it is these concerns that should determine whether radioactive shipments can and should be carried by air.

"The transport of radioactive material by air should be limited to only that which is absolutely necessary. In our opinion, this is primarily material related to medical applications including research, diagnosis and treatment."

Staff Response - This comment implies that the DES suggested that air transport should be required on the basis of security considerations. In this regard, it is noted that the FES expresses no such conclusion. It does note, however, that air transport is one of a number of modes for which effective means to protect radioactive material from theft and sabotage have been and can continue to be provided.

DES Chapter VII: 5

City of New York - Comment 1

". . .(The discussion of barging in the Safeguards section (VII 13-14) lists some difficulties with escorting barges carrying nuclear wastes. It is stated that the level of security of escorted trucks is not attainable with barges. We would suggest that the Coast Guard be consulted on this conclusion and would refer the writers of the DES to the Coast Guard's 'procedures for the Movement of LNG/LPG,' Captain of the Port, New York. 1. October 1975, for a discussion of the types of safety measures that can be taken for hazardous marine cargoes.)"

Staff Response - The use of barges under such circumstances would necessitate transfers from one mode of transportation to another thereby making a needless extra step in the transit of the material. Certainly, shipment by barge should not be totally discounted as a viable means of transportation solely because of these limiting factors. The DES discussed the security aspect of such shipments only in terms of escort measures. It is noted that the FES concludes that the level of protection of shipments attainable by barge, if such a mode were utilized, would be comparable to that attainable through other transportation modes.

State of New York - Affidavit of Mason and Leamer, Nov. 30, 1975 - Comment 4

"Each of the following military assisted transportation alternatives for enriched uranium is considered less vulnerable to terrorist action than current commerical practice. The least vulnerable alternative is presented first, the most, last:

(1) long haul military air cargo, leaving from and flying into a military airfield, and connecting with short haul military helicopter service between the airfield and the origin/ultimate destination;

(2) same as (1) but with military surface transport service between the airfield and the origin/ultimate destination;

(3) long haul commercial air cargo, leaving from and flying into a military airfield, and connecting with short haul military helicopter service between the airfield and the origin/ultimate destination;

(4) same as (3) but with military surface transport service between the airfield and the origin/ultimate destination;

(5) long haul commercial air cargo, leaving from and flying into a military airfield, and connecting with commercial surface (truck) service or commercial air (helicopter) service between the airfield and the origin/ultimate destination."

State of New York - Enclosure to Letter of May 17, 1976 - Comment 2 (partial)

"b. indicate that the military has the current safeguard capability to move SNM by surface transport which is significantly less vulnerable to terrorists than commercial air transport and related connecting transport;

c. specifically evaluate the air transport of uranium (as opposed to plutonium) and demonstrate that any one of five (5) military assisted transportation system alternatives is significantly more secure against terrorist action than commercial air transport, because of:

(1) rigorous control of future shipment movement information;
(2) more secure in-transit communications;
(3) reliable and highly motivated personnel with security training and clearances;
(4) appropriate selection of weapons and vehicles;
(5) superior reaction capability;
(6) physical remoteness of airfields and facilities;
(7) psychological deterrent of a U.S. military protection force."

Staff Response - The discussion of assessments and military options in the FES points out that the physical protection affordable through the private sector is adequate to protect against the postulated threat level and the use of military forces is neither legal nor necessary.

DES Chapter VII: 7

State of New York - Affidavit of Mason and Leamer, Jan. 20, 1976 - Comment 19

"Recent Information

19. We note that in a January 12, 1976, p. 11, col. 1 New York Times article by David Burnham, the following was reported:

> 'The commission (NRC), however, is considering recommending the possibility that an existing Defense Department agency such as the Army's special forces be given training to enable it to react to a situation where a terrorist band seizes and holds a nuclear facility for a relatively long period of time.'

"Moreover, it was stated in the New York Times, January 18, 1976, News Of The Week in Review, p. 3, col. 2:

> 'The Federal Nuclear Regulatory Commission is preparing to recommend that Congress consider, instead of creating a special police force to guard nuclear power plants, training Army units to prepare for attacks on the installations by terrorist groups.'

"It is clear that even defendant NRC now considers military safeguards against terrorist attack against nuclear facilities and materials to be necessary and desirable."

Staff Response - The articles incorporated by the comments speculate that the NRC is considering the use of military [Army] personnel for guarding certain nuclear installations or reacting to possible terrorist attacks. While many types of alternatives have been proposed and considered in evaluating what requirements might be appropriate if an increased level of protection were to be found necessary in the future, no conclusion to require an increased level of protection should be inferred at this time. A discussion on the use of military resources to protect SNM is included in the FES.

DES Chapter VII: 8

State of New York - Letter of Aug. 4, 1976

"The NRC is now once again urged to recognize that the continued commercial transport of SNM runs an unacceptable risk of diversion or loss of SNM. More secure modes of transport must be immediately designed and implemented. As this office has previously stated, it is our view that the NRC should require that shipments of plutonium be made by military surface transport and that shipments of uranium** be made by military air transport, using military bases as points of shipment and interim storage for all SNM."

Staff Response - The section of the FES describing the physical protection requirements for SNM in transit has been substantially revised to reflect recent improvements in the physical protection system. Specific note should be taken that features of this system include the use of an armored vehicle or the equivalent as the transporter, escort by a minimum of five armed individuals, a separate escort vehicle (two if at night), redundant means of communications, and several armed guards to protect SNM transfers. These measures have had the effect of significantly increasing the capability of NRC-licensed shipments of SNM to counter possible attempts of theft or sabotage of SNM in transit.

DES Chapter VII: 9

State of New York - Letter of May 17, 1976 - Comments 3 and 4

"3. The only discussion of military assisted air transport alternatives in the DES is limited to approximately one-half of a page (p. VII-12). What little discussion there is emphasizes only the military airfield aspect of these alternatives. It is apparent that the 5 military assisted options for uranium transport detailed in our affidavit of 30 November, 1975 (pp 4-7) were not considered.

"4. The DES does admit that the use of military airfields and/or aircraft 'appears technically feasible.' However, in a footnote, the DES suggests that the use of military airfields and aircraft may be prohibited and cites a law said to provide that: 'Except as otherwise provided by law, sums appropriated for the various branches of expenditure in the public service shall be applied solely to the objects for which they are respectively made.' 31 U.S.C. 628. In light of the obvious danger to the national security inherent to commercial air transport and related connecting transport of SNM, the failure of the DES to demonstrate that there are no sums appropriated which might properly be applied to the use of military airfields and aircraft for transport of uranium is significant."

Staff Response - As pointed out in response to comments on military alternatives elsewhere, the use of military resources is both unnecessary and illegal. The NRC does not agree that commercial air transportation and related connecting transportation of SNM constitute a danger to national security.

DES Chapter VII: 10

State of New York - Enclosure to Letter of May 17, 1976 - Comment 6

"6. Even though the DES makes no specific mention of military helicopters, it does make brief reference to helicopters generally (VII-13). This reference to helicopters, and STOL aircraft, together with their range and payload parameters, is without any qualification and hence without substance. After all this time, only conclusory speculation is offered. It is generally known, however, that a wide range of helicopters is used in the military and in industry with considerable flexibility in range and payload. In fact, a quick check reveals, for example, the following:

Helicopter Manufacturer/Type	Range	Payload (lbs.)
Boeing Vertol model 234	240 nm	20,000
	320 nm	4,000
Bell model 222 (undergoing modification)	425 nm	1350 (Estimated)"

Staff Response - Although no licensee currently utilizes helicopter or STOL modes of transporting SNM, there is no prohibition to do so since the NRC concludes that all modes can be afforded adequate physical protection.

DES Chapter VII: 11

State of New York - Affidavit of Mason and Leamer of Jan. 20, 1976 (Referring to J. Edlow Affidavit of January 1976) - Comments 5 and 6

"5. In paragraph 3. Edlow's concurrence with his father's recommendation of 'expediting' falls short of accomplishing the task of deterring a determined terrorist from successful seizure of SNM. The statement that '[t]his method and this method only will provide early notice that shipment is astray or diverted' is somewhat after the fact and does not preclude the possibility of diversion by seizure or hijacking. The only reaction to the discovery, or 'early notice,' that a shipment is diverted, is to notify the NRC or 'an appropriate law enforcement authority.' This is not security in the prevention sense and unless a more secure mode of transport is provided at the same time, seizure is not prevented and potential for recovery may be meager.

"6. As we have indicated in our earlier affidavits, one of the weakest links in the current security chain with respect to prevention of successful terrorist action is the wide dissemination of advance shipment information. 'Expediting,' as described by Edlow, is directed toward loss through misrouting or casual theft. However, such programmed pre-scheduling of times, routes, mode of transport, etc., provides precise information on shipment movement and unless access to such information is strictly limited, may add to a successful terrorist act. According to Peter N. Skinner, affidavit of April 20, 1975, a minimum of 124 people had knowledge of the details of the arrival of a specific shipment of plutonium before it arrived at J. F. Kennedy Airport from Brussels on February 25, 1975. As can be seen, the question of knowledge prior to shipment is one of the greatest short-comings of the civilian transport mode and one of the advantages of the military mode. Mr. Edlow at paragraph 15 of his affidavit stated categorically that 'SNM cannot be lost or diverted under current regulations....' Such an unqualified statement raises questions about his expert objectivity. We would not categorize the current system as failsafe."

State of New York - Affidavit of Mason and Leamer of Jan. 20, 1976 (Referring to Affidavit By Captain Echols (ALPA)) - Comment 11

"Captain James A. Echols, Affidavit of 28 November, 1975

"11. Captain James A. Echols' affidavit of 28 November, 1975 recounts numerous terrorist acts occuring aboard commercial aircraft and/or associated with commercial air facilities and

installations. The MITRE report itemizes no less than 26 commercial aviation-related terrorist acts in the last 6 years. These findings are consistent with the view expressed in one earlier affidavit that successful terrorist action against commercial aviation is feasible. We believe that transport SNM in commercial aircraft provides the terrorist with particularly attractive incentive for action."

State of New York - Affidavit of Mason and Leamer of Jan. 20, 1976 - Comments 12 and 13

"Assessment of 10 CFR 73 through 73.36 and 73.72 as Amended

"12. At paragraph 56 of our affidavit of 16 June 1975 we stated that the regulations as republished on December 28, 1973 were not adequate to prevent or deter a determined group of terrorists from succeeding with their mission. Those regulations were the regulations in effect on March 4, 1974. A review of 10 CFR 73.1 through 73.36 and 73.72 as amended through December 15, 1975, was made to determine whether amendments after March 4, 1974 would substantially alter our assessment of the vulnerability to terrorist action of SNM carried in commercial transport.

"13. Our assessment has not changed. The thrust of these Part 73 regulations remains that of protecting against loss, misrouting and casual commercial theft. Assuming full compliance with the letter and spirit of those sections of Part 73 by all responsible parties (an assumption with which we disagree), the amended regulations do not provide for adequate personnel, equipment or procedures to effectively deter and prevent successful terrorist action or organized theft."

State of New York - Affidavit of Mason and Leamer of Jan. 20, 1976 - Comments 17 and 18

"17. It is apparent that the conditions in the commercial transportation industry described by Sam Edlow in the 1969 speech attached J. Edlow's affidavit as Exhibit 1 have not substantially improved. Sam Edlow characterized the industry as untrustworthy (Exhibit 1, p. 3) and incompetent (Id. p. 9) and the environment in which the industry operates as one of criminality (Id. p. 6). Indeed he felt that the most that might be accomplished by strengthening requirements within the commercial industry might be early detection and recovery rather than prevention (Id. pp. 6, 10, 11, 12). As pointed out above in paragraphs 5, 6 and 7 current regulations regarding what Sam Edlow called 'expediting' refect (sic) a goal of detection, rather than prevention of diversion.

"18. As to demonstrating that the commercial air system is potentially unsafe from the terrorist threat viewpoint, the recent bombing of LaGuardia Airport is indicative of a level of vulnerability to terrorist activity which far exceeds the vulnerability of military controlled systems, vehicles and installations."

State of New York - Enclosure to Letter of May 17, 1976 - Comments 1a, 5 and 7

"The prior Mason/Leamer affidavits were submitted to:

a. Demonstrate that there is a substantial likelihood a higly motivated group of terrorists could be successful in destroying or seizing for destructive use special nuclear materials (SNM) in the course of commercial air transport, or related connecting transport, notwithstanding existing safeguard regulations and/or actual practice;

"5. The statement that 'adequate protection can be afforded at civilian airfields' (VII-12) is not supported by substantive discussion and misses the point that a military airfield has numerous advantages including inherent security, control of movement information, cleared, motivated and trained personnel, reaction capability, and location outside of highly populated areas.

"Military Assisted Transportation Alternatives for Plutonium

"7. The DES makes no reference whatever to the military surface transport alternatives for shipment of plutonium set forth in our Affidavit of 16 June 1975, pages 20 through 22."

Staff Response - Substantial increases have been made in the level of physical protection afforded to SNM in transit since the time referred to in the foregoing comments. Among other features described in the revised text, the current system of physical protection provides for a higher number of guards and the use of equipment with features of passive resistance to both theft and sabotage. Transfers of SNM from one mode to another now also require an increased complement of guards to be in attendance. (This is in addition to the greater participation of airport guards that is being provided as a result of heightened airport security awareness of the possibilities of hijacking and as required by FAA regulations.) As a consequence of the increased protection afforded to NRC-licensed shipments, the current level of protection for such shipments is considered to be adequate and comparably effective to that afforded to ERDA shipments.

The utilization of military forces and facilities as stated in the revised Chapter VII would be an unnecessary use of such forces.

DES Chapter VII: 12

State of New York - Affidavit of Mason and Leamer of Nov. 30, 1975 - Comment 17

"Although the entire affidavit thus far has addressed itself to enriched uranium transport, one comment regarding plutonium transport is worth making. A recent report by Ensign Dwight L. Gertz, USN, in Terrorist Weapons and the Terrorist Threat, 'U.S. Naval Institute Proceedings,' October, 1975, pp. 113, 114, confirms our conclusion expressed in our 16 June, 1975 affidavit that the terrorist motivation and threat to destroy aircraft is real and the weapons are readily available. In a recent instance, five Arabs rented an apartment in Ostia near Rome, 4 miles from Leonardo da Vinci Airport, directly underneath the North-South runway approach, and were only hours away from initiating a planned attack on a commercial airliner. They were equipped with two Russian made Grail missile launchers and a supply of missiles. In a second recent instance, when authorities were informed that terrorists in the Brussels area had been shipped Grail launchers, hundreds of troops were called out to cordon off airports in Brussels and

London. The Grail is combat proven and available to Soviet supplied nations and some 'neutral' countries. The missile is heat-seeking. The launcher is hand held and simple to use.

"In-transit dispersion of plutonium oxide in many instances would be both a highly effective terrorist act and one of far lesser difficulty than seizure and escape. Hence the threat becomes one of destruction of the aircraft in order to breech (sic) the plutonium oxide containers and disperse their contents."

State of New York - Affidavit of Mason and Leamer of Jan. 20, 1976 (Referring to J. Edlow Affidivit of January 1976) - Comment 4

"4. In paragraph 6, of his affidavit, J. Edlow's reference to 'strategic' quantities of SNM misses the point. Apparently Edlow is referring to the fact that CFR Sec. 73.30 sets minimum requirements for NRC licensee shipments of certain amounts of SNM computed by formula, which include 5,000 grams or more of plutonium. This regulation fails to cover various significant dangers. For example, any amount of PuO, if used as a dispersant, could cause death and injury. Also, the psychological aspects of SNM seizure are almost equally as real whether the material is low or highly enriched, or in small or large quantities. Any amount of SNM in the hands of a terrorist group would be of great blackmail value and could certainly be used to their advantage. Finally, the factor of multiple thefts must be taken into consideration, with the possible stockpiling of seized SNM."

State of New York - Enclosure to Letter of May 17, 1976 - Comment 9

"9. On page VII-7, the DES admits that plutonium oxide can be used as a dispersant in weapon form or by dispersing plutonium in transit by bursting its container and that such use would have serious consequences. However, in Appendix F, page F-4, the consequences of using plutonium oxide are said to be uncertain and such use is said to be inconsistent with observed behavior of terrorists. Peter Skinner's affidavit of 2 May, 1975 indicates that the consequences of use of plutonium oxide as a dispersant are not uncertain. While it may be true that terrorists have not yet used poisonous agents, that does not mean that they will fail to use them in the future. Moreover, terrorists might find particular appeal in a radioactive poison, not only because of its greater psychological value (over more conventional poisons), but also because of its extermely long life, assured effectiveness and its particular macabre method of destroying human tissue."

Staff Response - As indicated in the expanded section of the FES dealing with plutonium hazards, sabotage of a plutonium shipment of less than a strategic quantity would not result in a catastrophe, and even if plutonium oxide were dispersed in the atmosphere, relatively minor consequences would be expected. Calculations by Cohen indicate that, in a city, a fatality rate of one cancer death per 15 grams of plutonium would be anticipated if dispersal occurred without warning, the cancer death associated with the event resulting 15 to 45 years after the event. A ten-fold reduction in the death rate could probably be effected if warning of the dispersal were given.

DES Chapter VII: 13

State of New York - Affidavit of Mason and Leamer of Jan. 20, 1975 - Comment 16

"16. The Mitre report contains extensive corraboration of numerous points made by us in our current and previous affidavits e.g.:

Terrorists -- 54 pages directed to the history, tactics, capabilities, affiliations, motivations and recent activities of terrorists operating throughout the world. (Mitre Report, pp. 1-55)

Transport Industry -- 10 pages devoted to the extensive role of crime, corruption, employee colusion, and international influences in undermining industry services. (Mitre Report, pp. 55-64)

Weapons -- 6 pages citing types of weapons, their availability and recent employment by terrorists. (Mitre Report, pp. 65-70)

"Conclusions reached include 'terrorism has become commonplace in the Western World and weapons of large caliber and full-automatic fire can be easily procured,' and 'a veritable army of criminals and hoodlums in this country is waiting and willing to undertake any activity, including murder, if the profit justifies it.'"

Staff Response - The conclusions of the MITRE study are among several inputs to the NRC that are being evaluated and weighed in the continuing effort of determining whether to require an increase in the level of protection afforded to strategic quantities of SNM at facilities and in transit. Conclusions reached by firms under contract to the NRC should not be regarded as binding on the NRC.

DES Chapter VII: 14

State of New York - Enclosure to Law Letter of May 17, 1976 - Comments 12 and 13

"12. Plaintiff has demonstrated in three affidavits that the current requirements and practice regarding safeguards are inadequate to cope with the terrorist threat. The DES does not address itself in any meaningful way to the inadequacies previously specified by plaintiff. Indeed, the DES admits (VII-3) that 'present requirements are designed to protect against theft, diversion, or sabotage by one or two employees with access to the plant and material, by a small armed force attacking a plant or vehicle, or by both acting in combination.' '(S)mall force' is not defined in the DES. But, as to nuclear facilities, the Atomic Energy Commission ruled that licensees were only responsible for providing adequate security to repel not more than one or two individuals acting in concert (Nuclear Fuel Services, Inc. - UNC Docket #50-201, Atomic Safety Licensing Decision, November 29, 1974, p. 11). However, it is almost certain terrorists would employ 4, 5 or more persons. Moreover, the AEC ruled that licensees were not required to protect nuclear facilities against a well armed band of saboteurs whatever the size of the band; licensees need only concern themselves with 'an amateur group' (Id. p. 15).

