March 25, 1981

SECY-81-197

RULEMAKING ISSUE
(Affirmation)

For: The Commissioners

From: William J. Dircks
Executive Director for Operations

Subject: PROPOSED AMENDMENT TO 10 CFR PART 71 TO RESTRICT AIR TRANSPORT OF PLUTONIUM

Purpose: To obtain Commission approval of a proposed amendment to 10 CFR Part 71 that would restrict the shipment of plutonium by air, implementing the Scheuer Amendment (PL 94-79) with a rule and acknowledging the development of a plutonium package certified to be air-crash resistant.

Category: This paper covers a minor policy question. Resource estimates, Category 1, preliminary (see Section 1.3.1, Enclosure 3).

Summary: The proposed amendments to 10 CFR Part 71 are:

1. Replace, by a regulation, the existing order to licensees currently implementing the Scheuer Amendment.

2. In the regulation, permit air shipment of small quantities of plutonium in other than a container certified to be air-crash resistant (having decided that this is a reasonable interpretation of the Energy Reorganization Act of 1974, as modified by the Scheuer Amendment).

3. Do not codify qualification criteria for an air-crash-resistant package in the NRC regulations. Instead refer to the criteria as published.

Contact:
N. A. Eisenberg, SD
443-5946

Replacing the order to licensees by a regulation is desirable because: (1) a regulation provides for a more uniform and efficient licensing process, (2) the rulemaking procedure provides for public participation and (3) through rulemaking the NRC can permit shipment of small quantities of plutonium in other than an air crash-resistant package, as a reasonable interpretation of the law and without seeking legislative change by Congress. A rule that permits small quantities of plutonium (an A_2 quantity or less) to be shipped in other than crash-resistant packaging is desirable, because it avoids the expense and inconvenience to licensees of mandatory use of an air-crash-resistant package for small quantities of plutonium, while it prevents large public health consequences in the event that an aircraft carrying plutonium crashes--the goal of the Scheuer Amendment. Codification of the package qualification criteria through the rulemaking and public comment process is neither necessary nor desirable at this time. The criteria have been made public in NUREG-0360 and were given rigorous review by the ACRS and the National Academy of Sciences. It is not expected that public comment would result in any significant changes. Further, it is desirable to obtain experience with the use of such criteria before limiting flexibility by codification. Several procedural and technical alternatives were considered. These are discussed in the Value/Impact Statement (Enclosure 3).

As a follow up to this action, the staff will (1) consider whether to recommend that the Commission seek legislative relief to permit shipments, that are larger than an A_2 quantity, by air in other than an air-crash-resistant package of safeguards samples and of other small quantities of plutonium, for which rapid transport is required and is of identifiable benefit to the public interest and (2) evaluate whether to encourage DOT to consider changes to its regulations that would reduce inconsistencies with NRC regulations, as amended by this proposed rule.

Discussion: The following summarizes the detailed discussion of all the technical and administrative options considered in formulating this action paper, which is presented in the Value/Impact Statement, (Enclosure 3). A detailed evaluation of the pros and cons of the alternatives is also presented in Enclosure 3.

The Scheuer Amendment

The Scheuer Amendment is part of Public Law 94-79 and appears as a footnote to section 201 of the Energy Reorganization Act of 1974. Enacted into law August 9, 1975, it provides:

> "The Nuclear Regulatory Commission shall not license any shipments by air transport of plutonium in any form, whether exports, imports or domestic shipments: Provided, however, that any plutonium in any form contained in a medical device designed for individual human application is not subject to this restriction. This restriction shall be in force until the Nuclear Regulatory Commission has certified to the Joint Committee on Atomic Energy of the Congress that a safe container has been developed and tested which will not rupture under crash and blast-testing equivalent to the crash and explosion of a high-flying aircraft."

The NRC Certification Program

On August 15, 1975, NRC issued an order to its licensees, prohibiting the air transport of plutonium, except that contained in a medical device for individual human use. Since then, the NRC staff has developed a plutonium package capable of surviving an air crash (Model PAT-1), published qualification criteria for such a package (NUREG-0360), published a Safety Analysis Report for the package (NUREG-0361), and obtained the review of the National Academy of Science (NUREG/CR-0928) and the ACRS for both the certification criteria and the package. This effort culminated on August 4, 1978, when the NRC certified to Congress that a package (Model PAT-1) that would fulfill the requirements of public Law 94-79 had been designed and tested. A certificate of compliance was issued by NRC (See NUREG-0383, Volume 2, Revision 2, pp. 1-4) that authorizes use of the Model PAT-1 package for air transport of plutonium.

On September 1, 1978, the NRC issued an order to NRC licensees (superseding the August 15, 1975 order to licensees) which states:

> "Notwithstanding any provisions to the contrary in the NRC's regulations or in your license, shipments of plutonium by air, other than plutonium contained in a medical device designed for individual human application, may only be made in packages the design of which the NRC has specifically approved for transport of plutonium by air."

The Proposed Action

Now that the NRC plutonium air transport package certification program has been completed, the staff proposes issuing a regulation implementing the mandate of Congress. The rule formulated by the NRC staff to implement the law is a reasonable interpretation of the language of the law, permitting plutonium shipments

of small quantities and very low specific activities in packaging other than that certified by the NRC to be air-crash resistant.

The allowance to ship very low specific activities in other than crash-resistant packaging is a practical interpretation of the law, recognizing the definition of radioactive materials used in transport regulations. Similarly, the rule drafted by the NRC staff would, as a reasonable interpretation of the legislation, permit the air shipment of small quantities of plutonium in packaging other than that certified to be air-crash resistant. A legal analysis prepared by OELD, Appendix II to Enclosure 3 of this paper, elaborates on this issue. An NRC staff analysis, the Environmental Impact Appraisal, (Enclosure 4), shows that an A_2 quantity of plutonium released to the human environment as a result of an air crash would generally be expected to produce no more than minor public health consequences. This realistic, but still conservative, assessment which takes into account the environmental dispersion and population density exposed, shows the health effects produced would be a small fraction of a latent cancer fatality. With that margin of safety, large public health consequences would be essentially impossible, even if more than one package was involved in a single air crash. In addition, plutonium shipments of an A_2 quantity or less are currently exempt from the proposed Department of Transportation and NRC requirements for accident-resistant packaging (which are based on internationally accepted standards), because such small quantities pose small risk and hazard to the public, even if they were entirely released. These exemptions, of course, have been superseded by the NRC implementation of the Scheuer Amendment.

Petition to Ship Small Quantities

Related to this rulemaking, Eberline Instrument Corporation, in a letter dated July 18, 1977, formally petitioned the Commission (PRM-70-6) to allow air shipment of small quantities of plutonium (less than 5 microcuries) contained in calibration sources. On August 18, 1977, the NRC published a notice (42 FR 41675) of filing of that petition for rulemaking. Commission action on the rule proposed herein will define NRC policy and constitute a definitive response to this petition.

Inconsistencies with DOT and IAEA Regulations

Regardless of the particular manner chosen, any implementation of the Scheuer Amendment will go beyond current DOT and IAEA regulations, because those regulations do not require air shipment of plutonium in a crash-resistant package. If DOT or IAEA should decide to consider changes in their regulations to reduce

or remove the inconsistencies between those regulations and the NRC regulations, some staff activity would be involved in working with those organizations. The NRC staff will evaluate whether it should encourage consideration of such changes by DOT.

US/IAEA Safeguards Agreement

In the implementation of international safeguards in other countries, the IAEA needs to be able to airship safeguards samples of plutonium rapidly to their laboratories in Seibersdorf, Austria. Implementation of the US/IAEA Safeguards Agreement may also require the rapid shipment of safeguards samples of plutonium from U.S. nuclear facilities to Seibersdorf. The provision in this proposed rule to allow shipments of an A_2 quantity or less of plutonium in packaging other than that certified to be air-crash resistant will be consistent with the U.S. policy to support effective international safeguards by permitting the shipment of certain safeguards samples by air in packaging less expensive and less cumbersome than the air-crash-resistant package. This does not, however, completely solve the problem because many shipments of safeguards samples consist of quantities of plutonium that are larger than an A_2 quantity. OELD, NMSS, IP, OCA, and OGC will coordinate an evaluation of whether to recommend legislative change to relax requirements for the shipment by air of safeguards samples and of other small quantities of plutonium, for which rapid transport is needed and of identifiable benefit to the public interest.

Recommendations: The Commission:

(a) 1. Approve publication for comment of the notice of proposed rule making (Enclosure 1) which provides amendments to 10 CFR Part 71 to restrict the shipment of plutonium by air.

2. Approve the staff's conclusions set forth in Enclosure 6, which provides the analysis called for by the Periodic and Systematic Review of the Regulations. The criteria used were derived from Executive Order 12044 which was rescinded on February 17, 1981 by Executive Order 12291 (see memorandum from Bickwit to the Commission, February 27, 1981). This approach is proposed as an interim procedure until the staff can make recommendations and the Commission decides what to do in response to Executive Order 12291.

(b) Note

1. Staff actions will be initiated to: (1) evaluate whether to encourage DOT to consider changes to existing DOT

regulations that would reduce inconsistencies with the NRC regulations, as amended, and (2) consider whether there exist sufficient technical and policy bases for a staff recommendation to the Commission that NRC seek legislative relief for the air shipment of safeguards samples and other small quantities of plutonium, for which rapid transport is needed and is of identifiable benefit to the public interest. (The motivation for these considerations is discussed in detail in the Value/ Impact Statement, Enclosure 3).

2. The proposed amendment would be published in the Federal Register for 60-day public comment.

3. If after expiration of the comment period no significant adverse comments or significant questions have been received and no substantial changes in the text of the rule are indicated, the Executive Director for Operations will arrange for publication of the amendment in final form. If significant questions have been received or substantial changes in the text of the rule are indicated, the revised amendment will be submitted to the Commission for approval;

4. That in accordance with 10 CFR 51.7, 51.5 (c), and 51.5 (b)(6), a negative declaration is incorporated in the notice of proposed rulemaking (Enclosure 1). A Draft Environmental Impact Appraisal (Draft EIA, Enclosure 4), supporting the negative declaration, will be made available in the Public Document Room. If substantive comments are received, the staff will modify the Draft EIA to provide the Final EIA. If no substantive comments are received the Draft EIA will be used as the Final EIA.

5. The preamble to the proposed rule contains the statement that: "the Commission hereby certifies that this rule will not, if promulgated, have a significant economic impact on a substantial number of small entities." A copy of this certification and the accompanying succinct statement explaining the reasons for it will be forwarded by the Division of Rules and Records to the Chief Counsel for Advocacy of the Small Business Administration. A summary of information to assist the Commission in making this certification is given in Enclosure 5.

6. The Value/Impact Statement supporting this proposed rule will be made available in the Public Document Room for public inspection and comments.

7. The appropriate Congressional committees will be informed.

8. A public announcement, such as Enclosure 2, will be issued when the proposed amendment is filed with the Office of the Federal Register.

9. Copies of this proposed rule will be mailed to affected licensees and known interested parties.

10. These amendments are considered to be matters of basic compatibility between NRC and Agreement State regulations.

11. The basis for the NRC resource estimate is given in Section 1.3.1 of the Value/Impact Statement (Enclosure 3).

William J. Dircks
Executive Director for Operations

Enclosures:
1. Notice of Proposed Rulemaking
2. Draft Public Announcement
3. Value/Impact Statement
4. Draft Environmental Impact Appraisal
5. Information Summary for Regulation Determinations
6. Analysis with Respect to Periodic Systematic Review of Regulation

Commissioners' comments or consent should be provided directly to the Office of the Secretary by c.o.b. Friday, April 10, 1981.

Commission Staff Office comments, if any, should be submitted to the Commissioners NLT April 3, 1981, with an information copy to the Office of the Secretary. If the paper is of such a nature that it requires additional time for analytical review and comment, the Commissioners and the Secretariat should be apprised of when comments may be expected.

This paper is tentatively scheduled for affirmation at an Open Meeting during the Week of April 20, 1981. Please refer to the appropriate Weekly Commission Schedule, when published, for a specific date and time.

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ENCLOSURE 1

NUCLEAR REGULATORY COMMISSION

[10 CFR Part 71]

Packaging of Radioactive Material for Transport and Transportation of Radioactive Material Under Certain Conditions

AGENCY: Nuclear Regulatory Commission.

ACTION: Proposed rule.

SUMMARY: The Nuclear Regulatory Commission has under consideration proposed amendments to its regulations that would restrict the air transport of plutonium. Pursuant to the Scheuer Amendment, the proposed rule will require that shipments of plutonium by air be contained in a package specifically certified as air-crash resistant. However, plutonium may be shipped by air in other packages if the plutonium is in a medical device for individual human use or if the plutonium is shipped in quantities or concentrations small enough to present no significant hazard to the public health and safety, even were the plutonium released in an air crash. All NRC licensees authorized to transfer plutonium are subject to the provisions of this proposed rule.

DATES: Comments received after _____ will be considered if it is practical to do so, but assurance of consideration cannot be given except as to comments received on or before _____.

ADDRESSES: Interested persons are invited to submit written comments and suggestions on the proposed amendments, on the supporting Value/Impact Statement, on the Environmental Impact Appraisal, and on the certification criteria in NUREG-0360 to the Secretary of the Commission, U.S. Nuclear

Regulatory Commission, Washington, DC 20555, Attention: Docketing and Service Branch. Single copies of the Value/Impact Statement, the Environmental Impact Appraisal or NUREG-0360 may be obtained on request from Norman A. Eisenberg (address below). Copies of the Value/Impact Statement, the Environmental Impact Appraisal, NUREG-0360 and other reports cited under supplementary information below, and of comments received by the Commission may be examined in the Commission's Public Document Room at 1717 H Street NW., Washington, DC.

FOR FURTHER INFORMATION CONTACT: Dr. Norman A. Eisenberg, Office of Standards Development, U.S. Nuclear Regulatory Commission, Washington, DC 20555 (Telephone: 301-443-5946).

SUPPLEMENTARY INFORMATION:

Background:

The Scheuer Amendment, part of Public Law 94-79 and appearing as a footnote to section 201 of the Energy Reorganization Act of 1974, was enacted into law August 9, 1975. It provides that:

> The Nuclear Regulatory Commission shall not license any shipments by air transport of plutonium in any form, whether exports, imports or domestic shipments: Provided, however, that any plutonium in any form contained in a medical device designed for individual human application is not subject to this restriction. This restriction shall be in force until the Nuclear Regulatory Commission has certified to the Joint Committee on Atomic Energy of the Congress that a safe container has been developed and tested which will not rupture under crash and blast-testing equivalent to the crash and explosion of a high-flying aircraft.

On August 15, 1975, NRC issued an order to licensees, prohibiting the air transport of plutonium, except that contained in a medical device for individual human use. Since then, the NRC staff has developed a plutonium package capable of surviving an air crash (Model PAT-1), published qualification criteria for such a package (NUREG-0360), published a Safety

Analysis Report for the package (NUREG-0361), and obtained the review of the National Academy of Sciences (NUREG/CR-0928) and the Advisory Committee on Reactor Safeguards (ACRS) for both the certification criteria and the package. This effort culminated on August 4, 1978, when the NRC certified to Congress that a package (Model PAT-1) that would fulfill the requirements of Public Law 94-79 had been designed and tested. A certificate of compliance was issued by NRC (see NUREG-0383, Volume 2, Revision 2, pp. 1-4) that authorizes use of the Model PAT-1 package for air transport of plutonium. The Commission will consider certifying other packaging as air-crash resistant, if such packaging is demonstrated to satisfy the criteria stated in NUREG-0360. Comments on these criteria are invited, although selection of certification criteria is not part of this rulemaking action.

On September 1, 1978, the NRC issued an order to NRC licensees (superseding the August 15, 1975 order to licensees) which states that:

> Notwithstanding any provisions to the contrary in the NRC's regulations or in your license, shipments of plutonium by air, other than plutonium contained in a medical device designed for individual human application, may only be made in packages the design of which the NRC has specifically approved for transport of plutonium by air.

Now that the NRC plutonium air transport package certification program has been completed, the NRC plans to issue a regulation implementing the mandate of Congress.

The Proposed Rule:

This regulation is a reasonable interpretation of the law. Reflecting the specific language of the law, it will require the use of a package certified to be air-crash resistant for the air shipment of plutonium, unless the plutonium is contained in a medical device for individual human use. In addition the regulation permits air shipment of plutonium in packaging

other than that certified by the NRC to be air-crash resistant for low specific activities (less than 0.002 microcurie per gram) or for small quantities (less than an A_2 quantity*).

The allowance to ship very low specific activities in other than air-crash-resistant packaging is a practical interpretation of the law, recognizing the definition of radioactive materials used in transport regulations. Since the atmospheric nuclear weapon tests in the 1950s and 1960s, soil, animals, and virtually all terrestrial materials contain very small quantities of plutonium. Obviously the law was not intended to apply to these materials in an absolute sense.

Similarly this proposed regulation, as a reasonable interpretation of the legislation, allows the air shipment of small quantities of plutonium in packaging other than that certified to be air-crash resistant. An NRC staff analysis (The Environmental Impact Appraisal) shows that an A_2 quantity of plutonium released to the human environment as a result of an air crash would generally be expected to produce no more than minor public health consequences. This realistic, but still conservative assessment, taking into account the environmental dispersion and population density exposed, shows the health effects produced would be a small fraction of a latent cancer fatality. With that margin of safety, large public health consequences would be essentially impossible, even if more than one

*An A_2 quantity of plutonium is defined in Appendix C of the proposed amendments to 10 CFR Part 71 (44 FR 48234) published August 17, 1979 and in Table VII of the International Atomic Energy Agency Regulations for the Safe Transport of Radioactive Materials, IAEA Safety Series No. 6 (1973 Revised Edition).

package were involved in a single air crash. Furthermore the PAT-1 package certified to Congress by the NRC to be air-crash resistant allows the release of an A_2 quantity in a period of a week, after "crash and blast testing equivalent to the crash and explosion of a high-flying aircraft." Radioactive material shipments of an A_2 quantity or less would be exempt from the proposed Department of Transportation (DOT) requirements (44 FR 1852) and the proposed NRC requirements (44 FR 48234) for shipping in accident-resistant (type B) packaging, because such small quantities pose negligible risk and hazard to the public. For NRC licensees these exemptions would, however, be superseded by the NRC regulations implementing of the Scheuer Amendment. The allowance to ship as much as an A_2 quantity of plutonium in packaging other than that certified to be air-crash resistant will be consistent with the U.S. policy to support effective international safeguards by permitting the shipment of certain safeguards samples by air in packaging less expensive and less cumbersome than air-crash-resistant packaging. On this basis the proposed rule would allow these small quantities of plutonium to be shipped in other than air-crash-resistant packaging.

The A_2 quantity is in the context of the 1973 IAEA regulations, the same break point as 1 millicurie in the context of current NRC/DOT regulations. When the 1973 IAEA regulations are incorporated into the U.S. system by making final the NRC and DOT proposed rules, the reference to an A_2 quantity in this proposed rule will be consistent with the new regulatory structure. (For long-lived alpha-emitting isotopes of plutonium, the A_2 quantity is 2 or 3 millicuries; for Pu-241, a beta emitter, the A_2 quantity is 0.1 curie, but Pu-241 is substantially less radiotoxic than the other isotopes of plutonium.)

Petition to Ship Small Quantities:

Related to this rulemaking, Eberline Instrument Corporation, in a letter dated July 18, 1977, formally petitioned the Commission (PRM-70-6) to allow air shipment of small quantities of plutonium (less than 5 microcuries) contained in calibration sources. On August 18, 1977, the NRC published a notice (42 FR 41675) of filing of a petition for rulemaking. Commission action on the rule proposed herein will define NRC policy and constitute a definitive response to this petition.

Environmental Impact Statement:

The Commission has determined under Council of Environmental Quality guidelines (40 CFR Part 1500) and the criteria in 10 CFR Part 51 that an environmental impact statement for these proposed amendments to 10 CFR Part 71 is not required, based on a finding of no significant impact on the quality of the human environment. Concurrent with publication of this notice of proposed rulemaking, the Commission is making available for public inspection, in its Public Document Room at 1717 H Street NW., Washington, DC, an "Environmental Impact Appraisal for Proposed Amendments to 10 CFR Part 71 to Restrict the Air Transport of Plutonium," to support a Negative Declaration,** and copies of the Value/Impact Statement supporting the proposed rule. Single copies of either document may be obtained on request from Dr. Norman A. Eisenberg, Office of Standards Development, U.S. Nuclear Regulatory Commission, Washington, DC 20555 (Telephone: 301-443-5946). Copies of any comments received on these proposed amendments may be examined at the Commission's Public Document Room at 1717 H Street NW., Washington, DC.

** A copy of this appraisal is filed with the Office of the Federal Register.

Regulatory Flexibility Certification:

In accordance with the Regulatory Flexibility Act of 1980, 5 U.S.C. 605(b), the Commission hereby certifies that this rule will not, if promulgated, have a significant economic impact on a substantial number of small entities. The proposed regulation, if promulgated, will relieve the restrictions on the air shipment of plutonium imposed by the current NRC order to licensees by permitting the air shipment of small quantities of plutonium in packaging other than that certified to be air-crash resistant. Currently the schedules and work routines, principally of small organizations, are disrupted by the inability to acquire small calibration sources containing plutonium in a timely fashion by air shipment. Because the proposed regulation reduces the regulatory burden imposed by the NRC's current order to licensees, the proposed rule does not have a significant economic impact within the context of the Regulatory Flexibility Act.