"13. Given the purpose for which the safeguard requirements (10 CFR 73) were designed it is not surprising that the requirements and practice are grossly inadequate to cope with terrorism."

Staff Response - As the revised text of the FES points out, the significant improvements that have been made in the physical protection afforded to SNM in transit provide a system that can handle the postulated threat and that would not fail catastrophically under more violent attacks.

DES Chapter VII: 15

State of New York - Dept. of Environmental Conservation - Letter of Transmittal of Comments Dated June 3, 1976

"Therefore, the State of New York urges the Commission to consider the environmental impacts, and the alternative modes of transporting Plutonium and the security implications thereof separately from all other radioisotopes. Only in this way can the environmental consequences, benefits to society, and costs of alternative modes of transport and packaging requirements be adequately assessed."

Staff Response - The FES includes a discussion of theft and the consequences of sabotage involving shipments of plutonium.

DES Chapter VII: 16

State of New York - Enclosure to Letter of May 17, 1976 - Comment 11

"11. Plaintiff pointed out in the Mason/Leamer Affidavit of 20 January, 1976 that the provisions of 10 CFR 73 apply only to licensees shipping certain amounts of SNM computed by formula, which include 5,000 grams or more of U-235 enriched to 20 percent or more, or 2,000 grams or more of plutonium. Failure to subject smaller quantities to such regulations subjects the public to significant dangers specified in the above-mentioned Mason/Leamer Affidavit. The FES does not respond to this point."

State of New York - Affidavit of Mason and Leamer of Jan. 20, 1976 - Comment 14 (Partial)

"14. The requirements of Part 73 which may give the appearance of providing good security are grossly inadequate. Among the inadequacies are:

(1) shipments of less than 5,000 grams of SNM are not covered."

Staff Response - As pointed out in the revised text of the FES, the threshold for SNM in transit requiring physical protection measures relates to the prevention of an illegal nuclear explosive device. The quantities of plutonium at and below this threshold, even if dispersed in highly populated areas, would not result in catastrophic consequences.

DES Chapter VII: 17

State of New York - Affidavit of Mason and Leamer of Jan. 20, 1976 - Comments 7, 8, & 10

"7. In paragraph 11, Edlow's reference to the two principal additions to the regulations which 'prevents the possibility of loss or misrouting of SSNM while being transported,' i.e., 'continuous visual surveillance' and 'frequent communications,' again oversimplifies terrorist and related security problems. Adherence by shippers to these two requirements is intended to provide a degree of protection against misrouting and casual thefts but standing alone, it is inadequate protection against determined terrorist attacks and organized theft.

"8. Further, a report prepared for the NRC, released only in December, 1976 (MITRE Technical Report 7022, September, 1975, The Threat To Licensed Nuclear Facilities ('MITRE Report') para. 3.12.3, page 88) points out the inadequacy of current communications systems, 'One weakness in the operation of these private firms involves the communication system and the difficulties incurred during communication blackouts. Vehicles equipped only with a radio-telephone to handle communications to a base station are subject to periodic blackouts due to terrain and atmospheric conditions. Thus, to comply with a necessary two-hour check with headquarters (10 CFR Sec. 73.31) the driver must on occasion leave his vehicle and use a hand-line telephone. During these blackout periods and during the time the driver leaves his truck to use a telephone, the potential for a hijacking or theft is increased.'

"10. The MITRE Report confirms and augments the observations and conclusions stated in this and our earlier affidavits regarding the inadequacies of the requirements regarding visual surveillance and communications and armed guards, as outlined by NRC's 10 CFR Part 73, of April 1975."

Staff Response - A requirement for an escort vehicle with additional communication capability to accompany all road shipments of SNM was imposed by license condition in May 1976. Subsequent license conditions were issued in February 1977 to formalize security measures currently in use. These included an increase in guard strength and the use of an armored vehicle or equivalent as the transporter vehicle. These increases in physical protection requirements are reflected in the revised section of the FES.

DES Chapter VII: 18

State of New York - Affidavit of Mason and Leamer of Jan. 20, 1976 - Comments 14 (partial) and 15 (partial)

"(4) Communication requirements in terms of the frequency of communication in transit as well as the number and capability of communication channels is inadequate.

"b. So long as contact is not always possible with vehicles carrying high security material, the present communication system will contain weaknesses. Response capability suffers accordingly."

Staff Response - The May 1976 licensing actions by NRC have required additional radio communications capabilities to be provided for all SNM shipments. The February 1977 license conditions restricted road travel to major highways during daylight hours unless an additional (second) escort vehicle is also provided (Section 7.4.2).

DES Chapter VII: 19

State of New York - Enclosure to Letter of May 17, 1976 - Comment 17

"17. Plaintiff has previously demonstrated the wide dissemination of information regarding future SNM shipments (Affidavit of Peter Skinner, 2 May 1975) and emphasized the danger which this presents. The DES makes no response. Plaintiff has also pointed out the inadequacy of current communication systems used in commercial SNM transport. Again, the DES fails to respond."

Staff Response - The NRC does not believe the dissemination of SNM shipping information that is required by regulation represents danger to the transport of SNM. Response to the second point of the comment has been made elsewhere, and the text of the FES has been revised to reflect the current physical protection systems.

DES Chapter VII: 20

State of New York - Enclosure to Letter of May 17, 1976 - Comment 18

"18. The DES (VII-10) asserts that local law enforcement agencies located along a truck route would supply a secondary response. This is all well and good but for the fact that the regulations do not require communication equipment or frequency of contact which assures that such persons would be alerted when required. In connection with truck transport from airports to facilities, the DES (VII-11) states that convoys will have the additional protection of the facility's security force to act as a response capability, but fails to deal with the practical aspects involving distance, transport, communications, and on site responsibilities. The DES statement (VII-11) that 'airplane security personnel' would be present during airport SNM transfers in addition to the guards accompanying the truck is not supported by the regulations. The regulations do not provide for armed airplane security personnel."

Staff Response - The measures currently required for physical protection of SNM have been described in the FES and are referred to in response to several other comments. The NRC believes that these measures adequately protect against the postulated threat and ensure delay until local law agencies can respond in case of possible larger threats.

DES Chapter VII: 21

State of New York - Affidavit of Mason and Leamer of Jan. 20, 1976 - Comment 9

"9. Regarding Edlow's statements (Aff. paras, 12-14) concerning delivery by armored truck with armed guards, one should note that the MITRE Report, para. 3.12.4, page 69, points out:

'It should be noted that armed guards of an interstate shipment have no statutory authority to carry weapons in states other than the one in which they are licensed or across state lines, yet regulations require that they carry weapons in exercising their primary duty of protecting SNM in their custody. These guards are probably often in violation of both state and federal laws.'

"In other words, the fact that a guard is armed, and in an armored truck, is not necessarily a strong deterrent to terrorist or organized attack; the guard probably knows that he may be in violation of a state or federal statute or law, and, when faced with an armed attack situation, may simply not use the weaponry available for fear of legal, as well as physical, consequences to himself."

State of New York - Enclosure to Letter of May 17, 1976 - Comment 16

"16. Nevertheless, the DES (VII-6) makes the bold assertion:

'Licensee guards are expected at all times to (1) interpose themselves between SNM and any adversary attempting entry and (2) intercept anyone exiting with such material. A sufficient degree of force should be applied to counter that degree of force directed at them, including the use of deadly force. . . .' Considering the number of personnel and the weapons selection likely on both sides in a confrontation with terrorists, it would be tantamount to suicide for licensee guards to act in the manner suggested by defendant."

Staff Response - License conditions have made clear to licensees that guards are to be instructed to take appropriate action to thwart theft or sabotage of SNM. Guards are expected to "interpose themselves...and use force including deadly force if they have a reasonable belief their lives or that of another is threatened." The NRC expects guards to be trained in accordance with commitments contained in approved plans and expects the licensee to meet all requirements for the protection of SNM including the possession and use of weapons.

DES Chapter VII: 22

State of New York - Affidavit of Mason and Leamer of Jan. 20, 1976 - Comment 14 (partial) and 15 (partial)

"(2) Though plans for selecting, qualifying and training guards as well as for specially-designed trucks are called for, neither minimum standards or implementation dates are specified:

"(3) The number of guards provided for and their arming is minimal:

"15. The Mitre report states: (para. 3.12.5, pp. 89-90)

'a. A wide dispartiy (sic) presently exists in the various screening techniques used in selecting guard personnel and in the training they receive.'"

State of New York - Enclosure to Letter of May 17, 1976 - Comments 14 and 15

"14. The DES fails to respond to plaintiff's previously specified criticisms of various aspects associated with the use of private guards: inadequate training, lack of security clearances, low pay, and lack of military type motivation. When the DES discusses the number of guards employed it is misleading. At one point (VII-10), it states that in truck transport 'the number of guards would be varied to suit the particular shipment and received (sic) threat,' the regulations do not require this. At another point (VII-4), the DES states that when cargo aircraft are used, enroute transfers must be observed by more than one armed person; the regulations do not necessarily so require.

"15. Plaintiff has previously pointed out that the weapons and vehicles employed by private guards are inadequate for coping with the terrorist threat. The DES offers no meaningful response."

Staff Response - Regulatory Guide 5.20 was published in April 1974 to provide guidance to the industry on selection and training of guards. This guide is also used by the NRC staff in evaluating the adequacy of guards. Specific additional training requirements for guards escorting shipments of SNM were added in May of 1976. License conditions were issued in February 1977 to formalize security measures currently being employed. These included an increase in the minimum number of guards required and the use of armored vehicles or equivalent as transporters."

DES Chapter VII: 23

State of New York - Affidavit of Captain James A. Echols (ALPA) of November 28, 1975 - Comment 3

"3. Critical to the safety of commercial air transport of SNM is the severely inadequate security within the air cargo industry. Presently, regardless of cargo, multi-million dollar aircraft and pilots are subject to selection at any time as a 'target of opportunity' by sky-jackers, extortionists, terrorists or saboteurs. We received a clear lesson as to the very real terrorist threat as 3 Boeing 747's burned to ashes on a patch of Jordanian desert while crew and passengers were held hostage under the muzzles of terrorist sub-machine guns. We have seen as well:

-mid air sabotage
-grenade attacks on land
-attacks on terminals
-abductions
-diversions
-over 370 global acts of terror
-endangering 16,000 people.

"As I have stated, the lesson is clear, SNM must be removed from commercial air transport."

Staff Response - The commenter's affidavit reflects concerns predating the increased airport security measures required by FAA that have reduced hoaxes, threats, attempts, and diversions

of passenger aircraft within the USA. It also does not take account of security measures required by NRC for SNM shipments that have been instituted in the interim and are reflected in the FES.

DES Chapter VII: 24

State of New York Letter of May 17, 1976 - Comment 4

"The DES safeguards discussion bases portions of its analysis on the as yet incomplete and unreleased analysis of safeguards in the Generic Environmental Statement on the Use of Recycle Plutonium in Mixed Oxide Fuel in LWR's. WASH 1327 ('GESMO'). General references to uncompleted studies in other proceedings render the DES legally inadequate.

Staff Response - The safeguards discussion in the FES Chapter 7 is based on current efforts related to the overall level and quality of protection accorded the nuclear industry as a whole. The analysis and subsequent conclusions presented therein are not dependent in any way on the outcome of any uncompleted studies or decisions stemming from the NRC review of safeguards related to the wide-scale use of plutonium mixed oxide fuels (GESMO deliberations).

DES Chapter VII: 25

ERDA - Comment 58

"Page VII-1, Third Paragraph

"This paragraph indicates, according to the text, that nuclear material is subject to security procedures and safeguards intended to preclude the diversion or theft of nuclear material or sabotage of the nuclear facilities in which it is handled.

"This statement in regard to the safeguarding of strategic quantities and types of special nuclear material is misleading and should be revised. There is no option to safeguard special nuclear material in this category. NRC regulations prescribe the safeguarding both at fixed facilities and in transit. Additionally, safeguards and security procedures are not limited to "strategic quantities" but to all special nuclear material.

"That part of the paragraph which speaks to radioisotopes, such as cobalt-60 should be eliminated. There are no security and safeguards features in the context within which they are discussed, i.e., to preclude diversion or theft or sabotage, applicable to the handling of radioisotopes by NRC. Mentioning cobalt-60 raises numerous related questions regarding other hazardous radioactive materials not subject to NRC safeguards and security type control (e.g., radium)."

Staff Response - This section of the FES has been substantially revised to more clearly state the potentials of misuse of the various categories of radioactive materials. The revision describes those measures currently in effect that limit the hazards from misuse of cobalt-60. It also more clearly describes the basis for providing physical protection to special nuclear material.

DES Chapter VII: 26

ERDA - Comments 59-61

"59. Page VII-2 B(2) and (3)

"Meaning of 'Contractors' unclear. Contractors to NRC, U.S. Government, nuclear industry or what?

"60. Page VII-5, Second Paragraph

"The meaning of "supporting safeguards security systems" requires clarification.

"61. Page VII-8, Third Paragraph

"We see no reason to specify 'escort guards' but would refer to 'guards' without the qualification since it is unlikely that guards would be used solely for escort purposes. The same sentence apparently intends to refer to 'the transportation mode' rather than 'the transporation model.'"

Staff Response - The ambiguities and typing errors cited in the above comments have been resolved in the FES.

DES Chapter VII: 27

State of New York - Enclosure to Letter of May 17, 1976 - Comment 8

"8. In our Affidavit of 16 June 1975, pages 14-16, we cite a number of authorities in support of the following propositions:

a. That the information necessary for the design of a nuclear device is publicly available; and

b. That a technically competent group of terrorists could fabricate an effective, even if crude, nuclear device notwithstanding the fact that it had no prior experience in fabricating such a device.

"Notwithstanding some discussion regarding the benefits of prior experience in the fabrication of such a device, the DES admits that persons without such experience could produce a device with a low tonnage yield, apparently a yield of one kiloton or less, or even a device with a substantial yield (F 1-3). Moreover, the DES admits that 'the potential consequences arising from any nuclear explosive are so serious as to warrant the utmost vigilance, however low the probabilities may be.' (F-2). The DES places great emphasis on the supposed difficulty of 'emplacement' of a nuclear device because law enforcement agencies would be watchful (p. F-4). However, this is not very comforting when one considers the almost infinite opportunities for emplacement in a large city."

Staff Response - Primary reliance against the possibility of a terrorist group acquiring a nuclear explosive device is placed on denying the acquisition of SNM not on any technical difficulties in fabricating such a device. (Appendix F of the DES has been deleted.)

DES Chapter VII: 28

Enclosure to New York State Department of Law Letter dated May 17, 1976 - Comment 10

"10. The DES makes a significant admission regarding the NRC's overall policy on safeguards. The DES states (VII-2) that while safeguards must be capable of preventing acts which could result in a 'major civil disaster,' safeguards need only provide a 'high degree of protection' against acts that could result in 'serious civil damage.' No justification or analysis is presented to support such a policy and no definitions are provided for any of the salient concepts employed. One would think that, given the immense danger posed to the public by terrorist use of SNM, safeguards should be capable of preventing any such use."

Staff Response - This section of the FES has been revised to accurately describe the NRC responsibilities.

DES Chapter VII: 29

State of New York - Enclosure to Letter of May 17, 1976 - Comment 20

"20. The statement in the DES that hardware and techniques are currently available to allow an effective recovery effort is inexplicable in light of the admission that recovery cannot be relied upon as the strong link in the security system (VII-9)."

Staff Response - The recovery aspect of the national capability, which relies to a considerable extent on the expertise and organization structure developed to protect ERDA/DOD weapons programs, involves coordinated action by many Government agencies. Should nuclear materials be stolen or diverted, the national system would use the collective resources of the various departments and agencies involved in nuclear safeguards, including the FBI, ERDA, DOD, USCG, the intelligence community, and local law enforcement agencies (LLEA).

DES Chapter VII: 30

State of New York - Enclosure to Letter of May 17, 1976 - Comment 21

"21. With regard to monitoring and inspection of safeguard systems, the statements in the DES (VII-5) appear to be wishful thinking. Not even the DES claims this monitoring and inspection of SNM transport actually occurs."

Staff Response - The NRC inspects for compliance with physical security requirements all imports and exports of SNM shipped under the provisions of 10 CFR Part 73. These currently comprise approximately 90% of all such SNM shipments. Domestic road shipments are periodically inspected while in route.

DES Chapter VII: 31

State of New York - Enclosure to Letter of May 17, 1976 - Comment 22

"22. The fact that the DES fails to respond to the plaintiff's previous affidavits is not surprising when one notes that the DES admits that an 'in depth analysis of safeguards' is currently being undertaken (VII-9) and that studies are being completed to determine 'the cost and effectiveness of alternative systems' to safeguard SNM (VII-15). Thus, at this late date, NRC admits that it has not yet analyzed and studied the safeguards issue involved in the air related connecting transport."

Staff Response - Chapter 7 of the FES has been substantially revised. The analysis of safeguards for transporting SNM indicates to the NRC staff that the current measures for control of radioactive material in transit (including physical protection for certain quantities of SNM) are adequate. (See response to DES Chapter VII: 24.)

DES Chapter VII: 32

City of New York - Comment 8

"Scenarios involving sabatage (sic) or diversion of spent fuel or fissionable materials by terrorists or criminal elements are mentioned tangentially but are incompletely evaluated."

Staff Response - The section of the FES dealing with the potential for misuse for the various classes of radioactive materials has been expanded.

Dr. K. Z. Morgan - Comment 4

"There seem to be large discrepancies between this table and the values given in the GESMO report, WASH-1327, which I reviewed earlier. These discrepancies are shown below:

Radionuclide	% by weight in Table B-1	% by weight in WASH-1327	Ci calculated WASH-1327	g in WASH-1327
Pu-238	1.9	3.49	3.47×10^5	0.20×10^5
Pu-239	63.0	43.63	5.30×10^3	2.50×10^5
Pu-240	19.0	26.00	3.37×10^4	1.49×10^5
Pu-241	12.0	15.65	1.00×10^7	0.90×10^5
Pu-242	3.8	11.21	239	0.64×10^5
Am-241	0.6		2.52×10^4	7.78×10^3
Am-243			6.78×10^3	3.66×10^4
Cm-244			1.70×10^6	2.04×10^4

"When each new NRC report uses a new set of assumptions about the SGR-GESMO-120 day spent fuel inventories, how can we be expected to believe any of the numbers or evaluate the data? Which NRC report are we to believe?

"I have added also my calculations of Curies using the WASH-1327 data. Here we note that most of the risk is not from ^{239}Pu but from ^{238}Pu, ^{241}Pu, ^{244}Cm and ^{241}Am. Also, I have shown (HPJ 10, 151, 1964) that ^{238}Pu is 150 times more hazardous (Curie-for-Curie) than ^{239}Pu, ^{241}Pu is 3 times more hazardous, ^{244}Cm is 32 times more hazardous, and ^{241}Am is 16 times more hazardous. In addition, this 2.04×10^4 g of ^{244}Cm comprises 2.2 Ci of neutrons for which extra precautions must be taken."

Staff Response - The percent-by-weight values were taken from column 1, Table IV D-4, of Volume III of WASH-1327 (GESMO). Values closely approximating those suggested by Dr. Morgan also appear in that table in column 3. In using the values from that column, Dr. Morgan has made the tacit assumption of equilibrium plutonium recycle. Since the DES evaluated 1975 and 1985 only, the assumption of high-burnup LWR fuel is far more accurate and certainly doesn't represent a "new set of assumptions."