The Commission has made this certification regarding compliance with the requirements of the Regulatory Flexibility Act based on the analyses contained in the Value/Impact Statement and the Environmental Impact Appraisal. These analyses were based on the best estimates of costs and number of entities affected that were available to the Commission staff at the time these analyses were prepared. The Commission specifically invites comments on aspects of these analyses that will either support or dispute the determination made regarding compliance with the requirements of the Regulatory Flexibility Act. Unless the Commission receives comments on other information that causes the conclusions regarding these determinations to change, the Commission intends to repeat them at the final rule stage.

Pursuant to the Atomic Energy Act of 1954, as amended, the Energy Reorganization Act of 1974, as amended, section 553 of title 5 of the United States Code, and Public Law 94-79 (the Scheuer Amendment), notice is hereby given that adoption of the following amendments to Title 10, Chapter I, Code of Federal Regulations, Part 71 is contemplated.

PART 71 - PACKAGING OF RADIOACTIVE MATERIAL FOR TRANSPORT AND TRANSPORTATION OF RADIOACTIVE MATERIAL UNDER CERTAIN CONDITIONS

1. A new §71.43 is added to read as follows:

§71.43 Air transport of plutonium.

(a) Notwithstanding the provisions of any general licenses and notwithstanding any exemptions stated directly in this part or included indirectly by citation of 49 CFR Chapter 1, as may be applicable, plutonium in any form, whether for import, export, or domestic shipment, may not be transported by air or delivered to a carrier for air transport unless:

(1) the plutonium is contained in a medical device designed for individual human application; or

(2) the plutonium is contained in a material in which the specific activity is not greater than 0.002 microcuries per gram of material and in which the radioactivity is essentially uniformly distributed; or

(3) the plutonium is shipped in a single package containing no more than an A_2 quantity[1] of plutonium in any isotope or form and is shipped in accordance with §71.5; or

[1]An A_2 quantity of plutonium is defined in Appendix C of the proposed amendments to 10 CFR Part 71 (44 FR 48234) published August 17, 1979 and in Table VII of the International Atomic Energy Agency Regulations for the Safe Transport of Radioactive Materials, IAEA Safety Series No. 6 (1973 Revised Edition).

(4) the plutonium is shipped in a package specifically authorized for the shipment of plutonium by air in the Certificate of Compliance for that package issued by the Commission.

(b) Nothing in paragraph (a) of this section is to be interpreted as removing or diminishing the requirements of §73.24.

(Secs. 53, 161b. and i., Pub. L. 83-703, as amended, 68 Stat. 930, 948, as amended (42 U.S.C. 2073, 2201(b., i.)); Sec. 201, Pub. L. 93-438, as amended, 88 Stat. 1242, as amended, (42 U.S.C. 5841); Pub. L. 94-79.)

Dated at Washington, D. C. this _____ day _____ 1981.

For the Nuclear Regulatory Commission.

_____

Samuel J. Chilk
Secretary of the Commission

ENCLOSURE 2

DRAFT PUBLIC ANNOUNCEMENT

NRC PROPOSES AMENDMENTS TO REGULATIONS TO RESTRICT AIR TRANSPORT OF PLUTONIUM

The Nuclear Regulatory Commission is proposing to change its regulations to implement by a regulation an existing law requiring most air shipments of plutonium to be carried in packages certified as capable of withstanding the crash and explosion of a high-flying aircraft.

NRC licensees were ordered in August 1975 to stop shipping most forms of plutonium by air. The order reflected a statutory ban on NRC licensing of shipments of plutonium by air--except plutonium contained in a medical device intended for individual human use. The law also provided for resumption of shipments by air when the NRC certified to the Congress that a safe container had been developed and tested which would not rupture under conditions equivalent to an aircraft crash and explosion.

The NRC certified such a package (the Model PAT-1) to the Congress in August 1978 and the following month issued another order to its licensees permitting the shipment of plutonium by air in these NRC-approved packages.

Under the proposed amendments--which would replace the 1978 order--the certified-package restriction would not apply to air shipments of plutonium contained in a medical device for individual human use (a heart pacemaker for example). The proposed amendments also would permit air shipments of small quantities of plutonium which would not present a significant hazard to the public health and safety even if a package ruptured in a crash.

The NRC staff would also be authorized to review applications to use crash-resistant packages other than the Model PAT-1. New packages would have to meet certain qualification criteria including certain individual and sequential tests that simulate the conditions produced in severe aircraft accidents. The criteria also provide for operational controls which would have to be observed during transport.

A copy of the "Qualification Criteria to Certify a Package for Air Transport of Plutonium" (NUREG-0360) is available for public inspection at the NRC Public Document Room at 1717 H Street, NW., Washington, D.C., or for purchase from the National Technical Information Service, Springfield, Virginia 22161, at $5.25 for paper copy and $3.00 for microfiche.

Written comments on the proposed amendments, which are to Part 71 of the Commision's regulations, should be received by _____ (60 days following publication of the proposed rules in the Federal Register on _____. Comments should be addressed to the Secretary, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555, Attention: Docketing and Service Branch.

ENCLOSURE 3

VALUE/IMPACT STATEMENT FOR
PROPOSED AMENDMENTS TO 10 CFR Part 71
TO RESTRICT AIR TRANSPORT OF PLUTONIUM

Prepared by
Norman A. Eisenberg
December 1980

1. THE PROPOSED ACTION

1.1 Description

Restrict the shipment of plutonium by air in accordance with the Scheuer Amendment, part of Public Law 94-79 and appearing as a footnote to Section 201 of the Energy Reorganization Act of 1974, as amended. Since the shipment of plutonium by air is currently restricted by an order to NRC licensees, the following value/impact analysis considers two types of regulatory change: 1) the imposition of restrictions on shipping plutonium by air as embodied in the order to licensees and (2) the incremental change in restrictions effected by implementing the proposed rule which is different from the existing order to licensees. Since the proposed rule codifies the requirements of the existing order, it is necessary to perform a regulatory analysis of those requirements, as well as the requiements of the proposed rule which are different from the existing order to licensees.

In developing this rule three main issues have arisen; they are:

Issue 1 - Should PL 94-79 (the Scheuer Amendment) be implemented by a regulation restricting air transport of plutonium, or is an order to NRC licensees sufficient?

Issue 2 - Can the NRC reasonably interpret the Energy Reorganization Act of 1974, as amended by PL 94-79, as permitting air shipment of small quantities of plutonium in other than an air-crash-resistant package; and, if so, what amount is a small quantity and can be shipped this way?

Issue 3 - Should the package qualification criteria be codified in the NRC regulations?

Issues 1 and 3 are procedural questions discussed in sections 3.1 through 3.3 and 3.4 through 3.6 respectively. Issue 2 is a technical question discussed in sections 2.1 through 2.3. Technical aspects of the qualification criteria are discussed in sections 2.4 through 2.6. The decision criteria used for the pro/con discussion of various alternatives under each issue are:

1. Prevention of large public health consequences resulting from plutonium dispersal in a severe air crash.

2. Compliance with the Energy Reorganization Act of 1974 as modified by the Scheuer Amendment (PL 94-79) and with other laws.

3. The degree to which the particular mechanism chosen by NRC to implement this legislative mandate is inconsistent with the practices of other Federal agencies (primarily DOT) and international entities (primarily IAEA).

4. The degree to which NRC regulatory action burdens licensees without compensatory improvement in public health and safety.

5. The degree to which the public is permitted to participate in the NRC regulatory process.

6. The degree to which the U.S. policy to support effective international safeguards is accommodated.

1.2 Need for the Proposed Action

The primary reasons for the proposed action are: (1) policy direction mandated by the Congress through the Scheuer Amendment, (2) completion by NRC of the certification program for the air-crash-resistant package, (3) more effective and efficient use of the regulatory process for enforcement of the restriction on plutonium shipments by air, (4) the need to provide some ability to ship small samples of plutonium in support of effective international safeguards, and (5) disposition of a petition from a licensee requesting permission to ship small quantities of plutonium by air in other than an air-crash-resistant package.

The Scheuer Amendment, part of Public Law 94-79 and appearing as a footnote to Section 201 of the Energy Reorganization Act of 1974, as amended, was enacted into law August 9, 1975. It provides that:

> "The Nuclear Regulatory Commission shall not license any shipments by air transport of plutonium in any form whether exports, imports or domestic shipments: Provided, however, that any plutonium in any form contained in a medical device designed for individual human application is not subject to this restriction. This restriction shall be in force until the Nuclear Regulatory Commission has certified to the Joint Committee on Atomic Energy of the Congress that a

safe container has been developed and tested which will not rupture under crash and blast-testing equivalent to the crash and explosion of a high-flying aircraft."

On August 15, 1975, NRC issued an order to licensees, prohibiting the air transport of plutonium, except that contained in a medical device for individual human use. Since then, the NRC staff has developed a plutonium package capable of surviving an air crash (Model PAT-1), published qualification criteria for such a package (NUREG-0360), published a Safety Analysis Report for the package (NUREG-0361), and obtained the review of the National Academy of Sciences (NUREG/CR-0928) and the Advisory Committee for Reactor Safeguards (ACRS) for both the certification criteria and the package. This effort culminated on August 4, 1978, when the NRC certified to Congress that a package (Model PAT-1) that would fulfill the requirements of Public Law 94-79 had been designed and tested. A certificate of compliance was issued by NRC (see NUREG-0383, Volume 2, Revision 2, pp. 1-4) that authorizes use of the Model PAT-1 package for air transport of plutonium.

On September 1, 1978, the NRC issued an order to NRC licensees (superseding the August 15, 1975 order to licensees) which states that:

"Notwithstanding any provisions to the contrary in the NRC's regulations or in your license, shipments of plutonium by air, other than plutonium contained in a medical device designed for individual human application, may only be made in packages the design of which the NRC has specifically approved for transport of plutonium by air".

Now that the NRC plutonium air transport package certification program has been completed, it is time for the NRC to issue a rule implementing the mandate of Congress.

The direction of the effort to develop this rule has changed considerably since its initiation in August 1977, primarily by (1) inclusion of permission to ship small quantities of plutonium by air in other than packaging certified

to be air-crash resistant, and (2) issuance of a proposed rather than an effective rule. Because of this redirection, a copy of the Preliminary Value Impact Appraisal prepared at the time of task initiation is appended to this document (Appendix I).

1.3 Value/Impact of the Proposed Action

1.3.1 NRC Operations

Value of the proposed action to the NRC regulatory function results both from the restrictions already imposed by the order to NRC licensees and from the additional provisions of the proposed rule. The impact on the NRC regulatory function results primarily from the restrictions already imposed by the order to licensees. The value of this action to NRC regulatory functions is:

(1) Since over 8,000 licensees are potentially affected by this requirement, a rule, rather than an order to licensees, is a more effective and efficient means of implementation.

(2) Rulemaking on this subject allows an opportunity for public participation.

(3) Rulemaking is also a vehicle whereby the NRC can reasonably interpret the Energy Reorganization Act, as amended by the Scheuer Amendment, to allow the shipment of small quantities of plutonium by air in other than a container certified to be air-crash resistant, thereby avoiding a burdensome regulation, without needing to bring the issue to Congress for a decision.

(4) There were a number of ways to implement the Energy Reorganization Act as amended by the Scheuer Amendment; but, the preferred method of implementation by a regulatory agency, such as NRC, is by imposition of a substantive requirement of general applicability, like this, through rulemaking in accordance with the Administrative Procedure Act.

Since the Scheuer Amendment already has been implemented by an order to licensees, the major regulatory impact of the proposed action, i.e., restricting the air transport of plutonium, has already been effected. An additional impact on NRC operations, produced by the proposed action, is the staff time required to carry the proposed rule through to an effective rule. Resources required for this rulemaking (including primary effort by OSD staff and review by ELD and NMSS), because of the technical and legal complexities involved, is estimated to be 2000 man-hours (about 1 man-year effort) or $46,000. The allowance to ship by air small quantities and low specific activities of plutonium in other than air-crash-resistant packages is not expected to cause additional impacts on NRC operations; in fact these provisions may forestall additional work required to approve air-crash-resistent packaging for small air shipments of plutonium. In the event that an applicant applies to license a package other than PAT-1 for the air shipment of plutonium, a fee of $69,200 would be charged for license processing, through application ($7000) and approval ($62,200) (43 FR 7223). This represents 1 to 1½ man-years effort to license each additional package for air transport of plutonium. It is not expected that many of such license applications would be received, but the staff is aware of at least one such anticipated application.

1.3.2 Other Government Agencies

The value and impact of the proposed action on other government agencies results from the provisions of the proposed action already implemented by the order to NRC licensees and from the additional provisions in the proposed rule, but not in the order to licensees. DOE is involved with this proposed action, because it may choose to adopt a similar regulation for transportation under its control, with differences to reflect the different legislation to which

DOE is subject. Coordination with DOE can be accomplished through the rulemaking process, with minor effort for DOE. As part of its program to support effective international safeguards, DOE is developing a smaller, lighter air-crash-resistant package for shipments of safeguards samples, transported by air. DOE has expressed some concern about the stringency of the packaging criteria, especially for small quantities of plutonium. The DOE package will undergo license review at NRC. Since prompt shipment of safeguards samples is a necessary part of implementing the US/IAEA Safeguards Agreement, DOE, the Department of State (having negotiated the agreement), and the Office of the President all have an interest in this matter. Agreement States will adopt the effective rule as part of their body of regulations, but this will involve only a small effort. DOT is involved because this proposed rule extends NRC control to quantities of plutonium, which without the Scheuer Amendment, would be regulated by DOT under the division of authority embodied in the DOT/NRC Memorandum of Understanding. Furthermore, the NRC requirements on the air shipment of plutonium are inconsistent with the current and proposed DOT regulations. DOT will be able to coordinate with NRC through the rulemaking process on these issues.

1.3.3 Industry

Air shipment of plutonium does not appear to be a significant concern for most of the nuclear industry, because of the current national policy regarding nonproliferation, implemented in part by the deferral of recycling in the U.S. fuel cycle. Furthermore, several companies and government agencies ship standard sources containing small amounts of plutonium. Because a large number of entities are not currently involved in shipping plutonium, no more than 50 respondents are expected to prepare comments on the proposed amendments to the

regulations. Most of the comments are expected to merely endorse the proposal to permit shipment of small quantities in other than air-crash-resistant packaging, so a total of 14 man-weeks (40 x 1/2 day + 10 x 1 week) and $25,000 is estimated as the impact on industry to comment on the proposed regulation.

There are several anticipated values to industry from implementation of this proposed action. For the implementation of the requirements in the existing order to licensees, the values are: (1) the ability to ship plutonium by air in an air-crash-resistent package, and (2) a clearer definition, by issuing a rule rather than an order to licensees, of the NRC restrictions on the air shipment of plutonium. For the implementation of provisions in the proposed rule which are not currently in the existing order to licensees the value is removal of the burdensome requirement, to use the high cost air-crash-resistant package, on shippers of very small quantities of plutonium.

Since the proposed rule provides licensees with a less cumbersome means to comply with the legislative mandate, as opposed to the more burdensome requirements of the existing order to licensees, there is essentially no impact, just value, to the industry from the incremental differences between the proposed rule and the existing order to licensees. The impact to industry results primarily from the implementation of the restriction on the air shipment of plutonium as currently embodied in the existing order to licensees. This impact is estimated to be a tenfold increase in cost for packaging of those plutonium shipments required to be air-crash resistant and a substantial increase in shipping costs due to the special procedures and arrangements required for the deployment of an air-crash-resistant package. Prior to passage of the Scheuer Amendment the packages used for plutonium air transport cost in the region of $100 to $300 depending on quantity purchased, while the

air-crash-resistant container (PAT-1) has been estimated to cost $3500 in production (cost has been about $8000 for the small quantities required for package development). The cost to ship a PAT-1 package varies depending on a number of factors including distance shipped, but carriers have estimated costs of $900 to $7000; shipment in a 6M container prior to passage of the Scheuer Amendment typically cost $200-$300. In addition to the added cost for shipping the PAT-1 package (costs attributable to the increased weight and added operational requirements), logistical difficulties resulting from the NRC imposed operational constraints and air carrier response to those constraints have the potential and have been reported to make shipments by air in the PAT-1 package burdensome. Usage by a licensee of a package specifically approved for shipment of plutonium by air, other than the Model PAT-1, would be quite costly. In addition to the $69,200 in licensing fees required for submission and approval of the application for certification, the licensee would probably incur costs of $2-3 million for design, development, and testing of the package.

1.3.4 Public

Value and impact to the public result from the provisions of the proposed action already implemented by the order to licensees and from the provisions added by the rule to those already implemented by the order. Value to the public from the provisions of the proposed action already implemented by the order to licensees is reduced risk from plutonium shipments involved in air-crashes and virtual prevention of large public health consequences resulting from dispersal of plutonium in an air-crash. Impact to the public from these provisions of the proposed action results from the increased cost of activities requiring air shipments of plutonium, such as scientific research, laboratory

testing, and certain nuclear power instrumentation activities; these increased costs of air shipment of plutonium will be passed through to consumers of these services.

Provisions of the proposed rule differing from the existing order to licensees very slightly reduces the overall value to the public, but significantly reduces public impacts at the same time. Permission, included in the proposed action, to ship small quantities in packaging other than a certified air-crash-resistant package do not significantly add to the public risk from air shipment of plutonium. The Environmental Impact Appraisal (Enclosure 4) estimates these risks to be very small. It also shows that the consequences, resulting from the environmental dispersal of plutonium in the event that such shipments were involved in a severe air crash, are small. Furthermore, the risks of making these shipments by other modes is not zero. However, the value to the public resulting from the allowance to ship these small but quantities of plutonium by air in other then an air-crash-resistent package is to eliminate the unnecessary passed through cost of causing these small shipments to travel by other modes or in an air-crash-resistant package.

1.4 Decision on the Proposed Action

The Commission should approve publication for comment of the notice of proposed rulemaking which proposes amendments to 10 CFR Part 71 to establish restrictions on the shipment of plutonium by air. Key facets of this proposed action are: (1) the Scheuer Amendment is implemented by a rule; (2) a reasonable interpretation of the Energy Reorganization Act of 1974, as modified by the Scheuer Amendment, is for the NRC to permit air shipment of small quantities of plutonium in packaging other than that certified to be air-crash resistant;

(3) the qualification criteria for the air-crash-resistant package are not codified in the NRC regulations, but instead NUREG-0360 is referenced.

2. TECHNICAL APPROACH

Determination of the Quantity of Plutonium Permitted to be Shipped by Air in Other than an Air-Crash-Resistant Package.

2.1 Technical Alternatives

The technical alternatives correspond to various quantity limits such that packages containing amounts of plutonium equal to or less than the quantity limit would be permitted to be shipped by air in an air-crash-resistant package. The basic technical question, given that a reasonable interpretation of the legislation permits shipment by air of small quantities of plutonium in other than an air-crash-resistant package (as discussed in the Legal Analysis, Appendix II to this Value/Impact Statement), is what size shipments of plutonium should be permitted to be shipped by air in other than air-crash-resistant packaging? The following discussion evaluates various choices for the limits on quantities of plutonium that can be so shipped. Although not as basic as the question of what quantities of plutonium may be shipped by air in other than an air-crash-resistant package, other provisions of the proposed rule are also evaluated. The provision to ship plutonium by air in other than air-crash-resistant packaging, if it is contained in a medical device intended for individual human use, and the provision to ship plutonium by air in a package certified by the NRC to be air-crash resistant, are derived from the provisions in the Scheuer Amendment. The provision to ship low specific activity material by air is a practical interpretation of the law recognizing the definition of a radioactive material used in the transport regulations.

The alternatives listed in the order of decreasing strictness of interpretation are:

1. Issue a rule forbidding air transport of plutonium in any form, under any conditions. (This alternative does not permit shipments that are allowed by the Scheuer Amendment.)

2. Adopt a rule forbidding air shipment of plutonium except as: (1) contained in a medical device designed for individual human application, (2) contained in material with a specific activity not greater than 0.002 microcuries per gram, or (3) shipped in a package authorized by the Commission for shipment of plutonium by air. (This alternative does not allow shipment of small quantities of plutonium in packaging other than that certified to be air-crash resistant; it is a strict interpretation of the Scheuer Amendment.)

3. Issue a rule as in 2., above, but add the following provision: or (4) shipped in accordance with 10 CFR §71.5 for a single package containing no more than 10 microcuries of any isotope or mixture of plutonium. (This alternative would allow some packages containing small quantities of plutonium to be shipped by air in other than an air-crash-resistant package.)

4. Issue a rule as in 3., above, but in item (4) change the level from 10 microcuries to an A_2* quantity. The A_2 limit for shipments in other than air-crash-resistant packaging would apply regardless of the form of the plutonium. This is a less strict interpretation of the law than alternative 1. through 3., above, but more strict than 5. below.

5. Issue a rule requiring shipment of plutonium, in a package certified to be air-crash resistant, with exceptions for type A quantities of plutonium as is consistent with IAEA regulations and the proposed DOT/NRC regulations. For

*An A_2 quantity of plutonium is defined in Appendix C of the proposed amendments to 10 CFR Part 71 (44 FR 48234) published August 17, 1979 and in Table VII of the International Atomic Energy Agency Regulations for the Safe Transport of Radioactive Materials, IAEA Safety Series No. 6 (1973 Revised Edition).

plutonium in normal form shipments in other than an air-crash-resistant package would be limited to an A_2 quantity; however, for plutonium in special form up to an A_1 quantity of plutonium (for α-emitting isotopes of plutonium an A_1 quantity = 1000 A_2 quantity; for Pu-241 an A_1 quantity = 1 Ci) could be shipped in other than an air-crash-resistant package.