The risk comparison cited by Dr. Morgan (HPJ 10, 151, 1964) is a relative risk comparison ostensibly discussing the risk to laboratory or engineering process line personnel exposed to releases of material. It defines hazard by H = specific activity/MPC. This is an occupational analysis and is not suitable for application to an atmospheric release of material. The relative hazard of all isotopes shown to be present in plutonium obtained from high burnup versus LWR

fuel was taken into account in the DES. However, note that Table IV D-10 of GESMO does not show any curium isotopes although Dr. Morgan lists a significant amount.

DES Appendix B: 2

ERDA - Comment 69a

"Clearance half-time of 150-200 on page B-7 omitted units."

EPA - Comment 19

"The clearance time for soluble plutonium needs to have units added to it."

Staff Response - Units have been added.

DES Appendix B: 3

EPA - Comment 146

"The movement of particles captured in the mucoid lining is properly termed transported not sloughed."

Staff Response - The phraseology has been changed.

DES Appendix B: 4

ERDA - Comment 62

"A portion of material deposited in the tracheobronchial region may also pass directly to blood, depending on initial solubility. The term 'reticuloendothelial cells of the alveoli' is ambiguous; it is not clear whether this refers to fixed or mobile pulmonary macrophages."

Staff Response - The suggested addition has been made. Both types of pulmonary macrophages are involved in the phagocytosis process. The sentence will be changed to read "...in the alveolar region." to attempt to clarify this distinction.

DES Appendix B: 5

ERDA - Comment 63

"'Soluble plutonium' is a thoroughly non-specific term. Translocation half-times and fractions can vary several-fold depending on inhaled particle size, specific chemical form, and isotopes of plutonium. Use of the narrow range '150-200' is misleading and may be dangerous in risk estimates; the unit of time is not even given."

Staff Response - The discussion concerns plutonium in soluble chemical form that has already reached the pulmonary region. Material of this sort does translocate with the stated half-time.

DES Appendix B: 6

ERDA - Comment 64

"This figure is taken directly from publications by J. F. Park and W. J. Bair at Battelle Pacific Northwest Laboratories; reference and credit should be given.

Staff Response - The reference cited (Reference 7) was the source for the figure.

DES Appendix B: 7

ERDA - Comment 65

"This discussion is not complete; the lethal biological effect of progressive pulmonary fibrosis leading to death by respiratory insufficiency is not even mentioned. We suggest that this section be expanded."

Staff Response - This paragraph is not intended to deal with biological effects to specific organs. The discussion of effects of acute pulmonary exposure is given in Section E.3 of Appendix B (FES Appendix C, Section C.5.4).

DES Appendix B: 8

State of New York - Dr. John Gofman - Comment 4

"On page B-10, the DES states, 'Cancers have been induced in laboratory animals, although no cancers attributable to plutonium have been observed in humans.' This statement is not only meaningless, it is dangerous. What the DES should state is, 'No meaningful study has been undertaken to determine how many lung cancer fatalities have been caused by plutonium handling.' For the population-at-large, the best estimate currently available is that plutonium fallout has condemned 1 million persons in the Northern Hemisphere to lung cancer deaths. (Gofman, (3).)"

EPA - Comment 14d

"In the cited case of the Los Alamos personnel, the draft statement indicates that '. . . none of these people has shown any evidence of radiation injury.' It seems this statement is probably too broad and could be optimistic. We doubt that all possible indicators have been checked and even if they have it is quite unlikely that there has been no radiation damage. This statement, if taken literally, would indicate that the NRC has adopted a threshold model for radiation effects. If this is true, the decision should be documented."

Staff Response - Dr. Gofman's implication that the continuing studies of Manhattan Project workers, Rocky Flats workers, etc., are meaningless is questionable. These studies include

chest counts, urinalysis, and autopsy information and have been carried out by LASL, PNL, and other respected scientific organizations. The "best estimate of 1 million condemned people" is based on Dr. Gofman's own unconfirmed analysis. Healy et al. (Ref. C-28, Appendix C) have examined Dr. Gofman's plutonium lung cancer estimates in detail and concluded that "Gofman's speculations require the arbitrary acceptance of too many numerical parameters and unconfirmed mechanisms to be acceptable as even an approximate numerical estimate of potential lung carcinogenesis by plutonium." Several other reputable studies have also rejected Dr. Gofman's analysis (see Appendix C, Section C.6).

The assertion that the statement in paragraph 3 represents a threshold model is invalid. The statement is made that no one has shown any evidence of radiation injury, not that radiation injury at those body burdens is impossible. The conclusion drawn is that current data does not support some of the claims of excessive plutonium toxicity.

DES Appendix B: 9

EPA - Comment 14c

"On page B-10, to prevent confusion, a beta particle is not an ion and it is confusing to describe its nature as ionic, its nature is more properly termed that of a charged particle; also, beta particles can travel much further than a few microns in body tissue, in fact into the centimeter range."

Staff Response - The nature and range of beta particles has been clarified.

DES Appendix B: 10

ERDA - Comment 66

"Terms 'high,' 'low,' 'lower,' and 'relatively' should be given values or ranges; 'relatively high body burdens (.00007 to .09 microcuries)' spans 3 orders of magnitude. We suggest that '.00007 to .09 microcuries' be changed to '0.005 to 0.420 microcuries.' (Reference - WASH-1320, page 25)."

Staff Response - The suggested change has been made.

DES Appendix B: 11

EPA - Comment 14e

"In section E.3, first, there are no references cited for the information given; second, there are apparently symbols missing from the amounts of plutonium cited, 0.5 curies Pu-239/gram of lung is the same as 8.2 grams Pu-239/gram of lung."

Staff Response - The references are now cited and the curie values have been corrected to read microcuries.

DES Appendix B: 12

Dr. K. Z. Morgan - Comment 12

"Although the dose to the pulmonary lymph nodes is 100 or more times that to other lung tissue, this dose is ignored in the risk evaluations. I realize the ICRP has depreciated this risk because the ERDA studies of Thompson et al at BNW have failed to produce cancers in this part of the reticulo endothelial system in animal studies. However, I am uneasy in applying these data to man who lives 70 years instead of 20 years (dog's life span) and Thompson has in fact observed some malignancies in tissues adjacent to the lymphatic tissue which may suggest that blood vessels leading into these organs or tissue just beyond the α-particle complete kill within the lymph nodes may be the tissue at greatest risk in the case of man."

Staff Response - The question of lymphatic cancer is addressed in DES Appendix B (FES Appendix C). A qualifying statement has been added to indicate that dog and rodent experiments are not completely conclusive with regard to lymphatic cancers. As Dr. Morgan points out, however, the ICRP does not consider the lymph system to be a potential cancer site.

DES Appendix B: 13

ERDA - Comment 67

"It should be pointed out that 'increases in urinary excretion in some cases by orders of magnitude' may represent only a decrease of a few percent in long-term lung burden of insoluble plutonium."

Staff Response - This paragraph has been modified to specify that DTPA therapy is only effective in mitigation of exposure to soluble plutonium.

DES Appendix B: 14

EPA - Comment 14f

"The discussion in section F on chelating agents does not mention any side-effects on their use; e.g., possible deposition in other organs, rather than excretion, which could create worse problems."

Staff Response - "Advances in Radiation Biology" (Vol. 4) suggests that DTPA is very effective at reducing the overall body burden of systemic soluble plutonium. It states that the use of that material appears to reduce the concentration in liver and bone by causing the plutonium complexes to mobilize to extracellular fluid from which urinary excretion is likely. This does not appear to imply that redeposition in other organs is likely.

DES Appendix B: 15

EPA - Comment 14g

"And, finally, the comparisons given on p. B-12 are too simplistic. Nowhere is it stated that the effect of these materials depend on innumerable factors, e.g., exposure time, time between intake and effect, condition of the victim, and how the material acts in a biologic system. This should be corrected in the final statement."

FEA - Comment 2

"On page B-12, the median lethal dose of plutonium is compared with the lethal dose of other toxic materials. We suggest that this paragraph also point out that the projected death from the referenced dose of plutonium would result from cancer at some undetermined time after a latent period of approximately 15 years, but that death from the other toxins would occur within a short period of time."

ERDA - Comment 68

"We suggest that NRC staff may wish to reference Dr. J. N. Stannard's paper 'Plutonium Toxicology and Other Toxicology' in The Health Effects of Plutonium and Radium (Jee, W. S. S., ed.). J. W. Press, Salt Lake City, Utah (1976) pp. 363-372 rather than the B. L. Cohen reference. ERDA staff feels the suggested reference to be more current."

Staff Response - The toxicity section has been rewritten using Stannard's information. Both acute effects and carcinogenesis are included. The factors mentioned in the EPA comment have also been included.

DES Appendix B: 16

State of New York - Dr. John Gofman - Comment 3

"In Appendix B, page B-12 the DES refers to '...the median lethal dose of plutonium as 260 micrograms.' This statement is not only meaningless, it is grossly erroneous. The dose that guarantees a lung cancer fatality is 0.058 micrograms of Pu^{239} for cigarette smokers and it is 7.3 micrograms for non-smokers. Thus, for cigarette smokers, a dose 4483 times smaller than the DES will kill all humans, whereas the DES estimates their dose will kill 1/2 those exposed. Thus the DES is much more than 4483 times too low on plutonium toxicity. For non-smokers the amount required to guarantee fatality is 35.6 times lower than the dose DES calculates will only kill one half the exposed. Unless the Nuclear Regulatory Commission learns something of the true toxicity of plutonium, it is likely to continue to make such absurd statements as that on page B-12 that 'Although plutonium is certainly a potentially dangerous material, it is not orders of magnitude more potent than numerous other existing materials.'"

Staff Response - The values of 0.058 and 7.3 micrograms are based on Dr. Gofman's own unconfirmed analysis. Healy et al. (Ref. C-28, Appendix C) have examined Dr. Gofman's plutonium

lung cancer estimates in detail and concluded that "Gofman's speculations require the arbitrary acceptance of too many numerical parameters and unconfirmed mechanisms to be acceptable as even an approximate numerical estimate of potential lung carcinogenesis by plutonium." Several other reputable studies have also rejected Dr. Gofman's analysis (see Appendix C, Section C.6).

DES Appendix B: 17

EPA - Comment 14a

"The list of references should be more specific where appropriate when only one part of a book or one article in a collection is used. Other references need to give more information to be complete, such as numbers 5 and 12."

Staff Response - The list of references has been corrected.

DES Appendix C: 1

ERDA - Comment 29a

"Appendix C does not provide a deciphering code."

EPA - Comment 15

"The listing of incidents as presented is hard to follow since there are neither dates indicating when incidents occurred nor meanings of the abbreviations used. Such data needs to be included in the final statement."

City of New York - Comment 7

"The discussion of reported incidents involving transportation of nuclear materials is grossly inadequate. Appendix C, does not even contain an explanation of its codes. Nor is there any discussion of possible unreported incidents. Based on the DES's own figures, incidents in 1975 may well have doubled those reported in the four-year period 1971-1974 (IV-38), yet the risk assessment, which used the number of shipments projected for 1985 apparently relied on 1974 accident data."

Staff Response - The use of the information in Appendix C has apparently been misinterpreted: (1) No effort was made to project the effect of abnormal transport occurrences to 1975. (2) The listing of incidents in Appendix C includes incidents from the first 3-1/2 months of 1975. (3) It would be speculative at best to attempt to assess unreported incidents. The FES includes an explanatory section to accompany the data in Appendix C (FES Appendix F).

DES Appendix G: 1

State of New York - Dr. Marvin Resnikoff - Comment 24

"The sensitivity analysis presented in Appendix G of the DES covers a number of factors which can be varied for an examination of the range of effects on calculated impact. The 'theoretical basis' for this analysis is in equation (2). $\Delta I = dI/dX\Delta X$. This is an elaborate way of saying that, if the dependent variable (X) is changed by a certain amount (ΔX), ΔI will change on the basis of dI/dX. For the few variables analysed in this manner, none of the dI/dX components are presented and the methods and assumptions utilized to get them are missing as well."

Staff Response - The ΔI values are shown for a fixed variation of 10 percent in all X parameters that were analyzed. The text has been revised to clarify the computational method.

DES Appendix G: 2

State of New York - Dr. Marvin Resnikoff - Comment 26

"Assuming a linear dI/dX term, the 5.1% increase in baseline value (Figure G-2) would be increased by a factor of some 204%. Therefore LCF numbers would be doubled due to the four times greater density of population in the region at risk. The sensitivity of this parameter in the DES is contradicted by an uncontested affidavit filed by the State in its case against the NRC (Skinner and Wang, sworn to June 13, 1975). The affidavit shows that a 400% increase in population density would occasion a 400% increase in lung cancer fatalities (see Tables 1-9). The analysis of Annual Early Fatality Probability increases (DES Figure G-3) does not consider population density in such a way as to be meaningful in terms of figure V-13."

Staff Response - As discussed earlier, New York City is not a "representative" urban area because of its abnormally high population density. A 400 percent change in any parameter is not appropriate to a sensitivity analysis. Consideration of much higher population densities is included in the Final Environmental Statement.

DES Appendix G: 3

State of New York - Dr. Marvin Resnikoff - Comment 27

"This section in the DES on sensitivity analysis is totally inadequate, having failed to analyze those variables we have discussed herein and having further failed to consider other variables essential to a valid final impact assessment (e.g., shipments by barge, putting plutonium in 'bulk' form)."

Staff Response - Barge shipments are now discussed in FES Chapter 6, and "form" restrictions for plutonium were considered even in the DES, but not in the sensitivity analysis section. The number of parameters covered by the sensitivity analysis has been expanded in the FES.

8.5 DISCUSSION OF COMMENTS RECEIVED ON THE DRAFT FINAL ENVIRONMENTAL STATEMENT DATED FEBRUARY 1977

Dr. Karl Z. Morgan, ACRS Consultant

Comment 1

"My general impression of NUREG-0170 is that it is not an attempt to assess the effects on health and the risks of surreptitious diversion of fissile or radioactive materials during shipping, but rather an attempt to prove the effects on health and the risk of surreptitious diversion are completely negligible. Sometimes there is only a shade of difference in these two styles of writing, but the effect of one is concurrence and acceptance of the public and the result of the other is a challenge to the public to show the NRC is wrong. The job of the NRC would be easier if the public were made to believe NRC was simply stating the true facts and explaining their meaning. Nuclear energy could sell itself better sometimes without the aid of a salesman."

Staff Response - The assessments made on NUREG-0170 were performed in an objective manner. There was neither prejudging of the situation nor influencing of the results toward any particular conclusions.

Comment 2

"I do not believe this report treats adequately the long term problems of wide spread contamination of a city by plutonium and transplutonium following a major shipping accident. In Rocky Flats, Colorado, we have many square miles contaminated with plutonium above the 2.2 dpm level and this contaminated desert land is resulting in serious immediate and long-term problems. Not many persons would care to live in a building or make their home in a city that is badly contaminated with plutonium."

Staff Response - Decontamination costs attributable to transportation accidents are covered in Section 5.5 of NUREG-0170. Long-term effects on cities will be examined in the "Generic Environmental Impact Statement on Transportation of Radionuclides in Urban Environs" now being prepared by the NRC staff.

Comment 3

"I think a poor case is made for shipping plutonium and transplutonium material by air."

Staff Response - This Environmental Statement makes no attempt to promote any type or mode of shipping radioactive material. It presents facts about the current situation as it already exists.

Comment 4

"The cost comparisons for shipment via air, truck, train and barge are biased because of transhipments at each end. What would be the cost (in man-rem) were barge or train terminals

located at all nuclear facilities? In a proper comparison, I believe the man-rem cost by rail would be about 1/10 that by truck and the cost by barge would be about 1/100 that by truck."

Staff Response - The person-rem costs of rail, truck, and barge shipments are already quite small. A detailed analysis of alternative transportation modes is not justified by the small total dose.

Comment 5

"I would like to see the estimated saving in costs (in man-rem) were we to completely change our future nuclear power program and do the following:

a. Discontinue the LMFBR program for the present.
b. Establish large reactor parks over suitable bedded salt formations such that:
   1) High level waste would not have to be shipped
   2) Build converter (Pu ^{232}Th + ^{233}U) reactors at the parks
   3) Denature the ^{233}U with ^{238}U when it is shipped outside the park to reduce the risk of hijacking and diversion.
   4) Have proper isolation of these parks
   5) Several studies at Georgia Tech suggest Th-breeders are possible which would have a negative void coefficient in the coolant, and would have a doubling time much less than that of the LMFBR.
   6) Pu and trans-Pu elements would not be produced
   7) The problems of ^{232}U and ^{234}U production in the Th cycle are minor compared with the Pu problems.
   8) Of course, the parks would have fuel reprocessing and fabrication plants as well as power reactors (convertors and breeders)."

Staff Response - The suggested alternatives listed go far beyond the intended scope of this Environmental Statement. It is not possible to evaluate them within the constraints of the Statement.

Comment 6

"I think NUREG-0170 should have given more attention to the recommendation of the Special Panel to Study Transportation of Nuclear Materials and its report to the JCAE of Congress (December 17, 1974)."

Staff Response - All recommendations have been given the attention considered appropriate to the intent and scope of NUREG-0170.

Comment 7

"It was indicated by Mr. Hoppins (sic) in answer to my question that some of the shipping containers that were improperly designed and approved by the AEC (now NRC) are still in use under the grandfather clause. This presumably includes the C-10 industrial source shipping

container which occasioned the serious accident into Atlanta in which I became involved a few years ago. It was indicated that NRC places reliance on administrative control rather than upon safe design in these cases. I think this is a very serious situation because unless the operator is careful about what he is doing, the source will be pushed outside the C-10 shipping container where no shielding protection is provided. I think NRC must share responsibility for any accidents that result during the term of the grandfather clause because it (or the AEC) is responsible for this ridiculous design in the first place."

Staff Response - In the case of the container mentioned (C-10 container), the NRC has required it to be redesigned. The new design makes it impossible to misplace the source in the shield. In general, the Department of Transportation is phasing out the "grandfather clause" authority for using existing shipping packages.

H. M. Parker, ACRS Consultant

Comment 1

"I understand that it [the Environmental Statement] started in support of proposed rule-making concerning air transportation of radioactive materials (Federal Register June 2, 1975). Such a study would have considered alternatives to air transport but only for such packages as a reasonable person would have contemplated sending by air as one option. That vital distinction has not been observed so that one immediately becomes involved with the whole gamut of transportation scenarios."

Staff Response - The scope of this study as originally presented in the Federal Register (June 2, 1975) dealt only with air transportation. Subsequently the scope was expanded to include all modes of transport, referencing those environmental studies that had already been carried out. These studies include the "Environmental Survey of Transportation of Radioactive Materials to and from Nuclear Power Plants, WASH-1238," and the "Assessment of the Environmental Impact of the FAA Proposed Rulemaking Affecting the Conditions of Transport of Radioactive Materials on Aircraft (Draft)" sponsored by the Federal Aviation Administration. The scope was broadened in response to public interest in the entire area of transporting radioactive material. This study does investigate alternatives to air transportation of radioactive material. Using data from a survey of shippers, it looks at the effect of shipping by land or sea those packages actually shipped by air. These alternatives are discussed in Sections 6.2.1, 6.2.2, and 6.2.3.

Comment 2

"They [shipment models] are so different from the earlier NUREG-0034 versions in number and activity that one wonders whether a third look would bear any resemblance to either -0034 or -0170 tallies."

Staff Response - The standard shipment model used in NUREG-0034 was based on limited data from interviews with the shipping industry, while the NUREG-0170 model is based on a comprehensive shippers survey conducted for the NRC.