2.2 Discussion and Comparison of Technical Alternatives

Reasonable Interpretation to Permit Shipment of Small Quantities in Other Than Air-Crash-Resistant Packaging

In preparing this rule, the question arose as to what, if any, classes of shipments of plutonium by air should be permitted to be transported in other than a container certified to be air-crash resistant. Some of the reasons this question arose include: (1) a petition was received by NRC requesting that certain small quantities by permitted to be shipped in other than air-crash-resistant packaging, (2) the NRC staff did not consider it good regulatory practice to restrict the air shipment of plutonium in an unsupportably absolute, burdensome fashion, (3) the legislative history of the Scheuer Amendment indicated that an absolute guarantee of safety was not intended by the Congress, and (4) the ability to ship small samples of plutonium by air in other than air-crash-resistant packaging would help to implement the U.S. policy to support effective international safeguards. The Scheuer Amendment itself makes provision for only one such class of shipments, a medical device designed for individual human use, to be shipped in other than air-crash-resistant packaging. This legislated allowance to use other than air-crash-resistant packaging has the potential (albeit with low probability) for permitting a release of plutonium in an air-crash, which could cause large public health consequences. For example, the plutonium power sources for pacemakers are not tested against the qualification criteria used to certify that a package is air-crash resistant and there is no

guarantee that these devices would not rupture in an air-crash and possibly disperse plutonium into the human environment. Furthermore, there is currently no provision in the regulation to require any new medical devices containing plutonium to survive an air crash or even be as air-crash resistant as the pacemaker. However, because of the rigid requirements placed on the sealed plutonium source used in pacemakers, it is extremely unlikely that these devices would rupture in the event of the crash and explosion of a high flying aircraft, itself an unlikely occurrence. Using a very conservative analysis for the release and dispersal, in a highly populated area, of the 4 curies of plutonium, typically contained in a cardiac pacemaker, as the result of a very severe air-crash, about 120 latent cancer fatalities are estimated (see Appendix III). Unlike the NRC legislation that allows only a medical device for individual human use to be shipped in other than air-crash-resistant packaging, similar legislation passed for ERDA specifically cited additional types of shipments permitted less stringent packaging requirements. Also, comments made by Congressman Scheuer in the debate on this issue indicate his primary concern was to eliminate the possibility of large public health consequences resulting from the dispersal of plutonium in an air-crash. Small quantities of plutonium (less than a few millicuries) have been shown by staff analysis (The Environmental Impact Appraisal) to be incapable of causing such large public health consequences. Both the legislative history of this law and practical considerations would lead one to conclude that that Energy Reorganization Act of 1974, as modified by the Scheuer Amendment, can be reasonably interpreted to permit air transport, in other than a certified air-crash-resistant package, of small quantities of plutonium, such as quantities currently exempt from the requirements to ship in accident resistant packaging. A legal analysis prepared by the NRC Office

of the Executive Legal Director (Appendix II) substantiates this conclusion and indicates that an A_2 quantity would be an appropriate upper limit for shipments in other than air-crash-resistant packaging.

The current system of regulation divides shipments of any particular radionuclide into three classes: (1) very small quantities (limited quantities), with negligible potential for adverse health effects on an individual even though special requirements are not placed on the packaging, (2) small quantities that are shipped in Type A packages, with small potential for adverse health effects to an individual even though the packaging is only required to survive normal transport conditions, but not required to survive certain hypothetical accident conditions, and (3) large quantities that are shipped in type B packages for which the strong packaging, that is required to survive certain hypothical accident conditions, as well as normal transport conditions, is relied upon to provide an adequate level of safety. Two quantity values, or breakpoints, are used to separate shipments into these three categories. Each transport group of radionuclides has different breakpoints depending on radiotoxicity. Larger quantities may be shipped in a given packaging class if the material is in special form or is in a manufactured article. Materials that are essentially nonradioactive (i.e., materials in which the radioactivity is uniformly distributed and is less than 0.002 μCi/g) are exempt from the NRC and DOT transport regulations.

The certification of the PAT-1 package and the concurrent development of a set of qualification criteria related to much more severe accident environments than the qualification criteria for the Type B package, introduces an additional category of shipments into the regulatory scheme. This new category of shipments is comprised of plutonium shipments by air that are required to be transported in packaging required to survive testing substantially in excess

of testing required for Type B packages. The structure, and therefore public understanding, of the regulations would be simplified, if the new category for air shipment of plutonium introduced in response to the Scheuer Amendment is selected to correspond to one of the currently existing categories. That is, the breakpoint defining those shipments required to be transported in an air-crash-resistant package would be convenient, if it were to correspond to the existing levels used to require shipment in either a Type A package or a Type B package.

Selection of an A_2 quantity as the upper limit on the quantity of plutonium permitted to be shipped in packaging other than that certified to be air-crash resistant is based on the facts that: (1) shipment of an A_2 quantity or less has been shown by staff analyses (see Reference 1, the Environmental Appraisal) to be incapable of causing large public health consequences in the event of a severe air crash, (2) an A_2 quantity is consistent with the air-crash-resistant package qualification criteria permitting the release of a small amount of plutonium in the event of a very severe air crash, and (3) an A_2 quantity corresponds to the upper limit in size for shipments to be transported in type A packaging (for normal form) in the IAEA regulations and the proposed DOT and NRC regulations based on them. The legislative history of the Scheuer amendment indicates that the law was intended to prevent large public health consequences caused by the dispersal of plutonium in an air crash. The staff analysis (Ref. 1) shows that an A_2 quantity of plutonium released to the human environment as a result of an air crash would generally be expected to produce minor public health consequences. This realistic, but still conservative assessment, taking into account the environmental dispersion and population density exposed (a hyper-urban population density is assumed), shows these health effects would be a small fraction of a latent cancer fatality. With that margin of

safety, large public health consequences would be essentially impossible, even if more than one package were involved in a single air crash. The qualification criteria for an air-crash-resistant package permit the certified package to release an A_2 quantity in a period of a week, subsequent to the sequential tests related to severe aircraft accident conditions. (For long lived alpha-emitting isotopes of plutonium, the A_2 quantity is 2 or 3 millicuries; for Pu-241, a beta-emitter, the A_2 quantity is 0.1 curie, but Pu-241 is substantially less radiotoxic than the other isotopes of plutonium.) The qualification criteria as approved by the Commission and reviewed by the ACRS (Advisory Committee on Reactor Safeguards) and the NAS (National Academy of Science), permit the release of an A_2 quantity under very severe accident conditions. It is consistent to permit shipment of an A_2 quantity in other than an air-crash-resistant package, since an air crash involving such small quantities, would not exceed the accepted consequences of an air crash involving larger quantities shipped in the PAT-1 or other air-crash-resistant package, even if the entire contents were released from the air-crash-resistant package. Furthermore, as shown in the Environmental Impact Appraisal (Ref. 1), the annual radiological risk estimated to result from air crashes involving shipments of plutonium in other than air-crash-resistant packages is very small. Since both the consequences of any single air crash and risk from all shipments for plutonium shipped in other than air-crash-resistant packaging is small, the A_2 level is a suitable choice to define what quantities may be shipped in other than air-crash-resistant packaging.

A further consideration in permitting air shipment of plutonium in other than air-crash-resistant packaging is the increased cost of air-crash-resistant package acquisition and use, as discussed in Section 1.3.3. The PAT-1 package is costly to purchase and use. Other air-crash-resistant package designs would be costly to license. When the requirement to use an air-crash-resistant package

at its high cost is placed on shippers of very small quantities of plutonium, the costs outweigh the benefits.

The Petition for an Exemption

In addition to the staff impetus to implement the Scheuer Amendment with concern for effective integration into the body of existing regulations, and fulfillment of the spirit of the law, the Commission has been petitioned to permit shipments by air of small quantities of plutonium in other than a package certified to be air-crash resistant. In a letter dated July 18, 1977 Eberline Instrument Corporation formally petitioned the Commission (PRM-70-6) to allow air shipment of small quantities of plutonium (less than 5 microcuries) contained in calibration sources. The NRC published a notice (42 FR 41675) of filing of a petition for rule making on August 18, 1977.

Two comments, generally supportive of the petitioners view, have been received. The position taken by the staff with regard to the Eberline petition is that no definitive action was possible until the NRC had certified to the Congress that a package had been developed and tested to show it would not rupture under testing equivalent to the crash and explosion of a high flying aircraft, that consideration of the petition would be incorporated in this rule making proceeding, and that, until the rule was issued, the NRC order to licensees restricting all air shipments of plutonium to packages specifically approved for that purpose would be in effect. Commission action on this proposed rule will define NRC policy and permit disposition of the Eberline petition.

Related Issues

1. Inconsistency with DOT and IAEA Regulations.

Regardless of the particular manner chosen, any implementation of the Scheuer Amendment will be inconsistent with current DOT and IAEA regulations

and the proposed DOT/NRC regulations which incorporate in the U.S. transport regulations provisions of the 1973 revision of the IAEA regulations. The inconsistency occurs because the existing body of regulations: (1) does not require air shipment of plutonium in a package as crash-resistant as the PAT-1, and (2) permit exemptions for the shipment of small quantities of plutonium by air in other than air-crash-resistant packaging. If DOT or IAEA should decide at some point to consider changes in their regulations to reduce or remove the inconsistencies between those regulations and the NRC regulations, some staff activity would be involved in working with those organizations. The NRC staff will evaluate whether it should encourage consideration of such changes by DOT.

2. Air Transport Restrictions for Other Long Lived Alpha Emitters.

Other long-lived alpha emitting isotopes (for example, americium) are approximately as radiotoxic and pose a health hazard similar to that of plutonium. A Joint Committee on Atomic Energy Print, dated September 17, 1974, entitled Transportation of Radioactive Material by Passenger Aircraft (Appendix IV), recommends that certain radioisotopes, in addition to plutonium, have additional restrictions placed on their transport by air. Assuming that the Scheuer Amendment establishes a level of air transport safety that is acceptable for a material with a certain hazard potential, treatment of other isotopes in the same manner as plutonium would implement that policy level of safety in a uniform, logical fashion; this consistency could help to make the NRC action more easily understood. The NRC staff in conjunction with DOT and/or IAEA, could consider the appropriateness of extending air-transport restraints to other long-lived alpha emitters, thereby achieving a more consistent, logical regulatory structure. By restricting the air shipment of radionuclides with radiotoxicities similar to plutonium, the risk to public health and safety would be reduced, although the NRC staff considers that adequate

safety is provided for by current practices (Ref. 6). Additional substantial staff effort would be required to develop value/impact analyses on which to base more restrictive regulations for other isotopes, which would add further burdens to licensees. Since a staff evaluation (Ref. 6) has shown that an adequate level of safety is provided for by current regulations and since no other compelling reason to promulgate regulations in this area has surfaced, the staff will not consider further extention of the restrictions on air transport to isotopes other than those of plutonium.

3. Shipment of Safeguards Samples.

As a result of the US/IAEA Safeguards Agreement and the U.S. policy to support effective international safeguards, rapid air shipment of quantities of plutonium up to several hundred grams are necessary. The IAEA need was defined in a letter dated February 2, 1979, from A. von Baeckmann, Director, IAEA Safeguards Division of Development and Technical Support, to the U.S. IAEA Mission in Vienna (Appendix V).