Comment 3

"They [shipment models] contain packages whose 'hazard properties' are polar extremes."

Staff Response - Packages with very different hazards have been included in the analyses because they are the packages actually shipped. Differences in the degree of hazard have been considered in the analyses.

Comment 4

"In NUREG-0170 the so-called alternatives group all these classes together so that real differences between modes tend to cancel each other out."

Staff Response - Some of the differences do tend to cancel each other, but the study shows that the contribution from individual nuclides to the overall risk is too small to justify an individual analysis for each.

Comment 5

"The quoted differences in health effects for the various scenarios, are in my opinion below the uncertainty level of any of the calculations of risk and cost-effectiveness."

Staff Response - It is true that the health effects for the various scenarios differ by amounts less than the total uncertainty. However, other factors taken into account in assessing cost-effectiveness (shipping costs, for example) in some cases differ enough to establish whether or not the alternative is cost effective.

Comment 6

"I, for one, believe that air shipments should be limited to cases where speed is of the essence*--in practice, to the radiopharmaceutical case, where the public does accept a compensating social benefit. If that analysis had been made separately it would at once have been clear that innovative alternatives have not been included... one should make the alternatives for each generic type of shipment--not for all taken together."

Staff Response - Section 6.2.4 examines the effect of transporting all high-hazard dispersible material by land. All the remaining radionuclides shipped by air would then be less hazardous materials, mostly radiopharmaceuticals. Further detailed examination did not appear to be justified by the level of impact. In addition, the restrictions on shipments by air imposed by the Congress in the Transportation Safety Act of 1974 limited the available alternatives.

Comment 7

"Table IV-19 (p. IV-55) displays an annual individual dose to an airline passenger of 108 mrem... In view of the NRC's efforts to get reactor fencepost doses down to the range of 10

mrem/yr, casual acceptance of 108 mrem/yr for an unsuspecting passenger is incredible Surely the ALARA principle calls for reduction by about one order of magnitude."

Staff Response - This 108 mrem/yr figure, about the same as the natural background dose, was calculated as the maximum credible dose to any individual. It is not an expected dose to any real group of passengers. A more realistic figure is the 0.34 mrem calculated as the average annual dose to airline passengers from radioactive material shipments. An average dose of this size does not justify relocating radiopharmaceutical facilities, adding shielding, or radically changing the distribution system. Implementing the ALARA principle requires detailed consideration of such factors as economic and social impacts. We do not feel such a detailed study is justified by the small average exposure or by the estimated maximum dose.

Comment 8

"As examples, let it be assumed that estimated doses from air shipments are too high. Then, at the source of the transportation web, one must analyze the merits of radiopharmaceutical preparation at more and better chosen locations. Upon loading on planes, one must consider packaging with one thick shielding face under the passengers instead of conventional equal shielding on all sides.

"At the natural terminals, usually large cities with clustered hospitals, one must examine the possibility of underground tube delivery, and so on."

Staff Response - The small impact from transporting radiopharmaceuticals does not justify the effort necessary to investigate redesigning the distribution system.

Comment 9

"Genetic effects are excluded on the grounds of scarcity of information. Curiously, this is one area in which there is essential agreement on a dose and dose-rate effect. There is no real way to add genetic effects and cancer fatalities on a common scale, but some arbitrary allowance has to be shown."

Staff Response - Genetic effects are now quantitatively considered in NUREG-0170.

Comment 10

"There is much more scarcity of information on the somatic side than is reflected by an LCF Index of 121.6 per 10^6 person-rem. The implied precision for a number that may be 12 (or even zero) on the one side or perhaps 600 on the other side is entirely out of place."

Staff Response - The 121.6 figure, although perhaps overly precise, is the value implied by the "Reactor Safety Study" (WASH-1400).

Comment 11

"The best efforts of NRC to set dollar indices such as $1000 per person rem, or $8 million per LCF simply cannot be accepted."

Staff Response - The $1000 per person-rem figure is one established by United States Government agencies and reflects the best available data. The figure of $8 million per LCF is derived from the $1000 per person-rem figure and the 121.6 LCFs per 10^6 rem figure discussed in FES Section 3.7.

Comment 12

"Some of the basic dosimetry equations need better support. Even the point source formulation

$$\frac{Ke^{-\mu D}B(D)}{D^2}$$

where μ is some formal absorption coefficient and B(d) is a Berger build-up factor is arbitrary. The relevant absorption factor is rarely well known and the build-up factor is both empirical and terrain-variable. What is known is the total energy emitted from any well described source. Then, the integration of energy absorption over all space would demonstrate the appropriateness of the combinations of μ and B(d) used.

"In the integration of dose at a point from a source moving uniformly in a straight line, we have mathematically the same issue as dose at a point from a uniform line source, the familiar Sievert equations published in Acta Radiologica in 1928. Formal demonstration of this equivalence would have improved confidence in the result.

"In the second stage of double integration as in Fig. D-2 of p. D-4, the same result should be obtained by integrating the dose from an infinite disc of radioactive material (also a familiar Sievert equation) as the receptor moves uniformly across a diameter."

Staff Response - Although we did not recalculate the dosage results using the Sievert equations or energy considerations, we have established that the methods suggested by this comment do support the results of this study. A summary of the NRC staff calculations is available in the NRC Public Document Room in Washington, D.C.

Environmentalists, Inc

Comment 1

"The impact of transporting radioactive nuclear materials associated with nuclear weapons is excluded."

Staff Response - The relation of benefits to impacts for transporting nuclear weapons is evaluated on a different basis than that for transporting other radioactive material. The Atomic Energy Act of 1954, as amended, exempts nuclear weapons from licensing and other regulatory controls. Thus their transportation is not within the scope of this study.

Comment 2

"Accidental releases are not among the factors included in the models used to calculate radiation dose predictions. The long-term detrimental environmental impact from a major transportation accident, such as an unplanned release of radioactive materials, is not included in the models used to calculate radiation dose predictions. The pathways by which such radioactive releases might continue to increase the public's exposure to radiation are not considered."

Staff Response - Accident releases are included in the dose predictions of Chapter 5.

Comment 4

"The increase of radiation exposure to the public and to workers at those points where delays in shipment occur are not included as part of the model calculations, i.e., on highways, in rail, air, and barge transport, during switch operations in freight yards, and at transfer points."

Staff Response - The average transit times for all modes include allowances for reasonable delays. Specific cases have been analyzed for some modes.

Comment 5

"The failure to calculate radiation exposures with consideration for the converging of transportation routes to one central point is conspicuous."

Staff Response - Specific routing was not included in this Generic Environmental Study but will be included in the Urban Study now being prepared. Nevertheless, estimates of the total cumulative dose to the population have been made, and the risk from that exposure has been assessed. Thus the overall environmental impact of the convergence of routes has been evaluated.

Comment 6

"The study fails to include an estimate for the releases that might result during hijacking, theft, and other terrorist activities."

Staff Response - Consequences of terrorist activities are qualitatively treated in Chapter 7, which covers Safeguards.

Comment 7

"There is an absence of any evaluation of genetic damage resulting directly from transportation activities or indirect damage to the gene pool from such activities."

Staff Response - Genetic effects are now quantitatively treated in Section 3.7 of NUREG-0170.

Comment 8

"The study fails to reveal whether or not the 'No Threshold/Linear Hypothesis' is utilized in assessing the impact on public health. Any amount of man-made radiation is damaging and is an added harm over and above the harm done by natural radiation."

Staff Response - Use of the "Linear Hypothesis" in the Study is clearly stated in Chapter 5, which says:

> "...we do not intend to give the impression that we believe thresholds exist for the onset of radiation effects. Both for the accident case and under normal operational conditions, it is presumed that radiation damage varies linearly with exposure."

Comment 9

"The study fails to prepare a number of models which would be relevant to special areas. Many vicinities will be receiving radiation exposure from a number of sources: nuclear power plants, waste handling facilities, weapons operations, etc."

Staff Response - Environmental impacts from radioactive material in any particular location are the sum of those from this study and those from specific facilities in the vicinity. Although the risk from exposure to persons living in specific areas has not been evaluated, the total cumulative dose to persons from all transportation activities has been evaluated.

Comment 10

"The study fails to take into account the varying qualities of rail points in existence on the various routes proposed."

Staff Response - This Generic Study looks at the average impacts of rail transports. It does not aim at evaluating specific routes.

Comment 11

"The defects in calculating and assessing the effects of radiation exposure due to the transport of radioactive materials make the existing report practically useless. Environmentalists, Inc., is most concerned about transportation activities associated with the various

Barnwell facilities. The Barnwell area will be the terminal of many transportation routes. The population will be exposed to radiation not only from numerous shipments, but will be exposed to accidental and normal releases from the Savannah River Plant, BNFP, converging transportation routes, Chem Nuclear waste handling, nuclear submarine base, nuclear power plants --- including leaks to the drinking water. NUREG-0170 will be of small value in assessing the environmental impact of the Barnwell operations."

Staff Response - Environmental impacts from transportation associated with particular facilities are covered in the Environmental Statements associated with those facilities.

Comment 12

"We question the use of taxpayers' money for a report which appears to have little if any use. The report does not follow the provisions of NEPA. The alternative section does not include discussion of the possibility of not transporting nuclear materials nor the alternative of halting the use of nuclear energy. The cost-benefit analysis fails to quantify many of the transportation costs and some are not even listed."

Staff Response - This environmental impact assessment and statement was prepared to be a basis for deciding on the adequacy of existing regulations governing the transportation of radioactive materials. In this country there are medical, industrial, and commercial activities involving the transportation of radioactive materials. The statement treats alternative modes for such shipments but does not consider the alternative of stopping the shipment of radioactive materials entirely. That alternative could only be considered in the far broader context of evaluating whether any medical, industrial, or commercial use of radioactive material should be permitted. That vastly broader consideration is completely outside the scope and purpose of this statement and beyond the NRC's expressed intent to review its regulations to determine what changes, if any, should be made.

Comment 13

"Environmentalists, Inc., regrets not having had the opportunity to make initial comments on NUREG-0034. However, since NUREG-0170 appears to have such little merit, we anticipate a redundant study for the purposes of licensing the Barnwell facilities."

Staff Response - The licensing of the Barnwell facilities requires a separate Environmental Statement. This study was not intended to replace or remove the need for such a specific statement.

Georgia Public Interest Research Group

Comment 1

"G-Pirg's chief concern with the Final Draft Environmental Statement is with the adequacy of treatment accorded coordination between State and Federal Authorities. There are twenty

Federal and State agencies that could be called upon to act in the event of an incident. The instant document does not adequately deal with this problem."

Staff Response - NUREG-0170 assumes that authorities respond to transportation incidents involving radioactive material in the same way they respond to other transport incidents. No special response to radiological incidents was included in the model. There is a totally independent Federal interagency program as well as several State studies on responding to radiological incidents.

Comment 2

"The New York Department of Law asked similar questions in a letter to NRC dated May 17, 1976. The NRC failed to sufficiently address the issue. For example, there are no regulations or plans for communications equipment or frequent contact between local law enforcement agencies along truck routes (see VII-10). Nor does NRC's answer deal with distances, transportation, or communications between airports (see VII-11) or with regulations concerning 'airport security personal' (sic) as stated in VII-11, or airplane security personal (sic)."

Staff Response - The May 17, 1976, letter from the New York State Department of Law has been answered in Chapter 8 of NUREG-0170. Communications requirements for safeguarded shipments are described in Section 8.4 of NUREG-0170, as well as in 10 CFR Part 73.

Comment 3

"G-PIRG also feels that the FES should have focused more attention on the issue of financial responsibility in the event of an incident. Will the costs be borne by the agencies involved or by the carrier? If by the former, how would the liabilities be apportioned?"

Staff Response - Costs that may be involved in accidents have been estimated as environmental costs. Although the apportionment of financial responsibility may have an effect on the way people respond to an environmental impact, the source of the funds is not pertinent to this study. An analysis of financial responsibility is therefore not included in this Statement.

Comment 4

"G-PIRG also feels compelled to ask who is responsible for the planning and approving of routes and times of travel and for the notification of checkpoints. These activities are vital in the effort to reduce the risk of incidents. Again, these questions are not sufficiently dealt with in the FES."

Staff Response - The regulations of neither DOT nor NRC specify routing, times of travel, or (except for safeguards purposes) notification of checkpoints. Although some local restrictions may be imposed on routing and time of travel, these have little overall effect on transportation. Therefore, no discussion of responsibilities for them was considered necessary. Alternatives to current practices are analyzed in Section 6.3, "Alternatives Introducing Operational Constraints on Transport."

Comment 5

"Finally, G-PIRG cites the NRC for not confronting the potential problem of non-compliance. It is naive to assume that the regulations will be followed merely because they exist. We are mindful of the Brown's Ferry incident. G-PIRG also submits that it is extremely unwise to accept 'industry practices' as assurances of compliance."

Staff Response - An analysis of incidents from 1971 to 1975 is included in Section 4.6. This includes incidents caused by defective or improper packaging.

Comment 6

"In conclusion, we feel that the potential dangers of transport of radioactive materials are great enough to warrant an unhurried and careful consideration of all the issues and ramifications. These risks are particularly acute to Atlanta and to Georgia because of their location at the crossroads of America's transport links and because of their proximity to the Barnwell Nuclear Reprocessing Plant. In light of this, G-PIRG urges more thorough attention to the issues addressed in this paper and to the convening of another public meeting in Atlanta concerning NUREG-0170 with proper advance notice to all interested parties."

Staff Response - NUREG-0170 is the most comprehensive analysis of the environmental impacts of transporting radioactive material thus far produced. The public will be invited to participate directly in any decisions on conclusions drawn from this study. A more detailed study of transporting radioactive material in cities is now being prepared by the NRC Staff.

The Georgia Conservancy (Letter of February 1977)

Comment 1

"It is self evident that a generic statement such as this is inadequate to meet the needs of specific areas of the Nation where a concentration of nuclear facilities or a convergence of transportation routes to such facilities create circumstances demanding independent and detailed treatment. This is particularly true of Georgia, where the presence of the Savannah River Plant, Chem-Nuclear low level waste storage facility, Barnwell Nuclear Fuel Reprocessing Plant, together with the proposed Posiedon Base at Kings Bay, nuclear reactors, weapons systems and weapon components within the State, medical radio-pharamaceutical, industry, etc., will funnel a disproportionate shore of hazardous nuclear materials through Georgia's rails, highways, waterways, and airways. A separate Environmental Impact Statement incorporating the aggregate and cumulative effect of such activities is a minimal requirement of the understanding and protection of those asked to accept and support their existence. We need a comprehensive study of precisely what is moving through and to our State now, and a projection for 1985 and beyond."

Staff Response - It was not the intention of this study to investigate impacts to specific areas. NUREG-0170 assesses environmental impacts on the nation as a whole. Each licensed

facility is required to evaluate in a separate NEPA statement the specific environmental impacts it causes.

Comment 2

"The cost for land reclamation of a radiation accident site is stated to "exceed $200 million" in the Summary and Conclusions. However, Table V-14 shows the cost of decontamination being as high as $8.21 billion which is 40 times as much cost. We therefore find it materially misleading to include only the lower figure in the summary statement."

Staff Response - The Summary and Conclusions section has been revised to more accurately reflect the data from the body of the report.

Comment 3

"...the possible costs resulting from a radiation transport accident are enormous. It appears that insufficient attention has been given to the question of who will be responsible for absorbing these costs and their financial ability to pay. It is questionable that the shipper would be able to cover such costs and the State of Georgia should certainly not be required to bear the responsibility for reclamation and decontamination. What provisions have been made for assurances that these costs are paid? Will the Federal Government be prepared to cover such costs? Through what mechanism?"

Staff Response - Although financial indemnity and insurance coverage may affect the way people respond to an environmental impact, they do not directly affect the impact itself. Analyses of these factors is therefore not included in this statement. Information on insurance coverage can be obtained from the following:

> Joint Committee on Atomic Energy-HR-8631, "NRC Staff Study Concerning Financial Protection Against Potential Hazards Caused by Sabotage or Theft of Nuclear Materials," Appendix D, "To Amend and Extend the Price Anderson Act," Part IIB, "Geographic Limitation on Coverage."

Comment 4

"It's apparent that the accident risks and health effects due to a given accident are directly tied to the frequency of shipments and routes of transport. The full impact of radioactive transport on the State of Georgia or communities in the State cannot be fully assessed without adequate information on these factors.

"Is information on the projected frequency and routes of shipments available to the State of Georgia and concerned citizens?

"It is imperative that the State be provided with advance notice of radioactive shipments and that the State be given the option of prescribing acceptable routes and times of transport.

"It is our understanding that the State of Florida is already pursuing this option.

"Is there provision for Georgia to exercise this right?"

Staff Response - This Generic Study analyzes no specific cases. Frequency and routing information about radioactive material shipments is not available from this report. An ongoing study of transportation in urban areas is developing methods to model this information. Under contracts with NRC and DOT, several states have been inspecting the transportation activities within their borders. Also, legislation on preemption of regulations "inconsistent" with DOT regulations has recently been put into effect. Specific questions on the States' role in regulating radioactive material transportation should be addressed to the United States Nuclear Regulatory Commission, Office of State Programs, Washington, D.C. 20555.

Comment 5

"The magnitude of health effects following a radioactive transport accident will obviously depend to a large degree on what immediate action is taken at the accident site to minimize these effects.

"Has an established procedure been developed for handling such an event and have responsibilities for specific activities been fully defined?

"For example, who will be responsible for radioactive monitoring, for evacuation of adjacent areas, for retaining contaminated people at the site, for decontamination of the accident site?

"We question whether there are even adequate medical and personnel decontamination facilities in Georgia to handle victims of such incidents.

Staff Response - This Study considers the average response to incidents, not specific cases. The question of responsibility for accident response is partially answered in NUREG-0179, "Regulatory and Other Responsibilities as Related to Transportation Accidents," June 1977. Specific response actions are the subject of an ongoing NRC study of emergency response to transportation incidents. Also, both the Western Interstate Nuclear Board (WINB) and the Southern Interstate Nuclear Board (SINB) have carried out study programs and developed proposed plans on accident response.

Comment 6

"We question whether all reasonable alternatives have been considered to reduce the environmental effects of radioactive transport. For example, the alternative of limiting the amount of radioactive material transported should be addressed. This would include limiting the number of nuclear power plants in the country to those now in operation or under construction. This would significantly reduce the risk of adverse environmental effects due to transport, and particularly in Georgia, it would help to minimize the amount of nuclear materials transported across the State to and from the Barnwell, South Carolina Reprocessing Plant."

Staff Response - We have examined a cross section of reasonable alternatives in the transportation system. Questions of altering the types or quantities of radioactive materials transported are beyond the scope of this study, which analyzes the impacts of transporting the present types and amounts of material.

Comment 7

"Spent fuel shipments are specifically exempted from physical protection requirements of 10 CFR Part 73. No discussion of special precaution or less rigorous methods of protection proportionate to the risk are discussed. The rupture of a cask is a stated possibility, resulting in a total of 244 predicted deaths (page VII-2). A consequence of this magnitude (or worse, should the cask fall in a water supply for example) merits more serious consideration of escorts or other appropriate types of safety precautions."

Staff Response - The type of rupture referred to in this comment is a hypothetical result of an act of sabotage. Actually, far fewer fatalities would be expected, and they would be delayed and spread over a period of decades. We believe the absence of immediate fatalities make spent fuel shipments a relatively unattractive target for sabotage.