On April 25, 1979 representatives of NRC and DOE met with Maria Lopez-Otin, a member of Senator Glenn's staff. The purpose of the meeting was to discuss the interest of Senator Glenn and the Subcommittee on Energy and Nuclear Proliferation in the ability to ship safeguards samples of plutonium in packages other than the PAT-1. Several options for addressing this problem were discussed including:

(1) Design and development of a smaller package for safeguards samples that would meet the current NRC criteria.

(2) Legislative relief (either granting authority to NRC to allow air shipment of plutonium in other than air-crash-resistant packaging, when the Commission decides such allowances should be made, or a specific provision to

allow shipments related to U.S. support of effective international safeguards to be made in other than air-crash-resistant packaging.

(3) Modification of the criteria to make it easier to design smaller packages for smaller quantities.

The first and second options are being pursued to some extent. DOE is pursuing the first option. NRC has not initiated action to pursue legislative relief, the second option, although OELD has recommended such an action (memorandum dated January 7, 1980 from G. H. Cunningham, OELD, to A. DiPalo, OMPA, Appendix VI). However, the permission to ship up to an A_2 quantity of plutonium in packaging other than that certified to be air-crash resistant will assist the U.S. policy to support effective international safeguards by permitting the shipment of certain safeguards samples by air in packaging less expensive and less cumbersome than the air-crash-resistant packaging. This does not, however, completely solve the problem because there are shipments the IAEA will need to make that are larger than an A_2 quantity. The third option is not being pursued, because the NRC staff is not aware of any new technical data which would support development of less stringent criteria for plutonium package certification under P.L. 94-79. On May 31, 1979 Senator Glenn followed up the staff meeting with a letter to Chairman Hendrie (Appendix VII). The Chairman's response (Appendix VIII) of July 6, 1979 restates the NRC position that besides the development of a small air-crash-resistant package by DOE, "the other alternative is to initiate legislative action to provide an exemption to Public Law 94-79 for the quantities of plutonium or types of shipments involved in the IAEA sample shipment program." A more direct response to the IAEA request for assistance was provided by the June 6, 1979 letter from George Weisz, DOE, to Professor Johannes J. Gruemm, IAEA (Appendix IX); that letter reiterates much of the above discussion.

Pros and Cons for Alternatives

For the purpose of brevity and clarity, the Commission Paper discussed only three alternatives under Issue 2. Here a more extensive discussion including five alternatives is presented. Alternatives 1, 2, and 3 in the Commission Paper correspond to Alternatives 2, 3, and 4 respectively, below.

Alternative 1.

Issue a rule forbidding air transport of plutonium in any form, under any conditions.

Because of the conditional wording of the Scheuer amendment, if the NRC had not certified an air-crash-resistant package to Congress, then the ban on air shipment of plutonium would continue. Since then, NRC has developed not only criteria for air-crash resistance but also a package that meets the criteria. It is not reasonable to ignore that effort and ban air shipments of plutonium. However, prior to these developments, such a ban was a viable alternative and is included here to complete the public record of regulatory decision making. As discussed above, this rulemaking will codify features of the implementation of the Scheuer Amendment, as embodied in by the NRC orders to its licensees; this regulatory analysis must include those previously implemented features. Actually this alternative would include an item like (2) in Alternative 2, so that essentially nonradioactive material (e.g., terrestrial materials containing at low levels by plutonium) would not be restricted from air transport.

Pro: (1) Since the Scheuer Amendment allows plutonium contained in medical devices for individual human application to be shipped in other than air-crash-resistant packaging, these medical shipments, that have the potential (albeit with very low likelihod) for causing very large public health consequences by the release of plutonium in an air crash, would be permitted by the Scheuer

Amendment to be shipped by air; this alternative would eliminate even that very remote potential of large public consequences resulting from these medical shipments.

(2) A regulation of this type is more direct and clear, because of its simplicity.

(3) Since the plutonium in a medical device has essentially the same potential for public harm as other forms, the apparent inconsistency of an exemption for medical use is eliminated.

(4) The Scheuer Amendment is complied with, even though this interpretation goes beyond the law and is more restrictive.

Con: (1) This interpretation is unduly burdensome to licensees. However, elimination of the allowance to ship plutonium for individual human medical use in other than air-crash-resistant packaging affects a smaller part of the public and is more significant in its effect on public health than the allowance to ship small quantities, as proposed in Alternative 3.

(2) This alternative is the most inconsistent with DOT and IAEA regulations.

(3) There may be difficulty enforcing this alternative with regard to foreign travelers, entering the U.S., with implanted medical devices, e.g., a plutonium-powered pacemaker.

(4) No accommodation of the need to ship safeguards samples in connection with the U.S. support of effective international safeguards is provided.

Alternative 2.

Adopt a rule forbidding air shipment of plutonium except as: (1) contained in a medical device designed for individual human application, (2) contained in material with a specific activity not greater than 0.002 microcuries per gram, or (3) shipped in a package specifically authorized by the Commission

for shipment of plutonium by air. This alternative does not allow shipment of small quantities of plutonium in other than packaging certified to be air-crash resistant. It is a strict interpretation of the Scheuer Amendment.

Pro: (1) This is a more direct, literal implementation of the Scheuer Amendment than Alternatives 3 and 4, which do permit shipment of small quantities of plutonium in other than air-crash-resistant packages.

(2) Large public health consequences resulting from plutonium dispersal in a severe air crash would be prevented as in Alternatives 3 and 4; in addition, the likelihood of lesser public health consequences would be reduced below that of Alternative 1.

(3) Because it is simpler, this implementation is marginally easier to comprehend and implement than Alternatives 3 and 4.

(4) Provides greater protection to the public health and safety than all other alternatives but Alternative 1.

Con: (1) The impact of implementation is not commensurate with limited decrease in risk to public health and safety, as discussed in the Environmental Impact Appraisal (Ref. 1).

(2) This rule is more inconsistent with both DOT and IAEA regulations, than all alternatives but Alternative 1, because inconsistent requirements apply to a broader range of shipments.

(3) No accommodation of the need to ship small quantities, including safeguards samples in connection with the U.S. policy to support effective international safeguards, is provided.

Alternative 3.

Issue a rule as in Alternative 2, above, but add the following provision: ..., or (4) shipped in accordance with § 71.5 for a single package containing

no more than 10 microcuries of any isotope or mixture of plutonium. Ten microcuries is the level current DOT regulations exempt from packaging, labelling, and marking requirements.

Pro: (1) Same as Alternative 4.

(2) Same as Alternative 4, except in this case Alternatives 1 and 2 are more restrictive and Alternatives 4 and 5 are more liberal.

(3) Same as Alternative 4, except a smaller set of shipments is permitted to be shipped in other than air-crash-resistant packaging.

(4) Less accommodation of the need to ship safeguards samples is afforded by this 10 microcurie level exemption than by the A_2 quantity level of Alternative 4.

(5) Same as Alternative 4.

(6) The 10 microcurie level corresponds to the level in the current DOT regulations below which compliance with packaging, labelling, and marking standards is not required. Thus this Alternative is more consistent with the DOT and IAEA regulatory structure than Alternatives 1 and 2, but less consistent than Alternatives 4 & 5.

(7) The 10 microcurie level is a more conservative quantity than the A_2 quantity level of Alternative 4.

Con: (1) Same as Alternative 4.

(2) Same as Alternative 4.

(3) This alternative is less consistent with IAEA and proposed DOT regulations than Alternative 4, since an inconsistent requirement is applied to a larger range of shipments.

Alternative 4.

Issue a rule as in Alternative 3, but in item (4) change the level from 10 microcuries to an A_2 quantity. This is a less strict interpretation of the

law than Alternatives 1 through 3 above, but more strict than Alternative 5, above. This rule would forbid air shipment of plutonium except as: (1) contained in a medical device designed for individual human application, (2) contained in material with a specific activity not greater than 0.002 microcuries per gram, (3) shipped in a package specifically authorized by the Commission for shipment of plutonium by air, or (4) shipped in accordance with § 71.5, for single packages containing no more than an A_2 quantity of plutonium.

Pro: (1) The public health and safety would be protected adequately, even though not to the higher degree afforded by restricting all shipments to an air-crash-resistant package.

(2) The intent of the Scheuer Amendment is complied with, although more restrictive (Alts. 1, 2, and 3) and more liberal (Alt. 5) interpretations are possible. Since the atmospheric nuclear weapon tests in the 1950's and 1960's, soil, animals, and virtually all terrestrial materials are contaminated with small quantities of plutonium. The law was not intended to apply in such an extreme sense and item (2) in the statement of this alternative recognizes this fact.

(3) Licensees desiring to ship by air small quantities of plutonium with essentially no potential for large public health consequences would be permitted to do so without undergoing the expense and inconvenience of using the PAT-1 or other air-crash-resistant package.

(4) The allowance to ship an A_2 quantity or less of plutonium in other than air-crash-resistant packaging provides some accommodation for the need to ship safeguards samples in connection with the U.S. policy to support effective international safeguards and the US/IAEA Safeguards Agreement pursuant to that policy.

(5) Large public health consequences, resulting from plutonium dispersal in an air crash, would be prevented, except for the remote possibility of a release from a medical device; however, medical devices for individual human use are specifically permitted by the Scheuer Amendment to be shipped by air in other than air-crash-resistant packaging and the risk from such devices is minimal.

(6) This alternative is more consistent with IAEA transport regulations and the proposed DOT/NRC transport regulations than Alternatives 1, 2, and 3 which apply inconsistent requirements on a larger range of shipments. Those shipments of an A_2 quantity (or less) are defined by the IAEA and proposed DOT/NRC regulations to be equal to (or less than) a Type A quantity (under current DOT/NRC regulations a slightly different level is defined), which shipments are exempt from the requirement to ship in a package able to withstand hypothetical accident conditions. Although more consistent with the IAEA and proposed DOT regulatory structure, this alternative is still inconsistent with IAEA and proposed DOT regulations, since they do not require use of a package designed to be air-crash resistant for any shipments. As discussed under "Related Issues, 1. Inconsistency with DOT and IAEA Regulations," above, these IAEA and proposed DOT, regulations were developed prior to and without taking into account the legislative mandate of the Scheuer Amendment. For this reason any implementation of the Scheuer Amendment will be inconsistent with the existing body of regulation.

Con: (1) Does not afford the higher degree of protection to the public health and safety provided by restricting all shipments to the air-crash-resistant packaging.

(2) An interpretation of the Scheuer Amendment in a less literal manner (e.g., Alternative 2), may give some persons the impression that the Congressional mandate is not being followed.

(3) This is a less conservative legal position than Alternative 3. Although the Energy Reorganization Act of 1974, as modified by the Scheuer Amendment, may be reasonably interpreted to permit shipment of an A_2 quantity or less in other than an air-crash-resistant package, a 10 microcurie level is identified as a type of de minimis (for purposes of transport) quantity and is more defensible legally (even though the staff technical analysis shows no compelling technical basis for the legally more conservative level), since quantities of 10 microcuries or less are relieved of essentially all packaging, labeling, and marking requirement in the current body of DOT regulations.