Comment 8

"The final conclusion of Section VII dealing with special nuclear materials, states that 'alternative means of protection --- are neither necessary nor desirable for the protection of privately owned materials.' Apart from the highly debatable merit of this conclusion, a more profound question which should be addressed is 'What are materials such as these (which have the potential for cataclysmic harm to society in a variety of ways) doing in private ownership to begin with?'

"It seems to us that there is a substantial question as to whether bomb grade material should be introduced into the general stream of commercial traffic."

Staff Response - Private ownership of special nuclear material has been authorized by Congress. Weapons grade material is not in the general stream of commercial traffic. Virtually all of it is transported by the U.S. Government. All such material is transported with special safeguards beyond those used in normal commercial transport.

Comment 9

"Table VI - 2 sets forth the economics of rail and truck shipments of spent fuel. Do the 'costs' include the costs to the State for road damage and maintenance (particularly for overweight shipment), bridge strengthening where needed, increased police coverage and special equipment, if necessary? Who bears these costs? Sec. 168 of the AEC Act of 1954, as amended, and Sec. 91 of the Atomic Energy Community Act, of 1955, as amended, provide a specific statutory mechanism for the evaluation and determination of the need for financial assistance to local entities which may be affected by ERDA activities.

"Would these or similar costs imposed by any of the various modes of transport comtemplated by this statement qualify for relief under these provisions?"

Staff Response - Cost-per-shipment data in NUREG-0170 include State and local licensing fees, which go to support maintenance and road repairs. Provisions for reimbursement of costs as described are not within the purview of this study.

Comment 10

"On Page XXV of the Detailed Summary as one of the long term positive results from the shipment of radioactive materials the assertion is made that the use of nuclear fuels in reactors allows production of electricity for society with lower costs than is possible by more conventional methods of generating electricity.

"Statements like the above have for far too long accompanied cost benefit assessments. To state it now, without qualification or supporting data, in the light of increasing numbers of critical analyses which arrive at contrary conclusions, is simply inexcusable.

"This is particularly true when it is characterized as a 'long term' benefit, implying either (1) an adequate supply of uranium for the indefinite future, (2) the acceptability of plutonium recycle, (3) and/or the economic and environmental viability of a breeder reactor, none of which has or can be demonstrated at the present time."

Staff Response - This statement is based on the best available information.

The Georgia Conservancy (Letter of March 4, 1977)

Comment 1

"Among the final matters dealt with by the Committee was the question of what consequences might reasonably be expected as a result of a successful 'diversion of special nuclear materials,' a question wholly omitted in the Statement itself.

"The ultimate consequence of a successful theft of bomb grade materials, or any major credible catastrophe which might occur anywhere in the commercial fuel cycle [is not covered]. Such an assessment should address not just the immediate economic or biological effects of such an occurence as this statement does, but the predictable events which are likely to ensue, including the possible shutdown of the industry and the attendant disruption in our economy and other major effects (on our foreign policy for example). Alternatively, if the plants are not closed, what effect on public and worker morale? And to production costs if more stringent safety features were demanded?"

Staff Response - NRC efforts are directed at preventing the success of any attempted diversion of special nuclear material, rather than at controlling the consequences of the act. Therefore, an evaluation of the consequences of a diversion is felt to be unnecessary. A brief

description of the potential impacts was included in the Draft Statement, NUREG-0034, as Appendix F.

Comment 2

"A clarification of language using plain english rather than terminology which tends to obscure fact or meaning.

"First we would suggest that euphemistic terms like 'special nuclear materials' and 'diversion' be deleted entirely from any communication which is intended to enlighten or edify. 'Special nuclear material' means bomb grade material and 'diversion' means theft. It does not change the nature of a substance or an act to call it something else. The literature of this industry and the agencies governing it is replete with similar efforts to obscure reality. Please stop it. Learn to tell the truth in a fashion that can be understood and dealt with."

Staff Response - Congress originated the term "special nuclear material" in the Atomic Energy Act of 1954, including not only weapons grade material, but also nonfissionable plutonium, enriched uranium, and other materials enriched in plutonium or certain uranium isotopes. Most special nuclear material is not weapons grade material; to label it as such would be incorrect and misleading. The term "diversion" is used rather than "theft" because "diversion" is a more general term that more accurately covers the possible occurrences. Theft connotes an unauthorized removal of another's property, while diversion can be any unauthorized use of the material. Thus the two terms are not quite synonymous.

Comment 3

"In the NRC spokesman's formal presentation on the threat of 'diversion,' in the following sequence we understood him to say first that 'it is impossible to quantify the threat' and later on to state that 'any mode of transportation can be protected against any level of threat.' Those two statements are totally inconsistent. More importantly, they reveal an attitude, a 'way of thinking' as the Chairman expressed it, which in our opinion has characterized the Government's role in the nuclear industry from its inception, and accounts in large part for the growing mistrust and resistance on the part of the public to continued or increased reliance on nuclear power as the sine qua non of our economic existence."

Staff Response - We believe sufficient resources can be assembled to protect a shipment against any level of threat. Quantification of the threat in terms of expected attacks per year, or assigning probabilities to shipment attacks is not necessary for preventing their success. A review of the transcript of the February 1977 ACRS briefing on NUREG-0170 did not reveal the statement "...it is impossible to quantify the threat." However, a qualitative assessment of the safeguards necessary to protect a shipment does not require assigning a numerical value to the threat.

Comment 4

"The specific question addressed briefly in this proceeding were the probabilities and consequences of theft of bomb grade material. We suggest for your consideration that history

supports the view that any human endeavor whose success depends upon achieving 'zero defects' is doomed to failure. Recent examples in the realm of technology are the Apollo and SNAPS programs. A similar failure in the field of 'anthropology' is exemplified by the actions of Mr. Nixon's staff."

Staff Response - Security in the transportation of radioactive materials is not dependent on "zero defects." Protection lies in the small chance of success in an attempted diversion and in the very small probability of an attempt.

Comment 5

"We further suggest that any serious effort to achieve zero probability of failure, whether technological or anthropological, will, in itself, incur unprecedented costs to our society. Financially, power companies are already chafing under the escalating capital costs of nuclear facilities which knowledgeable critics proclaim to be still not safe enough. Societally, you gentlemen calmly discussed the introduction of guards armed with automatic weapons to traverse Amercia's expressways - a profound 'environmental impact' upon our society, we should say. We urge you to reflect upon it.

"The price already paid or incurred to generate electricity in this way is far greater than that which appears in any cost-benefit analysis. The more we seek to attain zero defects the more the price will rise.

"And we have no choice but to seek it, for the consequences of a major failure, whether it be a transportation accident, a successful theft, or any other mode, though not infinite would surely be intolerable. With costs in the billions, and fear of repetition rampant, regardless of who pays what to whom, what do you think would happen? Do you think it would end there? Would a new Rasmussen study placate the public?

"And suppose it happens when 20% - 40% of the electrical power of the United States is generated by nuclear fission and you are the President? What do you do?

"It seems to us, as it has for a long time now, that, in dealing with the nuclear questions we will remain torn between intolerable risk and intolerable cost."

Staff Response - We agree that to achieve a zero probability of failure would be very difficult. But the target is achieving a very high probability that there will be no successful diversion of special nuclear material. The safeguards program exists because of the chance of an attempted diversion and the magnitude of the possible consequences. Questions on probable U.S. policy in the event of an accident are beyond the scope of this Study.

Comment 6

"Nuclear power generation has already distorted our judicial system in a variety of ways. Most notably, the ancient doctrine of tort law creating liability to innocent third parties for

harm done them by a negligent act has been laid aside to accommodate the growth of this particular industry and for none other.

"Less obviously, but perhaps even more importantly, scientific dissent is quelled, not encouraged, as it properly should be in the search for truth. William Rowe, a ranking official of the Environmental Protection Agency, recently responded to a question on this topic by stating that no effort was made to discourage dissent 'except, of course, when it is contrary to departmental policy.'

"This EIS is inadequate in failing to consider the above questions. They are being discussed in other forums. As a presidential candidate addressing the Washington Press Club, Mr. Carter predicted that a major reactor accident would mean the end of the nuclear power industry. Dr. Lynn Weaver head of Georgia Tech's Nuclear Engineering Department has expressed the same opinion. Countless others share this view. Clearly, it is a credible consequence of any major nuclear disaster, including theft or transportation accident, and should be included in any responsible overall assessment of acceptablility. Adequate notice and availability of subject matter to all interested parties in timely fashion."

Staff Response - Neither the effect of nuclear power on our judicial system nor the quelling of scientific dissent are within the scope of this statement. Demise of the nuclear power industry is not considered to be a credible consequence of an attempted theft of special nuclear material or a transportation accident.

Comment 7

"Civilian guards armed with automatic weapons. What effects, subtle or overt, on travelers sharing the expressways and the general public? What specific instruction to the guards as to their response in a wide range of potential encounters, both real, or as they may be perceived by the guards in a sudden and unexpected confrontation: What quality of individual is contemplated to be recruited and trusted to bear these weapons? What program of indemnification and financial responsibility on whose part for error in selection, training, supervision or performance?"

Staff Response - NUREG-0170 neither assumes nor advocates automatic weapons for civilian guards. For many years ERDA shipments of special nuclear material have been made on public highways with armed escorts, with no discernible effect on the general public. Thus the civilian safeguards program, based on this ERDA experience, is expected to have no significant effect on the public. Specific responses and indemnity questions are not among the topics analyzed by this Study.

Comment 8

"What surveillance systems are specified and in place to identify and monitor potential threats to transportation of nuclear materials? The statement was made that there are no known groups who have the motivation and capability to successfully divert bomb grade materials. Who

made that determination? The FBI? The CIA? The NRC? Is the dollar cost of acquiring and maintaining such information charged to the public generally, or is it internalized and accounted for in the cost-benefit analysis? Apart from financial cost, what loss of freedoms is likely to occur to individual citizens? Will there be increased numbers of phone taps and similar encroachments on privacy deemed necessary to adequately protect these materials? Will the need to protect them result in the successful passage of legislation such as that proposed in the State of Virginia to grant to the Virginia Electric and Power Co. a variety of police powers?"

Staff Response - Information about possible threats to special nuclear material shipments is furnished to the NRC by all U.S. intelligence agencies that gather such information. Among the agencies that have worked with the NRC on the safeguards program are ERDA, the FBI, the CIA, the Department of Defense, and the Department of State. Financial and social impacts of intelligence gathering are not within the purview of the Environmental Study.

Comment 9

"What additional effects can be expected in our judicial and political systems to protect and encourage nuclear power generation? We have identified the abandonment of tort liability, the repression of dissenting opinion, and the extension of police powers to private firms. Will the states be preempted by the Federal Government from a voice in nuclear plant siting and the regulation of nuclear materials transported within their borders? Is that good or bad? Who decides? These are not frivolous questions and they are not adequately considered (if addressed at all) in the Final Environmental Impact Statement. We think they should be."

Staff Response - These topics are beyond the scope of this Study.

State of New York - Department of Law

Comment 1

"Pursuant to the Notice of Availability of the above-referenced Draft Environmental Impact Statement ('DES') published at 41 Fed. Reg. 12937 and the solicitation of comments on that DES as contained in the Notice of Availability, the New York State Attorney General submitted a series of comments on the DES. It was noted in the Attorney General's filing of May 17, 1976 that the DES did not address the issues set forth in the materials previously submitted by the office to the NRC in the course of this administrative proceeding on transportation of nuclear materials as originally noticed in the Federal Register. 40 Fed. Reg. 23768 (June 2, 1975). More specifically the DES did not address the materials submitted by way of this office's letter, dated July 2, 1975, which letter and materials are apparently on file in the Commission's public docket room.

"It has been brought to our attention that, as with the DES, the unreleased final environmental impact statement ('FES') ignores the above described materials and, in part, subsequent filings."

Staff Response - The comments in this and previous letters concerning the June 2, 1975, "Advance Notice of Rule Making Proceeding" will be considered in the course of that proceeding. Neither the DES (NUREG-0034) nor the FES (NUREG-0170) treats those topics.

Comments received on the DES were considered in the preparation of the FES.

Comment 2

"In addition, we have been informed that certain comments are dismissed as being based on 'unconfirmed analysis.' Such a response to the comments, calculations and estimates of this office is meaningless and displays a failure by staff to resolve factual disputes. All the comments and supporting materials filed by this office must be responded to in a thorough manner in order for the Commission to comply with the Guidelines of the Council on Environmental Quality under the National Environmental Policy Act, 42 U.S.C. K 4321 et seq. It is particularly appropriate for the Commission to attend to this matter now in view of its recent decision to have the FES redrafted."

Staff Response - The dismissal of comments about the "hot particle" and "enhanced risk to smokers" models for plutonium health effects is based on their lack of acceptance by the medical and health physics communities and on the conclusions of an extensive NRC staff study.

APPENDIX J

COMMENTS ON THE DRAFT ENVIRONMENTAL STATEMENT

DOCKET NUMBER
PROPOSED RULE PR-71.73 (40 FR 23768) (72) (Revised)
Transportation of Radioactive Mtl by Air

STATE OF NEW MEXICO
Environmental Improvement Agency

P.O. Box 2348 - Room 215
Santa Fe, New Mexico 87503

Guy A. Arlotto, Director
Division of Engineering Standards
Office of Standards Development
United States Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Arlotto:

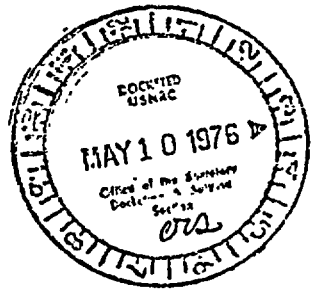
We have reviewed the Draft Environmental Statement on the transportation of radioactive material by air and other modes, and we see no conflict in the conclusions.

Thank you for the opportunity to comment.

Yours truly,

Charles A. Marquez

Charles A. Marquez
Environmental Planner



DOCKET NUMBER
PROPOSED RULE PR-71,73 (40 FR 23768)
Transportation of Radioactive (Revised)
Mtl by Air

STATE OF NEW MEXICO

Environmental Improvement Agency

PERA Building - Rm. #215
P.O. Box 2348
Santa Fe, New Mexico 87503

SPECIAL PROJECTS SECTION

April 21, 1976

Mr. Guy A. Arlotto, Director
Division of Engineering Standards
Office of Standards Development
United States Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Arlotto:

We have reviewed the Draft Environmental Statement on transportation of radioactive material by air and other modes. We have no additional comments to offer.

In our opinion this draft complies with the spirit and intent of the National Environmental Policy Act of 1969.

Sincerely yours,

Dick Burgard
Environmental Program Manager

DB/mtm

DOCKET NUMBER
PROPOSED RULE PR-71,73 (40 FR 23768) (14)
Transportation of Radioactive (Revised)
Mtl by Air

FEDERAL ENERGY ADMINISTRATION
WASHINGTON, D.C. 20461

APR 30 1976

OFFICE OF THE ASSISTANT ADMINISTRATOR

FEA 76-86

Mr. Guy A. Arlotto, Director
Division of Engineering Standards
Office of Standards Development
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Arlotto:

In response to your request for review of the draft environmental impact statement (EIS) on the Transportation of Radioactive Material by Air and Other Modes (NUREG-0034), we are providing the following comments.

The "Standard Shipments" used in assessing potential environmental impacts include plutonium, but do not include enriched uranium. Although the concern expressed during the past year by public officials and others about the air shipment of special nuclear material has emphasized plutonium, uranium has not been excluded. If the NRC is able to certify to the Joint Committee on Atomic Energy (JCAE) that a safe container for plutonium has been developed and tested which will withstand the crash of a high-flying aircraft, the public concern over air shipments could shift to enriched uranium. Accordingly, we suggest that low enriched uranium typically used in light water power reactors be included in the "Standard Shipments" analyzed in NUREG-0034.

On page B-12, the median lethal dose of plutonium is compared with the lethal dose of other toxic materials. We suggest that this paragraph also point out that the projected death from the referenced dose of plutonium would result from cancer at some undetermined time after a latent period of approximately 15 years, but that death from the other toxins would occur within a short period of time.

We hope that these comments are useful to you in preparation of the final EIS.

Sincerely,

Roger W. Sant
Assistant Administrator
Energy Conservation and Environment

DOCKET NUMBER
PROPOSED RULE PR-71.73 (40 FR 23768)
Transportation of Radioactive Mtl by Air (Revised)

FRIENDS OF THE EARTH 72 JANE STREET • NEW YORK, NEW YORK 10014 • (212) 675-5911

Friends of the Earth would like to submit the following comments on the Draft Environmental Statement on the Transportation of Radioactive Material by Air and Other Modes (NUREG-0034, U.S.Nuclear Regulatory Commission Office of Standards Development, March 1976)

- - -

Summary & Conclusions, p.v, para.3

The draft environmental statement refers here to air transport as an "effective means of protection"against theft and sabotage of radioactive materials. We strongly disagree. Sabotage of aircraft could lead to a crash and fire and possible dispersal of radioactive materials. Air transport is therefore not an alternative to ground modes of transport since it offers additional potential for such dispersal, in fact triple potential, through aircraft malfunction, pilot error, or sabotage. In our opinion, air transport is the least acceptable and by far the most risky of all transportation modes. Rather than offering an "effective means of protection", it offers instead a wider variety of possible events that could result in dispersal of radioactive materials.

Detailed Summary, p. xix, para.2

We take issue here, as elsewhere, with the reprehensible practice of averaging radiation exposure over large populations and thus submerging individual health effects. This averaging is misleading in that it infers lower radiation releases than actually occur; it also ignores the very real health effects, short- and long-term, on the individual who is unfortunate enough to contract cancer or leukemia, suffer genetic mutations, or give birth to a deformed infant. For this individual the risk is one, e.g. certainty.

One could compare this habit of averaging to the argument used by nuclear proponents in trying to refute public concern over plutonium toxicity. These individuals denigrate public concern by saying that perfectly uniform dispersal and ingestion of plutonium oxide is highly unlikely and therefore we should not worry about plutonium releases. Here, however, it is the NRC that is guilty of assuming - for their own purposes of underplaying the seriousness of radiation releases - that radiation resulting from an accident will be uniformly dispersed and uniformly received by vast populations numbering in the hundreds of thousands, even millions. Nuclear opponents and critics have never assumed such perfect dispersal, and we therefore insist that the NRC not make a similar assumption, and discontinue its use of the term man-rem.

p.xx, para. 2

We refer the NRC to the affidavits of Drs. John Gofman, Marvin Resnikoff and Karl Z. Morgan, prepared for the New York State Attorney General in his lawsuit against the U.S. government to halt air shipments of plutonium. The above are leading scientists with expertise in plutonium toxicity and dosimetry; the NRC figures of one fatality and sixteen latent fatalities are unsubstantiated by any expert studies or data and therefore indefensible.

(more)

p.xxiv

We take strong exception to the statement in paragraph d that nuclear fuels produce lower levels of gaseous and solid pollutants - not because the statement is false but because it compares apples and oranges, .eg. fails to note that nuclear fuels do in fact produce pollutants that are qualitatively different and much more lethal, namely radioactive fission products, in normal operation, through waste accumulation, activation products, and in unplanned releases. Furthermore, the potential for large radiation releases is always present in all parts of the nuclear fuel cycle, normal operational releases aside.

Chapter I, p. I-15

Paragraph 1 has an unfortunate error: the substitution of the word safeguards for the word security. Or is the NRC implying that highly radioactive spent fuel will never be the object of attempted diversion or sabotage because of its innate hazards? Or does the NRC mean that irradiated fuel needs no safeguards, period?

Chapter I, pp.I-22,24,28

If the subject of possible accidents in transport of radioactive materials were not so serious, one could be amused by the NRC's use of the geometric mean of the extremes in curies per package for shipments. The statement "The geometric mean was chosen to avoid attaching undue significance to the relatively few large quantity shipments" could be re-phrased to read:..."to avoid undue attention to the potential hazards from radioactive releases of those shipments exceeding the geometric mean".

One hardly needs to point out that accidents do not space themselves out for our convenience so as to select only small-quantity shipments. An accident is as likely to occur to a large package as to a small one. Does the NRC mean to infer that the health effects from dispersal of a 100-kilogram plutonium shipment (such as those that took place at Kennedy Airport up until last year) are negligible? That the likelihood of large quantities being dispersed is smaller than that for small quantities? In this particular stochastic game, the NRC has fallen flat on its face. One hopes that we do not need an accident involving plutonium to pull them to their feet.

Chapter III, para. H, p. III-15

We question the reliance on the WASH-1400 health effects model. The Union of Concerned Scientists-Sierra Club critique of the Rasmussen reactor safety study has criticized the assumptions of low numbers of health effects posited by WASH-1400 on the grounds that the study assumed near-perfect evacuation of the metropolitan New York area within several hours, while simultaneously assuming that most of the population would be indoors or underground and therefore shielded from radiation. More recently, Dr. J. Martin Brown, Assistant Professor of Radiology at Stanford University School of Medicine has criticized WASH-1400 for neglecting to assess long-term cancer deaths from a reactor core meltdown (Rasmussen uses only immediate deaths of people in the immediate vicinity). Nor does Rasmussen calculate genetic disorders, thyroid disease, etc.

Chapter V, pp.V-2,3

We dissent from the statement that "The most severe accidents are generally the least likely to occur" as yet another departure from logic and from knowledge of stochastic events. If the NRC wishes to persist in this type of argument, they should provide us with the mathematical model supporting this position. Similarly, they refer to "The complete logic model" of accident sequences leading to an environmental impact. A complete logic model is by definition impossible, since if all accident causes and sequences could be articulated, in theory all accidents could be foreseen and avoided. What disturbs us are those sequences that will be left out of the logic model and therefore are unknown.

p. V-13

Paragraph one states that "only 10% of the land area of the United States could be considered as 'unyielding surfaces' such as rock, concrete, or rock covered by soil. However, it should be pointed out that if air transportation is utilized to any great degree in the future (something we strongly oppose), this will mean a larger number of shipments departing from and arriving by air over concrete air strips. Thus, a larger per cent of shipments would be at risk.

p. V-14

Paragraph three states that accidents of severity VII or VIII are expected to occur randomly. If so, then how does the NRC justify its statement (see above, Chapter V, pp.V-2,3) that the most severe accidents are the least likely to occur? And how does the NRC justify non-random dispersal of radioactive materials?

p. V-24

NRC states that present shipping containers exceed required standards, apparently in reference to the Sandia Laboratories tests comparing severity of the thirty-foot drop onto an unyielding surface to a 2,000-foot drop onto hard prairie. The parameter excluded here is the 2,000-foot drop onto a hard surface, e.g. the surface of airports, which by the NRC's own standards, would therefore exceed both of the aforementioned tests.

p. V-29

We disagree with the statement that "Consequences to the aquatic environment are less well understood than for the land". At least one thing is known about living organisms in aquatic environments, namely that they concentrate radionuclides in their flesh(and bones, if they are bony fish), and that these concentrations can easily end up in the food chain that terminates with man. It is also quite obvious that radioactive spills in water are irreversible and cannot be cleaned up, unlike contamination of buildings, solid materials, etc. Consequently, radioactive contamination of bodies of water and of aquatic organisms is likely to be highly detrimental to non-human species of plants and animals, whereas radioactivity released into air can be more injurious to human beings through ingestion or high whole-body doses from gamma radiation.

Chapter V, p.V-30

In paragraph three, the NRC states certain population densities as their method of calculating person-rems from accidents involving radioactive materials, and then states that 98% of the U.S. area has a population density lower than any of these densities. However, they have overlooked the fact that insofar as air transportation is involved, most airports are located in metropolitan areas, particularly those of the heavily populated northeast where a good proportion of existing nuclear facilities are now located. Since only 25 states have no commercial nuclear reactors, it hardly matters what their population densities are. It is the population density in the areas near nuclear facilities that count.

p.V-51

NRC inexplicably says that the risk of plutonium accidents goes down in the 1985 projections. We would like to inquire: why? How can this statement be justified, in view of the government's determination to proceed with experimental, and later commercial, plutonium recycle and the fast breeder plutonium economy? It is not unreasonable to assume that greater use and transport of plutonium increases the risk of accidents due to plutonium release (or diversion).

Chapter VI, p.VI-19

In discussing the alternative of shifting all radioactive cargo to passenger aircraft, the report states that although this would increase passenger exposure, it would decrease the exposure (presumably to the public at large) by reducing the total miles travelled in secondary modes. We take issue with the practice of separating passengers - or cargo handlers - or nuclear industry workers - from the public at large, specifically as it relates to the genetic effects of radiation. NRC can hardly take issue with the fact that there is gene flow via reproduction between workers and non-workers, or between passengers and non-passengers. This indefensible distinction becomes particularly odious when one becomes aware of recent studies indicating that ingested plutonium may concentrate in the gonads.

Table VI-31, p. VI-53

In this table of alternative transportation modes, two modes that could reduce radioactive exposure are inexplicably left out: avoiding cities (by barging materials where possible, as with Brookhaven National Laboratories, and the Shoreham and Jamesport reactors on Long Island); and barges themselves as an alternate or for part of a trip. Cities could be avoided by the use of not only barge but of trucks and railroads; surely the avoidance of populated areas - a general government policy where hazardous materials are involved - could substantially reduce potential effects from accidents or releases. Why is this not considered? Why were barges not considered?

Chapter VII, p. VII-2

The report goes to great lengths to assert its desire to protect civil liberties while maximizing safeguards. Yet the Special Safeguards Study has

already suggested considering such anti-civil liberties measures as wiretapping, surveillance, and infiltration of groups that the government considers potentially subversive or violent.

p. VII-4

The footnote referring to an NRC ban against plutonium air shipments is in error. NRC should be reminded that they refused to implement such a ban, and that only a Congressional amendment introduced by Congressman James Scheuer put such a ban into effect. The ban unfortunately does not apply to ERDA shipments.

-Lorna Salzman
Mid-Atlantic Representative
Friends of the Earth
May 11. 1976

DOCKET NUMBER PR-71,73 (40 FR 23768)
PROPOSED RULE
Transportation of Radioactive Mtl by Air

Babcock & Wilcox Nuclear Materials Division
609 North Warren Avenue, Apollo, Pa 15613
Telephone. (412) 842 0111

May 12, 1976

U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Attention: Director, Office of Standards Development

Dear Sir:

On March 29, 1976, the NRC announced the publishing of NUREG-0034, "Draft Environmental Statement on the Transportation of Radioactive Material by Air and Other Modes". Enclosed herein is one comment.

The DES assumed that dose rates were proportional to the transport index. While this is true for non-fissile material, it is not so in the case of plutonium, where the transport index is derived from criticality considerations. It is felt that the exposure rate is the correct number to use, and it is not clear that this number was used in the DES. (See Page IV-42, for example). Experience has shown the exposure to be about 1 mr/hr at one meter from a container of PuO_2. Thus, the transport index of 5 that was applied to shipments of PuO_2 in the DES is too large by a factor of five.

In closing, I would like to express appreciation at the opportunity to comment.

Sincerely,

J. C. DelSignore (raa)

J. C. DelSignore,
Regulatory Projects Manager

JCD/raa

The City of New York

LAW DEPARTMENT
MUNICIPAL BUILDING
NEW YORK, N Y. 10007

W. BERNARD RICHLAND,
Corporation Counsel

DOCKET NUMBER
PROPOSED RULE PR-71,73 (40 FR 23768)
Transportation of Radioactive Mtl by Air

May 14, 1976

Secretary
Nuclear Regulatory Commission
Washington, D.C. 20545

Dear Sir:

The City of New York will be mailing out its comments on the Draft Environmental Impact Statement on the Transportation of Radioactive Material by Air and other Modes on May 17, 1976.

The Commission should receive its copy on Tuesday, May 18, 1976.

Very truly yours,

William R Coleman

WILLIAM R, COLEMAN
Assistant Corporation Counsel

The City of New York
LAW DEPARTMENT
MUNICIPAL BUILDING
NEW YORK, N Y 10007
(212) 566-2097
W. BERNARD RICHLAND,
Corporation Counsel

May 17, 1976

Secretary
U.S. Nuclear Regulatory Commission
Washington, D.C. 20545

Dear Sir:

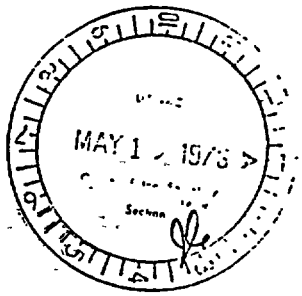
Enclosed please find an original and 20 copies of the Comments of the City of New York on the Draft Environmental Statement on the Transportation of Radioactive Material by Air and Other Modes. If additional copies are required, please contact the undersigned and they will be provided.

Very truly yours,

William R. Coleman

Enc.

WILLIAM R. COLEMAN
Assistant Corporation Counsel
N.Y.C. Law Department
1625 Municipal Building
New York, New York 10007



UNITED STATE OF AMERICA
NUCLEAR REGULATORY COMMISSION

The Transportation of Radioactive Materials by Air and Other Modes

Docket No. PR-71,73
(40 FR 23768)

COMMENTS OF THE CITY OF NEW YORK

The City of New York here submits its comments on the Draft Environmental Statement on the Transportation of Radioactive Material by Air and Other Modes, Docket No. PR-71,73 (40 FR 23768). It is our view that the DES is fatally inadequate and thus cannot serve as a basis for determining the effectiveness of NRC's present rules governing the air transportation of radioactive materials and of possible alternatives to those rules.

I

The rule-making proceeding to which this DES is addressed arises from a nationwide expansion of the nuclear material transportation program. However, even if

the DES at issue were adequate (as it is not) as a generic environmental statement, if the rules purport to apply to transportation within and through New York City, there must be an additional DES prepared for shipments in and through New York City. See Sierra Club v. Morton, 514 F. 2d 856, 872 (D.C Cir. 1975); Scientists' Institute for Public Information v. AEC, 481 F.2d 1079, 1086-87 (D.C. Cir. 1973); Nelson v. Butz, 377 F. Supp. 819 (D. Minn. 1974). To an even increasing extent New York City has been sought as a conduit for the transportation of nuclear materials. The DES upon which we are commenting utterly fails to deal with New York City's unique problems, which include its density of population, the exceptionally high number of nuclear shipments which shippers have sought to make in and through the City, and the combined impact of these two factors. See Nelson v. Butz, supra.

II

The DES is made virtually worthless by its unexplained exclusion, as "outside the scope of this document" (I-19), of all government shipments. The degree of such shipments is unstated, but they are undoubtedly substantial in number and in degree of ratioactivity. The cumulative impact on the environment of all shipments to and from an area must be assessed in a proper ES. Scientists' Institute for Public Information v. AEC, 481 F. 2d 1079, 1086 - 1087 (D.C. Cir. 1973); Jones v. Lynn, 477 F. 2d 885, 891 (1st Cir. 1973). Clearly, no meaningful assessment of cumulative impact, either nationwide or in a given area, can be made if a substantial portion of the shipments are arbitrarily excluded and treated, in effect, as if they make no adverse contribution to the environment. There is thus a failure to make the required comprehensive and integrated assessment of the environmental risks associated with the transportation of nuclear materials. In addition, exclusion of any discussion of government shipments contravenes one of the main purposes of the EIS requirement,

namely, the coordination of different federal agencies in environmental policy matters. Portland Cement Association v. Ruckelshaus, 486 F. 2d 375 (D.C. Cir. 1973), cert. den. 417 U.S. 921, 94 S. Ct. 2628, upp. after remand 513 F. 2d 506, cert. den __ U.S. __. 96 S. Ct. 469 (1975). Henry v. F.P.C., 513 F. 2d 395, 406 (D.C. Cir. 1975).

III

There is a failure to make a rigorous and objective evaluation of all reasonably available alternatives. To take but one egregious example, barging is described as creating a "negligible" population exposure (IV-34), and barging has been recognized by USEPA as a desirable alternative to land transportation, yet no assessment of it is made in "Chapter VI - Alternatives" or in the "risk assessment section of Chapter IV." Thus, the DES fails to "...set forth those alternatives 'sufficient to permit a reasoned choice,'" Life of the Land v. Brinegar, 485 F. 2d 460, 472 (9th Cir. 1973); NRDC v. Callaway, 524 F. 2d 79, 92-93 (2nd Cir., 1975); NRDC v. Morton, 458 F. 2d 827, 836 (D.C.Cir. 1972); Sierra Club v. Froehlke, 359 F. Supp. 1289, 1343-44 (S.D. Tex 1973) mod. on other grounds, 499 F. 2d

982 (5th Cir. 1974); EDF v. Corps of Engineers, 348 F. Supp. 916, 931 (ND.Miss. 1972) (The discussion of barging in the Safeguards section (VII 13-14) lists some difficulties with escorting barges carrying nuclear wastes. It is stated that the level of security of escorted trucks is not attainable with barges. We would suggest that the Coast Guard be consulted on this conclusion and would refer the writers of the DES to the Coast Guard's "procedures for the Movement of LNG/LPG", Captain of the Port, New York. 1. October 1975, for a discussion of the types of safety measures that can be taken for hazardous marine cargoes.)

Not only is there a failure to adequately analyze alternative modes of transportation, there is a virtually total lack of discussion of the impact of alternative routing of nuclear transportation shipments. The DES acknowledges the importance of population density in determining the significance of an accident (V-48), but nonetheless fails to discuss routing alternatives which would take difference in population density into account. (It may also be noted that the population assumptions used in the DES risk assessment section (V-14,30) bear no

relationship to the City of New York, which has a density of population grossly in excess of that assumed by the DES for a high population area.)

IV

The DES purports to review a 30 year program but fails to include increases in nuclear shipments beyond 1985. Nor is there adequate basis for the DES's forecast of a 250% increase of shipments. For example, in New York State in 1974 the only nuclear plants in operation were Indian Point I and II (990 mw) and Nine Mile Point I (610 mw). By the end of 1985, eight additional plants or upgrading of existing plants for a total of 8552 mw, may be in operation. Six more plants are projected by 19991 with a total additional capacity of 7640 mw.

V

While the DES purports to be evaluating certain existing regulations, there is no attempt to deal with the critical issue of compliance with, and enforcement of those regulations. The NRC, in the course of its purportedly close supervision over shipments of nuclear materials, appears to have no accurate idea of how many shipments are made per year, where they go, by what route they go and to what extent their transport is in accord with applicable law. We submit that no proper assessment of the environmental impact of the nuclear transportation program can be made in the absence of both accurate data and an evaluation of the extent to which existing rules and regulations in fact achieve their purpose.

In addition, in order for the public and Congress to be able to evaluate a DES, it is essential for the DES to explain the assumptions made therein. The DES at issue is replete with unexplained assumptions and references to what unspecified "expermental work" or "private communication"

has shown (See, for example, pp. II-9, II-10, V-14, V-24). It is also replete with reliance on undocumented and apparently unrequired and unenforced industry "practice" (See, for example, pp. II-8 and II-30). Such reliance hardly provides assurance to the public that the NRC has adequately evaluated the environmental impact of the nuclear transportation program.

VI

Chapter V of the DES, "Effect of Transport under Accident Conditions" is fatally defective. We will briefly note only a few errors which, in themselves, totally undermine the validity of the DES's conclusions.

1. Computed estimates of alleged risk are singularly deficient in statistical confidence limits. For example, the risk assessment relies upon a progression of modelling stages; the cummulative effect of the degree of precision lost at each stage makes the study of little or no value.

2. At pages V-8 through V-15, there, the probability of spillage model which purports to calculate accident statistics, takes accident data not from actual aircraft accidents but from Clark's model, based upon laboratory simulations of crashes on unyielding surfaces. Clark's results are then modified by an unexplained process of "engineering judgment" (at page V-13 an explanation is included which provides no proofs nor any basis for the assumptions made). No attempt is made in this analysis to use actual aircraft collision data in a study similar to that performed by Bovet, "Preliminary Analysis of Tanker Collisions" D.M. Bovet. Reported by U.S. Coast Guard Office of Research and Development, November 30, 1970, or Monorsky, "An Analysis of Ship Collisions with Reference to Protection of Nuclear Power Plants, " Journal of Ship Research, October 1959.

3. The accident classification scheme improperly relates severit of an accident to fire duration and speed of impact. It fails to evaluate crush and puncture damage.

And it fails to consider population density as a contributing factor to accident severity.

VII

The discussion of reported incidents involving transportation of nuclear materials is grossly inadequate. Appendix C, does not even contain an explanation of its codes. Nor is there any discussion of possible unreported incidents. Based on the DES's own figures, incidents in 1975 may well have doubled those reported in the four-year period 1971-1974 (IV-38), yet the risk assessment, which used the number of shipments projected for 1985 apparently relied on 1974 accident data.

VIII

Scenarios involving sabatage or diversion of spent fuel or fissionable materials by terrorists or

criminal elements are mentioned tangentially but are incompletely evaluated.

Respectfully submitted,

W. BERNARD RICHLAND
Corporation Counsel of the
City of New York

By _____
NINA GERSHON GOLDSTEIN
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William R. Coleman
Of Counsel

May 17, 1976

Commonwealth Edison
One First National Plaza, Chicago, Illinois
Address Reply to: Post Office Box 767
Chicago, Illinois 60690

DOCKET NUMBER
PROPOSED RULE PR-71,73(40FR23768) (78) May 17, 1976
Transportation of Radioactive Matl Eq Dir

Mr. Guy A. Arlotto, Director
Division of Engineering Standards
Office of Standards Development
U.S. Nuclear Regulatory Commission
Washington, D. C. 20555

Subject: Comments on The Draft Environmental Statement on The Transportation of Radioactive Material by Air and Other Modes

Dear Mr. Arlotto:

Thank you for the opportunity to provide comments on the subject statement.

We have reviewed the Draft Environmental Statement and have no comments. However, we would appreciate reviewing future documents as they become available.

Very truly yours,

R. L. Bolger
Assistant Vice President

Acknowledged by card 5/26/76

DEPARTMENT OF TRANSPORTATION
UNITED STATES COAST GUARD

MAILING ADDRESS (G-WS/73
U S COAST GUARD
400 SEVENTH STREET SW
WASHINGTON D C 20590
PHONE (202)426-2262

REPLY REFER TO
PROPOSED RULE PR 11,73 (40 FR 23768)
Trans. of Radioactive Mtl by Air

15 MAY 1976

Mr. Guy A. Arlotto
Director
Division of Engineering Standards
Office of Standards Development
Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Arlotto:

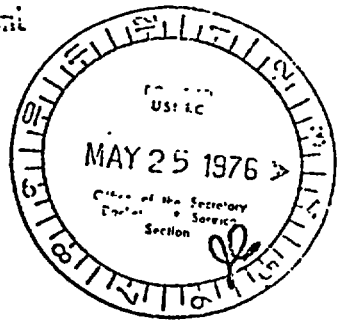
This is in response to your letter of 24 March 1976 addressed to Mrs. Judith Conner concerning a draft environmental statement dealing with the transportation of radioactive material by air and other modes.