Alternative 5.

Issue a rule requiring shipment of plutonium, in a package certified to be air-crash resistant, with exceptions for type A quantities or less of plutonium, consistent with IAEA regulations and the proposed DOT/NRC regulations. Although similar to Alternative 1 in that type A quantities are not required to be shipped in air-crash-resistant packaging, this alternative would allow substantially larger shipments, up to an A_1 quantity, for plutonium in special form (for α-emitting isotopes of plutonium an A_1 quantity = 1000 A_2 quantity; for Pu-241 an A_1 quantity = 1000 Ci). Since the requirements for special form encapsulation are less stringent than the air-crash-resistance criteria, these larger quantity shipments would be permitted under this alternative without the high degree of crash-resistance afforded by an air-crash-resistant package.

Pro: (1) By replacing the NRC requirements for Type B packaging by the air-crash-resistant package qualification criteria, for air transport of type B quantities of plutonium, inconsistency with DOT and IAEA regulations is minimized.

(2) This would be the alternative least burdensome to licensees.

(3) This would provide a greater degree of accommodation of the need to ship safeguards samples.

Con: (1) The risk of large public health consequences resulting from plutonium dispersal in a severe air crash would be greater than with any other alternative.

(2) Some might misunderstand this implementation and consider that the Scheuer Amendment was not adhered to.

2.3 Decision on Technical Approach

Considering the minor effect on public health and safety of shipping small quantities of plutonium in other than the PAT-1 package, the major cost of requiring such small quantities to be shipped in the PAT-1 package, and the intent of the Scheuer Amendment, the recommended decision is to publish a proposed regulation in which air shipment of plutonium is forbidden except as: (1) contained in a medical device designed for individual human application, (2) contained in material with a specific activity not greater than 0.002 microcuries per gram, (3) shipped in accordance with §71.5 for a single package containing no more than an A_2 quantity of any isotope or mixture of plutonium, or (4) shipped in a package authorized by the Commission for shipment of plutonium by air.

The Environmental Impact Appraisal (EIA, Ref. 1) supports this decision. The EIA estimates an annual radiological risk of 3×10^{-4} latent cancer fatalities to result from potential air crashes and release of package contents. This risk corresponds to the shipment by air of 5200 packages containing an A_2 quantity of plutonium in other than an air-crash-resistant package. A conservatively high estimate for the shipment of small quantities of plutonium by air is $100 to $300 per shipment. The cost to ship in an air-crash-resistant package is estimated to be $900-$7000. Using a conservative cost differential of $1000 per shipment, the added cost of requiring 5200 packages containing

small quantities of plutonium to be shipped in air-crash-resistant packaging is about $5 million. This does not include the cost of acquiring the air-crash-resistant packages. The reduction in risk corresponding to this increased cost is about a factor of 250, but since the risk is so small to begin with, a favorable cost/benefit ratio is not obtained. Since large public health consequences resulting from air crashes involving shipments of small quantities of plutonium are not expected, regardless of whether these small quantities are shipped in air-crash-resistant packaging, the potential for creating large public health consequences is not a consideration in this decision, given that the small quantities are chosen to be an A_2 quantity or less.

Another consideration is that instead of eliminating the shipment of small quantities of plutonium by air or requiring their shipment in air-crash-resistant packaging, an alternative might be to transport such small quantities by other modes. In most cases, use of other modes is logistically inconvenient and in the case of international shipments inconvenient to the point of almost precluding such shipments. Use of modes other than air for small plutonium shipments, requires excessive time, possibly higher cost (in the case of transport by ship, this is certainly the case), and the potential for the loss or misdelivery of a package in a transport system not designed for or used to handling small, valuable packages. The reduction in risk effected by using other modes is essentially zero, since other transport modes can cause very severe accident environments and in some cases would produce releases at a higher frequency than air transport. Thus, a favorable cost/benefit ratio is not obtained.

Codification of the Qualification Criteria

2.4 Technical Alternatives

2.5 Discussion and Comparison of Technical Alternatives

The technical alternatives, i.e. various forms of the qualification criteria, are enumerated, discussed, and compared in the following documents:

1. NUREG-0360, Qualification Criteria to Certify a Package for Air Transport of Plutonium, Office of Nuclear Material Safety and Safeguards, U.S. Nuclear Regulatory Commission, January 1978.

2. NUREG/CR-0428, Review of Criteria for Packaging Plutonium for Transport by Air, National Academy of Sciences, 1978.

3. U.S. NRC Public Announcement No. 78-187, Letter from Stephen Lawroski, Chairman, ACRS, to Joseph M. Hendrie, Chairman, NRC.

No further discussion is required or presented here.

2.6 Decision on Technical Approach

The Commission should approve the use of the qualification criteria stated in NUREG-0360 in the licensing process.

3. PROCEDURAL APPROACH

Rule vs. Order

3.1 Procedural Alternatives

The procedural alternatives for restricting the air shipment of plutonium are:

1. Adopt a rule restricting the air shipment of plutonium to specially approved packages (at present only Model PAT-1), medical devices designed for

individual human use, or certain small quantities and concentrations.

2. Continue reliance on the existing order to licensees, rather than issuance of a rule.

3.2 Discussion of Procedural Alternatives

Alternative 1.

Adopt a rule restricting the air shipment of plutonium to specially approved packages (at present only Model PAT-1), medical devices designed for individual human use, or certain small quantities and concentrations.

Pro: (1) Although there were a number of ways to implement the Scheuer Amendment, the preferred method of implementation by a regulatory agency, such as NRC, is by imposition of a substantive requirement of general applicability, like this, through rulemaking in accordance with the Administrative Procedure Act.

(2) Since over 8,000 licensees are potentially affected by this requirement, a rule, rather than an order to licensees, is a more effective and efficient means of implementation.

(3) Rulemaking permits public participation.

(4) Rulemaking is also a vehicle whereby the NRC can implement a reasonable interpretation of the Energy Reorganization Act of 1974, as amended by the Scheuer Amendment, to allow shipment of small quantities in other than air-crash-resistant packaging, thereby avoiding a burdensome regulation and keeping Congress and the public informed.

Con: (1) Since there may be very little interest by the general public in this rule and since the Scheuer Amendment has already been implemented by the NRC order to licensees, a rulemaking proceeding could use a significant amount of staff time for what amounts to a pro forma procedure.

Alternative 2.

Continue reliance on the existing order to NRC licensees rather than issuance of a rule.

Pro: No further staff activity would be required; the law could be implemented without incurring the cost of what may prove to be a pro forma administrative exercise.

Con: (1) Although this is a Congressionally mandated action, the preferred implementation of the law is through the normal rulemaking procedures in accordance with the Administrative Procedure Act.

(2) Implementation by the order currently standing is burdensome, because no allowance to ship small quantities in other than air-crash-resistant packaging is allowed. Granting such an allowance in an order to licensees, without a rulemaking proceeding, is not considered feasible by the staff.

(3) It is less effective and efficient to implement a general condition such as this by separate orders to several thousand licensees.

(4) The U.S. policy to support effective international safeguards is not well accommodated, because the existing order to licensees contains no provision to ship small safeguards samples in a package other than that certified to be air-crash resistant.

3.3 Decision on Procedural Approach

Clearly rulemaking is desirable; the Commission should adopt that procedural approach.

Codification of the Qualification Criteria

3.4 Procedural Alternatives

The procedural alternatives for making the qualification criteria known are:

1. Take no further action on the qualification criteria, except reference in the statement of considerations that they are published in NUREG-0360 and request comments.

2. Issue a regulatory guide stating the current package qualification criteria as one acceptable way of meeting the regulatory requirement to ship plutonium by air only in an air-crash-resistant package.

3. Amend the NRC regulations to incorporate the package qualification criteria, i.e. packaging standards for the air-crash-resistant package (test conditions, acceptance criteria, and operating conditions).

3.5 Discussion of Procedural Alternatives

Alternative 1.

Take no further action on the qualification criteria, except reference in the statement of considerations that they are published in NUREG-0360 and request comments.

Pro: (1) This would require the least effort by the NRC staff.

(2) Because of limited interest in air shipment of plutonium, numerous applications for approval of packages other than Model PAT-1 are not anticipated, so the effort required to codify the qualification criteria in the NRC rules is not warranted.

(3) This would provide for flexibility in applying the criteria until sufficient experience had been gained to better define them.

(4) Request for public comment on the criteria in NUREG-0360 would be included in the statement of consideration for the proposed amendments so that the public would be provided the opportunity to comment without the need for the staff time being spent in formal publication of a guide or rule for comment.

Con: (1) This approach diminishes public input on the qualification criteria.

(2) A NUREG report has no status as a regulation or acceptable method of compliance.

(3) An opportunity to better accommodate the need to ship safeguards samples in connection with the U.S. policy to support effective international safeguards by altering the qualification criteria (to make smaller packages easier to design, but not less crash-resistant) is not provided.

(4) The precedent for licensing Type B packaging is that the qualification criteria are codified in the regulations.

Alternative 2.

Issue a regulatory guide stating the current package qualification criteria as one acceptable way of meeting the regulatory requirement to ship plutonium by air only in a crash-resistant package.

Pro: (1) This allows public participation in the formulation of the qualification criteria without the time, expense, and effort required for a rulemaking proceeding. Providing this opportunity for public participation may refine the criteria to improve the protection of the public, make the criteria more understandable, and achieve a less burdensome requirement, while still adequately protecting the public health and safety.

(2) Same as Alternative 1.

(3) If alternative qualification criteria were to be found acceptable and if these criteria would make it easier to design smaller packages that are no less air-crash-resistant, then this would better accommodate the need to ship safeguards samples in connection with the U.S. policy to support effective international safeguards.

Con: (1) A regulatory guide is an acceptable method of compliance with the regulations, not a requirement. Public health and safety might be compromised by use of other criteria.

(2) This approach does not provide as great an opportunity for public participation as involvement in the formulation of regulations, since a guide defines an acceptable means of compliance, not a mandatory method of compliance.

(3) Staff time would be required to publish information already in the public domain and subject to public comment.

(4) The precedent for licensing Type B packaging is that the qualification criteria are codified in the regulations.

Alternative 3.

Amend the NRC regulations such that the package qualification criteria, i.e., packaging standards for the air-crash-resistant package (test conditions, acceptance criteria, and operating conditions), are incorporated.

Pro: (1) By obtaining public comment on the qualification criteria the opportunity exists to refine the criteria to improve the protection of the public, to make the criteria more understandable, and to achieve a possibly less burdensome requirement, while still adequately protecting the public health and safety.

(2) Codifying the qualification criteria through rulemaking in accordance with the Administrative Procedure Act appears to be a preferred method.

(3) Providing an opportunity for comment on the packaging criteria could lead to changes that would better accommodate the need to ship safeguards samples in connection with U.S. policy to support effective international safeguards, by making it easier to design smaller packages that are no less air-crash resistant.