The concerned operating administrations and staff of the Department of Transportation have reviewed the material submitted. We have no comments to offer nor do we have any objection to this project.

The opportunity to review this draft statement is appreciated.

Sincerely,

[illegible]
Chief, Office of Marine Environment and Systems



Acknowledged by card 5/26/76

-71,7 (40FR23768)

GEORGIA INSTITUTE OF TECHNOLOGY
ATLANTA GEORGIA 30332

SCHOOL OF
NUCLEAR ENGINEERING

May 17, 1976

Mr. Guy A. Arlotto
Division of Engineering Standards
Office of Standards Development
Nuclear Regulatory Commission
Washington, D. C. 20555

Dear Mr. Arlotto:

This communication is being sent on May 17, 1976, the date on which comments "must be received by your office"--thus I cannot meet your deadline.

First I would like to emphasize that I am sending a few hurried comments, not as a paid consultant but as a private citizen or university professor interested in these matters. Perhaps on this basis alone I am disqualified. In any case, the short time I have had a copy of NUREG-0034 for review (since May 10, 1976) assures I can only make a rather cursory examination of its contents and check a few of its assumptions. Needless to say, since I am oing this entirely on my own time, other things associated with my employment at Georgia Tech must take precedence. However, I cannot restrain my desire to make a few observations about report NUREG-0034 since I am a member of the Special Panel to Study Transport of Nuclear Materials reporting to the Joint Committee on Atomic Energy of Congress and I am passing on to you some evaluations which are in line with comments and opinions I volunteered earlier in reference to what I considered a bad practice of permitting plutonium and other actinide elements to be transported into and out of densely populated areas.

A quick perusal of the report fails to indicate you have made an adequate comparison of all possible modes of transportation. Some studies have indicated the population exposure (man·rem) from the shipment of radioactive materials decreases in the order of shipments by truck, rail and barge. I realize nuclear power plants, reprocessing plants, fuel fabrication plants, etc, have not in most cases been located where direct barge shipment is possible, but I regret to say I can only conclude this has been by design and refusal of the AEC and now NRC to take this mode of transportation into proper account in the environmental impact statements and in the lisencing of new nuclear operations. For example, discussion of radioactive shipments by barge was not permitted at the Barnwell hearings or the St. Lucie hearings in which I took part.

In general, I am disappointed with the report because of so many half truths and unsubstantiated statements. It presumes to take a conservative stance and to treat the "worst case" but in many cases just the opposite seems to be the case. I am <u>for</u> nuclear energy and for 34 years I have tried to show

Acknowledged by card 5/26/76

we can make and keep this one of the safest of all modern industries, but I fear reports like this may shake the confidence of some of us in those we hold responsible for making and keeping this industry acceptably safe.

In order to be as brief as possible and because of my growing concern about the shipment of Pu and the other actinide elements, I will limit this discussion mostly to the treatment of the risks of shipping plutonium. In what follows I give a few random examples of why I am concerned about this report.

1. Page V-39 Here I read "The Contribution to the Total Dose from Cloudshine, Groundshine, and Resuspension can be obtained by the application of established factors to the results shown in Fig. V-11. For ^{239}Pu and other isotopes of interest, these radiation effects are negligible...."

I believe one has to be a bit naive to assume resuspension makes a negligible contribution to the human Pu dose. For example, several papers at the IAEA San Francisco meeting (November 1975) indicated the importance of resuspension. Here Romney (University of California) indicated that small particles of Pu are rapidly blown away from the source, and when resuspended they are deposited on plants that are eaten by animals and man. Most of the Pu found in vegetation got there by resuspension of dust. Jakublick (of Germany) indicated this PuO_2 on the soil migrates 100 times faster than soluble Pu (e.g. nitrate). Bondietti (of ORNL) indicated the Pu in soil forms complexes that are much more available for uptake by plants and animals. Becker (of EPA) suggested that the action of microorganisms in the soil may render this Pu available for uptake. McLendon (Savannah R. Plant) found a high concentration of Pu in plants (~1/10 that of core samples). This all suggests we cannot disregard the Pu in the soil where, in time, it may be transformed such that its fractional uptake by the human body may increase from 10^{-6} to 10^{-2}.

2. Tables V-7, V-12 and V-13 are good examples of an attempt to give the impression of a very conservative consideration of the problem and an evaluation of the "worst case accident" and yet your worst case assumes a shipment of only 20 kg of Pu when it is an established fact that larger Pu shipments have passed through some of our airports. When the reader notes such tactics used to depreciate the risks, he is inclined to question the credibility of the rest of report.

3. Table III-8 is given without explanation and I have reason to question its reliability. I was chairman from the beginning until 1972 of the Internal Dose Committee of ICRR that made such calculations and set the standards for all these radionuclides (and I was chairman of the NCRP internal dose committee for 20 years). Since 1972, I have been busy with research and teaching at Georgia Tech, so I am not completely up-to-date with the latest ICRP calculations. However, the following Table shows discrepancies I found in your table for Pu radionuclides in comparison with ICRP Committee 2 values as of 1974, and I doubt there have been substantial changes since then.

Values of Rem/Ci Given by NUREG-0034 and by ICRP

Plutonium Radionuclide	Table III-8 Values			Values Given by ICRP (1974)				
	Lung	Bone	Marrow	Lung	Bone*	Marrow	Liver	Ovaries
Pu-238	3.1×10^{8}	7.6×10^{8}	1.3×10^{6}	3.1×10^{8}	4.0×10^{9}	6.7×10^{3}	3.6×10^{8}	1.7×10^{8}
Pu-239	2.0×10^{8}	8.7×10^{8}	1.5×10^{6}	2.9×10^{8}	4.6×10^{9}	4.4×10^{3}	4.1×10^{8}	2.0×10^{8}
Pu-240	2.0×10^{8}	8.7×10^{8}	1.5×10^{6}	3.0×10^{8}	4.7×10^{9}	7.6×10^{3}	4.1×10^{8}	2.0×10^{8}
Pu-241	5.6×10^{5}	1.7×10^{7}	3.2×10^{4}	5.5×10^{5}	9.8×10^{7}	1.3×10^{3}	8.3×10^{6}	4.4×10^{6}

*This value is for trabecular bone. I do not know for what type of bone the Table III-8 is representative.

From the above it is seen there are some significant discrepancies. For example, the bone risk (where most of the malignancies develop from Pu) is underestimated by a factor of 5. The risk to the liver and ovaries may be as great as that to the lungs, but they are not even considered. Surely some consideration should be given to the genetic risk!

Table B-1 There seem to be large discrepancies between this table and the values given in the GESMO report, WASH-1327, which I reviewed earlier. These discrepancies are shown below:

Radionuclide	% by weight		Ci calculated WASH-1327	g in WASH-1327
	in Table B-1	in WASH-1327		
Pu-238	1.9	3.49	3.47×10^{5}	0.20×10^{5}
Pu-239	63.0	43.63	5.30×10^{3}	2.50×10^{5}
Pu-240	19.0	26.00	3.37×10^{4}	1.49×10^{5}
Pu-241	12.0	15.65	1.00×10^{7}	0.90×10^{5}
Pu-242	3.8	11.21	239	0.64×10^{5}
Am-241	0.6		2.52×10^{4}	7.78×10^{3}
Am-243			6.78×10^{3}	3.66×10^{4}
Cm-244			1.70×10^{6}	2.04×10^{4}

When each new NRC report uses a new set of assumptions about the SGR-GESMO-120 day spent fuel inventories, how can we be expected to believe any of the numbers or evaluate the data? Which NRC report are we to believe?

I have added also my calculations of Curies using the WASH-1327 data. Here we note that most of the risk is not from ^{239}Pu but from ^{238}Pu, ^{241}Pu, ^{244}Cm and ^{241}Am. Also, I have shown (HPJ 10, 151, 1964) that ^{238}Pu is 150 times more hazardous (Curie-for-Curie) than ^{239}Pu, ^{241}Pu is 3 times more hazardous, ^{244}Cm is 32 times more hazardous, and ^{241}Am is 16 times more hazardous. In addition, this 2.04×10^4 g of ^{244}Cm comprises 2.2 Ci of neutrons for which extra precautions must be taken.

5. Pages XIX and I-24 I am forced to conclude that this Draft Environmental Statement (NUREG-0034) like other NRC Draft Reports (e.g. WASH-1327) was hurriedly and perhaps carelessly written. I believe there are acceptable ways of shipping radioactive materials (as there are acceptable ways of recycling Pu), but I am convinced that more carefully prepared and properly reviewed draft reports, before they are issued for almost instantaneous review and comment by members of the public, would go a long way toward easing the tasks of some of us who are trying to develop a reasonably safe nuclear power industry that is worthy of strong support of the public.

On page XIX we find the statement, "It is estimated that the total annual population exposure resulting from normal transport is about 9600 person·rem." Such a statement is completely meaningless and valueless because the year is not indicated and there is no indication of whether this man·rem is to the total body, thyroid, trabecular bone, deep lung compartment, etc.

On page I-24 we have another useless statement because of insufficient qualifications. I refer to, "The total amount of Pu shipped annually is estimated to be 2000 kg." Presumably, this was for 1974? From WASH-1327 we find that for a BWR-1.15 SGR fuel discharge after 120 days decay we have 574 kg of Pu. Thus the 2000 kg corresponds to only 2000/574 = 3.5 reactor discharges per year assuming 1000 MWe per reactor.

I could go on and on pointing out weaknesses in this report, but in order to mail this on your deadline date I will close with a few general comments as follows:

a. I believe the severity of aircrash accidents assumed in this report comes far short of the worst case.
b. There are too many rather arbitrary and unsubstantiated assumptions.
c. There are serious inconsistencies between this and previous NRC reports and statements of NRC officials.
d. Average cases and the standard or reference man data are used in estimating cancer risk. Don't the children, the persons with respiratory diseases, etc, count? It seems we should protect them as well as the healthy adult worker to whom the standard man data apply.
e. The ICRP lung model is used improperly. If the 750 ml lung tidal volume curve had been used (for the child) instead of the 2150 ml curve, it would be noted that about 28% and not 14% of the particles of 3 microns mean size distribution are retained in the lower pulminary compartment of the lungs, and in either case (for the child or the adult) the larger Pu dust particles should not be neglected in the calculations of risk.

f. The man-rem dose for normal and accident situations should be integrated over the entire population for all age groups and for all dose rates. Arbitrary cut-offs, and boundary assumptions lead to serious underestimates of the risk.

g. Although the dose to the pulmonary lymph nodes is 100 or more times that to other lung tissue, this tissue was ignored in the risk evaluations. I realize the ICRP has deprecated this risk because the ERDA studies of Thompson et al at BNW have failed to produce cancers in this part of the reticulo endothelial system in animal studies. However, I am uneasy in applying these data to man who lives 70 years instead of 20 years (dog's life span) and Thompson has in fact observed some malignancies in tissues adjacent to the lymphatic tissue which suggest that blood vessels leading into these organs or tissue just beyond the particle complete kill within the lymph nodes may be the tissue at greatest risk in the case of man.

I hope you will find these hurried comments helpful and constructive in the redraft of report NUREG-0034.

Sincerely,

Karl Z. Morgan
Neely Professor

KZM:tm

May 17, 1976

Mr. Guy A. Arlotto, Director
Division of Engineering Standards
Office of Standards Development
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Dear Mr. Arlotto:

Further to your letter of April 26, the following are our brief comments on the Draft Environmental Statement prepared by your department in support of the Nuclear Regulatory Commission's advance notice of rule-making action:

Chapter I - Page 1

This reference page states that the purpose of the publication is to assess the impact upon the environment from the transportation of radioactive materials, primarily by aircraft, etc.

This would appear to indicate that an effort has been made to justify an increase in the allowable limits for air movement. We will need to be extra careful in reviewing future rule making actions.

Capter VI - Page 36 - Paragraph B. 2-2.1

To prohibit shipments of radioactive material during adverse weather would be impractical because it changes so quickly in widely separated geographic areas.

Chapter VI - Page 38 - Paragraph B. 2-2.2

To restrict movement to daytime flights would eliminate most freighter flights. This would be very undesirable.

Chapter VI - Page 39 - Paragraph B. 2-2.3

It would not be practical to restrict movement by air to airports in low population areas, since service by air is so limited at such locations. A better alternative, if this is a valid concern, would be to prohibit transport by air.

Chapter VII - Page 15

Air transport should not be required for the movement of radioactive shipments based on security considerations. The much more important consideration relates to the exposure of people, equipment and facilities to radiation and it is these concerns that should determine whether radioactive shipments can and should be carried by air.

The transport of radioactive material by air should be limited to only that which is absolutely necessary. In our opinion, this is primarily material related to medical applications including research, diagnosis and treatment.

We trust this information may be of some assistance.

Sincerely,

E. Stohr/mw

Edmund Stohr
Vice President
Industry Affairs

DOCKET NUMBER
PROPOSED RULE PR-71,73 (FR...)

TRANSNUCLEAR, INC.

May 24, 1976

JUN 7 1976

Mr. Donald R. Hopkins
Office of Standards Development
U.S. Nuclear Regulatory Commission
Washington, D.C. 20545

Subject: Draft Environmental Statement on the Transportation of Radioactive Material by Air and Other Modes Docket No PR-71,73; NUREG-0034

Dear Mr. Hopkins:

Transnuclear, Inc. is a fuel cycle services company specializing in all aspects of the transportation of radioactive materials. We are responsible for arranging transportation of much of the nuclear fuel cycle materials which move etween the U.S. and Europe each year. Modes of shipment used include air, ocean, road and rail.

We own and utilize several different types of packagings for unirradiated nuclear fuel material. We will also have licensed spent fuel casks available for service in mid-1977. These casks are suitable for transport by rail or road and will hold 3 PWR assemblies or 7 BWR assemblies and are currently being used in Europe on a routine basis.

The purpose of this letter is to comment on the DES and request that the final statement include the use of these intermediate size casks as another alternative to the rail casks and small truck casks.

There appear to be some typographical and/or mathematical errors in the tables and discussion relating to spent fuel transportation.

Table I-2 on page I-20 shows a total of 370 spent fuel packages per year in 1975 with a truck/rail split of 14.2/85.8 percent. However, the Baseline Shipment Information as shown on Table IV-1, page IV-11, shows 54 shipments by truck and 326 by rail for a total of 380. The percentage split in Table I-2 is compatible with the number of shipments in Table IV-1, so perhaps the 370 total packages per year is incorrect.

Acknowledged by card 7/2/76

ONE NORTH BROADWAY • WHITE PLAINS, NEW YORK 10601

In Chapter VI the discussion in Section B.1-6 indicates that seven times as many shipments will be required by truck as compared to rail. However, in Table VI-17, there are 380 shipments per year by truck and none by rail. This value should be 54 + 7(326) = 2336 if all 326 rail shipments are to be transferred to truck. If the radiological impacts as reported in Table VI-18 are based on Table VI-17, there may be significant errors in the results.

We also question the economics of spent fuel transport as reported in Section B.1-6.2. A recent study by the Edison Electic Institute on Nuclear Fuels Supply reported in Appendix V:

" The cost of transporting a normal spent fuel annual discharge for a 1200-1300 MWe reactor over a distance of 1000 miles to a reprocessing plant is about $680,000 using a legal weight truck, $275,000 using an overweight truck, $460,000-$530,000 for a non unit train, and $750,000-$860,000 or a unit train."

We suggest that the alternative for spent fuel transport be presented as follows:

Mode	Legal weight truck	Special permit truck	Rail
PWR elements/cask	1	3	7
Trip distance miles	1,000	1,000	1,000
Trips per year (1975)[1]	2,336	780	334
Cost per assembly[2]	11,300	4,600	7,600-14,300

1 Assumes only one mode used

2 Based on costs in EEI report and 60 assemblies per year for an 1100 MWe PWR

The radiological impacts should be calculated using the above values.

We would appreciate an opportunity to discuss this with you at your convenience. We will be glad to review the results to be published in the FES prior to publication. Please contact us if you have any questions.

Very truly yours,

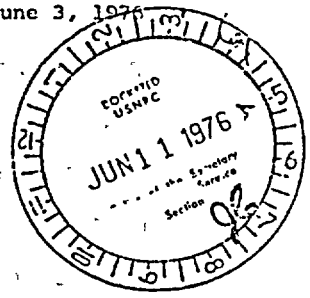
Bill R. Teer
Vice President

Ne 'ork State Department of Environmental Conservation
50 Wolf Road, Albany, New York 12233

Peter A.F. Berle
Commissioner

DOCKET NUMBER
PROPOSED RULE PR-71,73 (40 FR 23768)
Trans. Radioactive Mtl. by Air

June 3, 1976



Mr. Robert B. Minogue, Director
Office of Standards Development
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Minogue:

The State of New York has completed its review of the U.S. Nuclear Regulatory Commission "Draft Environmental Statement on the Transportation of Radioactive Material by Air and Other Modes", issued in March, 1976. In preparing the enclosed comments, we have taken into consideration the views of interested State Agencies including those represented on the NYS Atomic Energy Council.

The draft statement (NUREG-0034) indicates that consequences of an accident involving shipments of plutonium vastly outweigh the consequences of transporting all other radionuclides.

Therefore, the State of New York urges the Commission to consider the environmental impacts, and the alternative modes of transporting Plutonium and the security implications thereof separately from all other radioisotopes. Only in this way can the environmental consequences, benefits to society, and costs of alternative modes of transport and packaging requirements be adequately assessed.

The draft statement should also discuss idemnification for any damages that may result from transportation of radioactive shipments made under Federal regulations including human exposure, contamination limits, etc.

Thank you for providing the State the opportunity to comment on this environmental statement.

Sincerely yours,

Theodore L. Hullar, Ph.D.
Deputy Commissioner for
Programs and Research

Enclosure

Comments of the

STATE OF NEW YORK

ON THE

U.S. NUCLEAR REGULATORY COMMISSION

"DRAFT ENVIRONMENTAL STATEMENT ON

THE TRANSPORTATION OF RADIOACTIVE MATERIAL BY

AIR AND OTHER MODES" (NUREG-0034) ISSUED

MARCH 1976

NRC DOCKET NO. PR-71,73

May 28, 1976

1. General Comment

The Draft Environmental Statement indicates that radiation exposure from normal transportation averaged over the number of people exposed is small. It would result in a statistical increase of one latent cancer fatality in the U.S. per year.

While the use of average exposure is reasonable to predict the effects resulting from normal transportation, the use of the estimated average accident risks can be misleading. The low average accident risk results from taking the very low accident risks associated with the large number (some 70% of total shipment) of radiopharmaceutical shipments and distorts the risks associated with the transportation of plutonium.

Table V-14 notes that the plutonium oxide accident risk analysis results for 1975 shipments indicate a risk total of 6.5 latent cancer fatalities. This same table notes that accidents involving the release of plutonium oxide would account for 99.8% of the total accident risks.

Tables VI-31 and VI-32 - these tables list alternative actions ranked in order of the impact in decreasing transportation risks. The first two alternatives, i.e., developing more stringent packaging standards for plutonium and establishing a 1% respirable plutonium criteria for shipment, should be given high priority and established as regulatory criteria. In addition, the third most significant alternative in reducing transportation risks, shipment of plutonium by rail, should by fully evaluated (including security implications) prior to authorizing resumption of shipment of plutonium by air.

The Draft Environmental Statement notes that the accident risks of latent cancer fatalities and early fatalities arise principally as a result of a very unlikely event of a major release of plutonium associated with the nuclear fuel cycle. The statement acknowledges that the consequences of such an accident, although very unlikely, could be severe for a few individuals. Accidents in a densely populated area were estimated to produce one fatality within 365 days and approximately 16 exposures sufficient to produce death from cardiopulmonary

insufficiency in some cases. In addition, the Draft Environmental Statement notes th latent cancer fatalities associated with this major release are estimated at twenty per year over a 30-year period, or 600 cancer fatalities. The Draft Environmental Statement then indicates the probability of such an occurrence is estimated to be 10^{-9} per year in 1974.

In spite of the low probability of a major release of plutonium the severe consequences of the accident merits attention to the further analysis of the alternative transportation and packaging modes and security implications thereof in order to further reduce the probability of plutonium release in an accident. Therefore, New York State suggests that the alternative modes of transporting plutonium be considered separately from other radionuclides. In such a separate review, the need for developing an "air-safe" container for plutonium shipment must be considered as part of the requisite overall analysis of the environmental consequences (in normal and accident situations) of alternative modes of plutonium transportation and packaging and the security requirements associated therewith.

2. General Comment

The concern for the severe consequences of the release of plutonium should not be used to require a major modification of packaging and shipping requirements of small quantities of radiopharmaceuticals, for example. However, the Draft Environmental Statement notes that packages being used for transportation of radioactive materials perform significantly better than the present packaging standards and that the present shipping procedures result in shipments well below the packaging and transportation index standards. It is, therefore, recommended that the present standards for packaging and shipping be made more stringent to reflect present practices. The report notes that this can be done without changing shipping practices and with no change in present overall risks. This would, however, prevent the increase in exposure that would result from increased use of packages and shipping practices that would just meet the existing standards.

3. General Comment

The various modes of Transportation including options within each mode should be subjected to systematic analysis wherein all of the risks, (i.e., normal transportation; accidents and security consideration), are interrelated so that both the impact and a Transportation strategy could be developed. The Draft Environmental Statement fails to perform this function and, therefore, does not provide a meaningful comparison of the benefits and risks of alternative transportation modes.

4. General Comment

The draft statement should reference and thoroughly discuss the safety analyses performed for the development of spent fuel shipping containers and the accident parameters used to develop safety analyses.

5. General Comment

It is noted by the NYS Dept. of Commerce that the suggestions offered by the New York State Atomic Energy Council to the NRC on August 1, 1975 were generally addressed in the subject document. Although specific assumptions and input data may be subject to question, the methodology used in the DES is technically sound. The DES recognizes that the transportation of radioactive materials is a necessary and beneficial action, and that the associated risk is extremely small - several orders of magnitude less than other commonly accepted societal risks.

6. PI-24 Section I.D. The last sentence of the middle paragraph states:

"The annual numbers of spent fuel shipments for 1975 and for 1985 are estimated to be 370 and 3600 respectively."

The NYS Department of Transportation notes that the number of 370 shipments for 1975 appears to be too low for the following reasons.

a. NYS Department of Transportation has conducted a survey by mail of the nuclear power plants and government reactors that could be shipping spent fuel across New York State and to date have determined that 199 shipments of spent fuel were made from just two nuclear power plants and two federal reactors in 1975 across New York State.

b. Supplement 1 to WASH-1238 (NUREG 75/038) - "Environmental Survey of Transportation of Radioactive Materials To and From Nuclear Power Plants" includes on Pages 4, 5 and 6, a Table S-1, entitled Summary of Transportation Data for Nuclear Power Reactors. Table S-1 is the result of individual analyses by the Commission during the period January 1972 through March 1973 of the environmental impact of such transportation for 84 individual nuclear power reactors at 53 different sites.

Using the data for irradiated fuel shipments from Table S-1 and excluding movement by rail where optional methods of transportation were shown New York State Department of Transportation arrived at the following totals.

Irradiated Fuel	
Number of Truck Shipments	2516
Number of Rail Shipments	283
Total Shipments	2799

7. General Comment

The New York State Department of Health notes that the annual population dose during normal transportation is low and that shipments of radiopharmaceuticals, Mo-99 and radioiodines, represent a greater source of exposure than the shipment of spent nuclear fuel and plutonium oxide.

8. General Comment

Information should be added to the Draft Statement that clearly establishes the level of enforcement action being undertaken by the U.S. Department of Transportation, the Nuclear Regulatory Commission and various states in connection with the transportation of radioactive materials. This information should include tabular material about the number of inspections relating to

radioactive materials that have been undertaken and the type and number of enforcement actions that have been taken in connection with radioactive materials during the last five years. There should also be an indication of the number of inspections that are scheduled during the coming year.

9. Pi-Summary and Conclusions - In the event that NRC proposes a significant change in the regulations for Transportation of radioactive material, an environmental impact statement must be prepared pursuant to NEPA for such a proposed federal action. NUREG-0034 will obviously be an excellent reference for such a study.

10. Piv, No. 7 - The Draft Statement indicates (P. iv) that a few individual transport workers whose radiation exposures exceed the limits established for members of the general public should be, and in most cases are monitored and otherwise treated as radiation workers. There does not seem to be clear indication of when such transportation workers are to be treated as radiation workers. It is necessary that workers required by their job to work with radioactive materials and radiation, whether in a laboratory or on a loading platform, are dealt with in a consistent manner. Therefore, it is important that the class of transportation workers and work situations involving significant shipments of radioactive materials should be identified so appropriate radiation protection measures can be taken. The regulations should be amended so that transportation workers likely to receive a dose in any calendar quarter in excess of 25 percent of the applicable value in paragraph (a) of 10 FER 20.101 are provided with appropriate personnel monitoring equipment

11. PI - 3 Section A - The Draft Statement indicates (P. I-3) that updated shipment information will be available in time for use in the fina version of the Statement. We urge that such shipping data be incorporated fully into the final Statement. The newer data, in other words, should be used not only to revise Tables I-2 and I-3 but also to recompute transport impacts and to reevaluate alternative transport modes in the event that the newer data warrents such effort. If this information significantly alters the results of the draft environmental statement, than NRC should issue another draft statement for comment prior to the issuance of a Final Environmental Statement.

12. PI 4 Section I.B. This section should present quantitatively the various applications for which radioactive materials are used and the benefits to society from these applications.

13. Pages I-4 and I -19

The DES uses a figure of 600,000 packages of radioactive material shipped annually. This differs from other estimates previously used, including an estimate of 800,000 packaged cited by the U.S. Atomic Energy Commission on page 61 of WASH-1238, dated December 1972. The reason for using the 600,000 figure should be indicated.

14. Page I-20

Table I-2 indicates that 85.8% of the estimated 370 spent fuel shipments transported in 1975 were shipped by rail and that the other 14.2% were moved by truck. This information does not agree with information provided to "The State" regarding 186 motor truck shipments of spent fuel

to the West Valley, New York reprocessing plant in 1975. These shipments, which came from only two nuclear power stations would alone account for over 50% of the estimated 370 shipments.

15. Page I-25:

The first sentence of the second paragraph refers to "Figure I-2". It appears that it should refer to "Figure I-3".

16. Section V.B.

The basis is not provided for the distribution of accidents among the various population densities for each of the transportation modes considered. Although some description of the basis for the fractions used for aircraft accidents is provided, almost no basis is provided for expecting the low severity truck accidents to occur mainly in urban areas. If these assumptions are based on a statistical analysis, that analysis should be identified.

17. Section V.B. 2

This section indicates that in the case of accidents involving motor carriers the dominant factors in the determination of accident severity are crush and fire. Currently, packaging standards do not include crush specifications. It is recommended that the responsible regulatory agencies consider implementation of a crush standard.

18. Tables V-12 and V-13

These tables should include the consequences of accidents involving spent fuel.

19. Table V-13

For the 20 kg Pu Case, the number of persons receiving doses greater than 15 rem, 10^4 rem, and 10^5 rem are listed.

Since the number of persons receiving a dose greater than 15 rem is several orders of magnitude greater than those receiving a dose greater than 10^4 rem, the number of persons receiving doeses at intermediate levels should be provided.

20. Pages V-24:

The first sentence of the last paragraph refers to "Table V-2". It appears that it should refer to "Table V-6".

21. Page V-44:

Table V-11 does not identify the first radionuclide on the list. It appears that it should specify Plutonium.

22. Page V-54:

The last sentence of the first paragraph refers to a number of injuries and fatalities "per reactor year". It appears from what is presented previously in the paragraph that it should refer to the number of these events "per year".

23. Pg. V-57:

Justification should be given for assuming that the population at risk is 75 million persons.

24. General Comment

It is recommended that the environmental statement be expanded to include

24. General Comment - (continued)

Federal monies expended, (1) in the development of regulations and (2) in the enforcement of regulations followed by a discussion as to the optimal amount of money that should be expended to effectively minimize the hazard to the Public from the transportation radioactive materials.

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
OFFICE OF THE SECRETARY
WASHINGTON D C 20201

MAY [illegible] 1976

Mr. Guy A. Arlotto
Director, Division of Engineering
Standards
Office of Standards Development
Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Arlotto:

We have reviewed the draft Environmental Impact Statement concerning the transportation of radioactive material by air and other modes. On the basis of our review, we offer the following comments:

1. We note that the June 1975 public comments on the proposed rulemaking concerning air transportation of radioactive materials are not included in the draft document.

2. Detailed Summary: As presently contained in the document, the detailed summary does not present the reader with a thorough examination of the probable effects expected to occur from a shipping accident involving radioactive materials. Information should be included in the final document on the individual effects of each of the various types of accidents that could happen, modes of shipment, and the identity and quantity of materials involved. These should be described with and without ameliorating actions and/or safeguards. Comparing the overall exposure to populations from accidents involving radioactive material to the overall exposure from other sources does not address the consequences of a shipment accident in absolute terms.

3. Page I-15: It is noted that the shipments listed and their modes of transport are representative of the radioisotope industry (Table I-1). There are no estimates for postal shipments, which probably use any and all modes of transportation. Although these are of small individual quantity, they may be large in volume.

4. Page I-19: Weapons shipments and all shipments in government-owned vehicles are not considered. These omissions may have seriously affected the calculations presented in the statement.

5. Page III-8: It is stated that the Biological Effects Ionizing Radiations (BEIR) report was used in the Health Effects Model. Actually, the Health Effects Model used is that found in Appendix VI of the Reactor Safety Study (WASH-1400). WASH-1400 significantly modified the risk estimates contained in the BEIR report by introducing "Dose Effectiveness Factors" (Table VI, 9-70, Appendix VI, WASH-1400). These factors do not access a straight linear extrapolation, (as does the BEIR report), making these risk estimates of low doses and dose rates used in the draft statement lower by a factor of five than those found in the BEIR report. It is erroneous to give the impression that the health effects calculated in this draft document would be equivalent to those that would be arrived at by using the BEIR report.

Also, references are made to studies which seem to indicate that rodents exposed to radiation have longer life spans. It has been theorized that radiation creates a more sterile environment, thus reducing the probability of respiratory infection in rodents, increasing their life span in a radiation environment. We are of the opinion that the draft statement should clearly state the reasons for an increased life-span among the rodents, as well as mention the above cited hypothesis.

6. Page III-9: The source should be cited for the statement that declares that EPA has adopted the dose limits proposed by the National Council on Radiation Protection (NCRP). We are of the impression that EPA is in the process of reviewing these radiation standards but has not agreed to the limits proposed by NCRP.

7. Page III-13: We suggest that line 12 in paragraph 2 read as follows: "Technetium -99 can be given in rather large quantities with little radiation dose." As presently used in the draft document, the word "dose" refers to pharmaceutical dose (which in this instance is not the case). Also a discussion of the short half-life of Technetium-99 should be included in the final document as a means to support the above statement.

8. Page III-13/14: It should be noted that the use of pertechnetate for brain scanning is relatively low, amounting to 1.5 million administrations during 1972. The impact of other technetium compounds and kits as well as ^{67}Ga, ^{75}Se, and ^{133}Xe should also be considered.

9. Page III-15: It is important that the basis for simplifying assumptions be documented, even if only briefly, since they can significantly influence the risk estimates.

10. Page III-17: We do not agree with the statement made in paragraph one. Soluble Plutonium is listed in Table III-7 and represents a material that can enter the food chain. Since I_{131} constitutes an inhalation hazard, it also represents a potential health threat to the food chain in the event that a dairy or truck farming area were to become contaminated.

11. Page IV. Item 7 indicates that a few individual transportation workers might possibly be exposed to radiation limits which exceed those established for the public. The draft document devotes little attention to the problems of identifying, monitoring, and controlling the exposure to "truckers", "handlers" and others.

12. Page IV-49, Statement 6: The average individual dose from transportation is stated as 0.5 mrem/year. This is a factor of 2, not 20 less than the average per capita dose from radiopharmaceuticals (Table III-3).

13. Page V-29, line (1): This represents two cycles incorporated into one and is usually referred to as "grass-cow-milk-man" and "grass-cow-man" cycles.

14. The statement does not project the latent cancer fatalities (LCF) or early fatalities (EF) to the year 1985. Although exposure is projected to increase by a factor of approximately 3 from 9589 (1975) to 28,590 (1985), this suggests the LCF could increase from 1.2 in 1975 to 3.6 in 1985 as a result of normal transport only. Assuming the increase of a factor of 3 and an essentially equivalent population exposure, one may project the fatality date on pg. xx to be as follows:

	1975	1985
Early Fatality	1	3
Other deaths	16	48
Latent cancer deaths (30 yr. period)	600	1800

The alternative analysis is based on current shipment impact, pg. VI-1, and does not appear to be projected in terms of conditions which might be expected in 1985. Essentially, the

alternatives are compared on a basis of cost benefit vs. radiological effects(s), pgs. VI-1 and VI-3. If one accepts the figure of 8.22×10^6 per LCF or any other death, an investment benefit in terms of citizen protection may be calculated.

It is therefore suggested that as a minimum alternative B.3-1, Restriction of Physical and/or Chemical Form, of B.4-1, Revision of Packaging Standards, be required for radioactive material shipments.

Thank you for the opportunity to review the document.

Sincerely,

Charles Custard
Director
Office of Environmental Affairs

United States Department of the Interior

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

ER-76/290 DOCKET NUMBER PROPOSED RULE PR-71 73(40FR23766) JUN 8 1976
Trans. Radioactive Mtl. by Air

Dear Mr. Arlotto:

Thank you for your letter of March 24, 1976, requesting our comments on the draft environmental statement on the Transportation of Radioactive Material by Air and Other Modes (Docket No. PR-71, 73, dated March, 1976).

Our comments are submitted according to the format of the statement or by subject.

Detailed Summary

It would be helpful to summarize the proposed action more clearly at the outset of the environmental statement. We conclude that it is proposed to continue regulating the transport of radioactive materials under present Federal regulations, pending completion of further studies of the costs and effectiveness of alternate transportation systems. While these studies are referred to generally (i.e., page v, paragraph 3), we find no summary of the specific studies in progress or of their expected date of completion.

The non-radiological consequences of accidents involving vehicles used solely for transport of radioactive materials are variously given as "two injuries and less than one fatality each four years" (for example, page iii, page xx, page xxiii). It would be advisable to use the same terminology throughout. In addition, some indication should be given of what percentage of transport is by vehicles used solely for transport of radioactive materials; otherwise, the figures on non-radiological consequences of accidents have little or no meaning or relevance to an evaluation of overall risk to individuals.

Acknowledged by mail 6/16/76

CONSERVE AMERICA'S ENERGY

Save Energy and You Serve America!

Since hydropower is a significant conventional energy source, we suggest revision of the ninth line of page xxiv, by adding the words "such as by fossil-fuel plants" at the end of the sentence.

Introduction

Throughout the statement there is little information on the adequacy of regulations as applied to the transport of large-curie radiation sources that are stated to contain as much as hundreds of thousands of curies, for use in large-scale sterilization operations (page I-9). These are described as consisting chiefly of the radioisotopes cobalt-60 and cesium-137. Large curie sources of up to 10,000 curies are also said to be shipped to cancer treatment centers both in the United States and abroad, with overseas transport by ship and domestic transport by truck or rail (page I-9, paragraph 2). However, we found little or no information on the size or weight of the casks, or particularly on the adequacy of protection afforded the transport of the large-curie radiation sources under existing regulations.

Tabular data in Chapter I, that appears to provide comprehensive information for most classes of radioactive materials shipments, provides little or no information on the large-curie radiation sources, which appear to be among the potentially most hazardous materials shipped. For example, Table I-2 (page I-20) shows no shipment class having an average of more than 5,000 curies per package. We feel that comparable information, including the number of packages shipped annually in 1975 and 1985, should be provided for the teletherapy sources containing up to 10,000 curies of radioactivity and for the radiation sources that contain as much as hundreds of thousands of curies of activity, particularly in view of the fact that some of these large-curie sources are said to be shipped to locations abroad and by means of truck, rail, and ship. These shipments appear particularly important for inclusion in this evaluation because it is noted that 6,600 industrial 100-curie sources were estimated to be shipped in 1975 (Table I-2), but a single shipment of a radiation source containing hundreds of thousands of curies of radioactivity appears to be potentially as hazardous as thousands of the 100-curie-source shipments.

Transport Impacts Under Normal Conditions

Several statements suggest that the study is based on surprisingly incomplete information in some important areas pertinent to transport of radioactive materials. For example, it is stated: "While no specific information is at hand to suggest that radioactive materials are not shipped on passenger trains, no evidence of such use was discovered in an informal survey of the industry" (page IV-31, paragraph 1). This suggests that the facts now available to the staff provide no information on whether or not radioactive materials are shipped on passenger trains. It is also stated that "it is suspected that barge may be a method for transport of new and spent fuel to reactors and reprocessors located on appropriate waterways" (page IV-34, paragraph D.4-1). This lack of certainty on the part of the Nuclear Regulatory Commission regarding even the basic mode of transport in use for such materials does not provide reassurance that transport of radioactive materials is being carefully regulated in all cases.

Security and Safeguards

Chapter VII, concerning security and safeguards, raises further concerns relative to the transport of the large-curie radiation sources discussed previously. It is noted that one of the two groups of nuclear material that may require safeguarding consists of "a few radioisotopes such as cobalt-60," the other group being Special Nuclear Materials (SNM), and it is stated further that "isotopes such as cobalt-60 could be used by a terrorist in the form of a dispersal weapon" (page VIII-1, last paragraph). However, only the safeguarding of the SNM appears to have been considered in depth. Specific mention of the adequacy of present regulations to assure the safety and security of the large-curie sources containing cobalt-60, particularly when shipped overseas, should be presented in the final statement.

It has been stated that "other materials, such as cobalt-60, which are in special form, might be stolen and then dispersed in a highly populated area" (page VIII-7, paragraph 3). In spite of acknowledgment of the hazard, there is no specific discussion of risks in shipment of the high-curie sources or of adequacy of safeguards provided by existing regulations, even though these could contain several hundred thousand curies, evidently largely of cobalt-60. It is stated that "adequate safeguard measures are available if it is determined that some isotopes need added protection" (page VII-12, paragraph 1), but the need has evidently not yet been fully evaluated with respect to shipments of large quantities of cobalt-60.

The report does not specifically analyze consequences of accidents resulting in significant quantities of radioactive materials entering surface waters. While the probability of such occurrences would no doubt be very low, such an analysis might still be desirable to determine if conditions could arise requiring emergency measures to protect public water supplies.

Sincerely yours,

Deputy Assistant Secretary of the Interior

Mr. Guy A. Arlotto, Director
Division of Engineering Standards
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Nuclear Regulatory Commission
Washington, D. C. 20555