(4) Codifying the qualification criteria would clarify NRC policy.

(5) The precedent for licensing Type B packaging is that the qualification criteria are codified in the regulations.

Con: (1) Would require staff resources for rulemaking that now can be done on a case-by-case basis for the small number of cases anticipated.

(2) Would limit flexibility in applying the criteria until experience had been gained from their use.

3.6 Decision on Procedural Approach

The Commission should take no further action on the qualification criteria, except to reference in the preamble to the proposed rule that they are published NUREG-0360 and to request comments on them.

4. STATUTORY CONSIDERATIONS

4.1 NRC Authority

These amendments are proposed pursuant to the Atomic Energy Act of 1954, as amended (which gave the AEC the authority to regulate possession, use, and transfer, including transportation of certain radioactive material), the Energy Reorganization Act of 1974, as amended (which transferred this AEC authority to NRC), section 553 of title 5 of the United States Code, (Rulemaking Requirements of the Administrative Procedure Act) and Public Law 94-79 (the Scheuer Amendment requiring NRC to restrict air transport of plutonium).

4.2 Need for NEPA Statement

In compliance with the National Environmental Policy Act of 1969, the Commission has determined, under Council of Environmental Quality guidelines (40 CFR 1500) and the criteria in 10 CFR Part 51 - Licensing and Regulatory Policy and Procedures for Environmental Protection, that an environmental impact statement for these proposed amendments to 10 CFR Part 71 is not required, based on a finding that this action has no significant impact on the quality of the human environment. An environmental impact appraisal supporting the finding of no significant impact has been prepared.

5. RELATIONSHIP TO OTHER EXISTING OR PROPOSED REGULATIONS OR POLICIES

The proposed rule is inconsistent with both IAEA transport regulations and the current (and proposed) DOT regulations, since those regulations do not restrict air shipments of plutonium to an air-crash-resistant package and since those regulations allow shipment of plutonium by air in ordinary packaging. This inconsistency appears unavoidable, since the requirements of the Scheuer Amendment are basically at variance with the established body of transport regulations. The Congress has not imposed a similar requirement on DOT. A similar requirement has been imposed on DOE.

6. SUMMARY AND CONCLUSIONS

The Commission can most effectively and efficiently implement the Scheuer Amendment without undue risk to the public health and safety and with minimum expenditure of NRC and public resources by a rulemaking procedure which would forbid air shipment of plutonium except as: (1) contained in a medical device designed for individual human application, (2) contained in material with a specific activity not greater than 0.002 microcuries per gram, (3) shipped in

a package specifically authorized by the Commission for shipment of plutonium by air, or (4) shipped in accordance with §71.5 for single packages containing no more than an A_2 quantity of plutonium. The NRC staff would authorize packages for air shipment using those criteria published in NUREG-0360.

In addition, staff will undertake actions directed toward: (1) evaluating whether to encourage DOT to consider changes to existing DOT regulations that would reduce inconsistencies with the NRC regulations, as amended, and (2) considering whether there exist sufficient technical and policy bases for a staff recommendation to the Commission that NRC seek legislative relief for the air shipment of safeguards samples and other small quantities of plutonium, for which rapid transport is needed and is of identifiable benefit to the public interest.

REFERENCES

1. Environmental Impact Appraisals for Proposed Amendments to 10 CFR Part 71 To Restrict Air Transport of Plutonium, C. M. Mattsen and N. A. Eisenberg, July 1979.

2. NUREG-0360, Qualification Criteria to Certify a Package for Air Transport of Plutonium, Office of Nuclear Material Safety and Safeguards, U.S. Nuclear Regulatory Commission, January 1978.

3. NUREG/CR-0428, Review of Criteria for Packaging Plutonium for Transport by Air, National Academy of Sciences, 1978.

4. U.S. NRC Public Announcement No. 78-187, Letter from Stephen Lawroski, Chairman, ACRS, to Joseph M. Hendrie, Chairman, NRC.

5. Code of Federal Regulations, Title 10, Parts 0 to 199.

6. U.S. Nuclear Regulatory Commission, Office of Standards Development, "Final Environmental Impact Statement on the Transportation of Radioactive Material by Air and Other Modes," Volume 1, December 1977, NUREG-0170.

APPENDIX I

PRELIMINARY VALUE/IMPACT APPRAISAL FOR A RULE ON THE AIR TRANSPORT OF PLUTONIUM

January 1978

PRELIMINARY VALUE IMPACT APPRAISAL FOR A RULE ON THE AIR TRANSPORT OF PLUTONIUM

Introduction and Summary

A rule is needed to implement the Scheuer Amendment because NRC implementation of this Congressional edict has been accomplished, since August 15, 1975, solely by issuance of an order to licensees. The Scheuer Amendment to S.1716, enacted into law August 9, 1975 provides:

> "The Nuclear Regulatory Commission shall not license any shipments by air transport of plutonium in any form, whether exports, imports or domestic shipments; provided, however, that any plutonium in any form contained in a medical device designed for individual human application is not subject to this restriction. This restriction shall be in force until the Nuclear Regulatory Commission has certified to the Joint Committee on Atomic Energy of the Congress that a safe container has been developed and tested which will not rupture under crash and blast-testing equivalent to the crash and explosion of a high-flying aircraft."

Now that the NRC plutonium air transport package certification program is nearing completion, it is timely to issue a rule implementing the wishes of Congress.

The effective rule is planned for issuance in May 1978. This schedule is based on greatly attenuated estimates of time required for various reviews and concurrences, assuming action on this rule will be accelerated by all involved parties. The schedule presumes: (1) that the rule will be issued effective, without issuance of a proposed rule (i.e. the provisions of 10 CFR Part 2, Subpart H do not apply, because a Congressional edict is being implemented) and (2) that neither an environmental impact statement, nor a negative declaration is required (i.e. the provisions of 10 CFR Part 51, §51, §51.5(b)(6) or §51.5(c)(2) do not apply, for the same reason given above).

Alternatives to this task such as reliance solely on the order to licensees or codification of the certification criteria are not viable. No contractual effort is required for this task. An estimate of staff resources for this task is 4 man-months in SD and 12 man-months for NRC.

Schedule for Task Completion

The proposed schedule for task completion is shown on the enclosed management network diagram. This task, TP-714-1, is proposed to terminate with the issuance of the effective rule in May 1978.

Significant milestones for task completion are as follows:

Initial Draft of Rule Circulated for 1st Division Review ... 02/17/78
Revised Draft of Rule Circulated for 2nd Division Review ... 03/10/78
Effective Rule Circulated for Office Concurrence..... 03/31/78
Commission Review of Effective Rule and Office Concurrence Completion..... 05/12/78
Effective Rule Published in Federal Register..... 05/31/78

The staff rationale in proposing this schedule presumes many of the normal regulatory procedures can be short cut, because this action is congressionally mandated. Specifically the schedule presumes: (1) that the rule will be issued effective, without issuance of a proposed rule (i.e. the provisions of 10 CFR Part 2, Subpart H do not apply, because a Congressional edict is being implemented) and (2) that neither an environmental impact statement, nor a negative declaration is required (i.e. the provisions of 10 CFR Part 51, §51.5(b)(6) or §51.5(c)(2) do not apply, for the same reason given above). The proposed schedule also makes greatly reduced allowances for the time required for various reviews and concurrences, and assumes the man loading required for task completion is less than that required for even simple rules. This greatly accelerated schedule assumes top priority and rapid processing by all involved parties, including the Commission and Agreement States.

The Need for Task Completion

The Scheuer Amendment is a Congressional mandate to which NRC must respond; an order to licensees is only a temporary means of response. Further, issuance of a rule would dovetail with the certification program of NMSS.

Alternatives

Alternatives to issuance of this rule include:

1) Continued reliance on the order to licensees
2) Codification of the certification criteria
3) Banning of air shipment of plutonium
4) Issuance of a rule permitting exemptions consistent with DOT and IAEA regulations.

The order to licensees is an expedient temporary means of implementing this legislation, but issuance of a rule is clearly a more appropriate response. Codification of the certification criteria, in a manner similar to the statement of standards for type B packaging, is possible, but not advisable at this time because: (1) codification of the criteria would considerably lengthen the time required for issuance of the rule, (2) only slight domestic commerce in plutonium is expected, because of the Administration decision to reject the plutonium fuel cycle option, (however, administration nonproliferation policy may greatly increase import/export shipments), (3) other modes of transport are available so only a very few shipments will necessarily go by air (for example certain exports), (4) the criteria are not necessarily

definitively established (until after certification), and (5) a policy on whether to include the plutonium air transport package criteria in the regulations has not been established. Advantages of codifying the certification criteria include: (1) consistency with the manner in which other NRC packaging standards are stated and (2) formal utilization of the output from the certification program which, not only developed an air crash resistant package, but also determined a set of certification criteria which define air crash resistance. Banning shipment of plutonium by air could cause undue hardship to certain licensees and elements of the general public. Furthermore the considerable effort to certify a package meeting the Scheuer amendment criteria would be wasted, if air shipment were banned. PL 94-79, as drafted, allows an exemption from restrictions on shipments of plutonium by air only for plutonium contained in a medical device designed for indivdual human use. Futhermore correspondence between NRC and members of Congress indicates that an opportunity for some additional exemptions to be written into the law was provided, but refused by NRC. Finally parallel legislation restricting ERDA from shipping plutonium by air contains additional exemptions explicitly stated. Thus issuing a rule, permitting other than the medical device exemption and an exemption for de minimis quantities, appears impossible without seeking legislative relief. Issuance of a rule permitting no exemptions for small quantities of plutonium appears to be a burdensome regulation and not fully consistent with the intent of Congress. Ever since the atmospheric weapons tests, virtually all terrestrial materials are contaminated with small quantities of plutonium. Thus most soil, plants, animals, foods, and humans contain small quantities of plutonium; it would be clearly inappropriate to institute a blanket ban on transport of these materials. At somewhat higher levels, but still small levels of plutonium content, a ban on air shipment could compromise the public health and safety. For example, medical, biological, and environmental samples, that could contain small amounts of plutonium from routine or accidental releases, need to be transported by air, for example, to prevent decay of shortlived radionuclides, to prevent deterioration of biological samples, or to provide an early determination of the radionuclide content of the sample. Other shipments of plutonium by air could include devices used for the calibration of radiation detection equipment, which is required to protect the public health and safety. Furthermore the legislative history of the Scheuer Amendment would appear to indicate that no absolute standard of safety was intended and that the air transport prohibition apply only to "other than exempt quantities of plutonium." Mr. Scheuer expresses concern over "deaths of hundreds of thousands of people"; such a disaster would clearly be impossible from a small exempt shipment. Finally the crash resistant plutonium package allows the release of small quantities (A_2 per week) for the most severe crash environment; allowing small quantity exemptions from the requirement of shipment in the crash resistant package is consistent with this implementation of the Scheuer amendment. Implementation of the Scheuer amendment with an allowance for small quantity exemptions appears to be a responsible regulatory position; however, without a change in the

law that regulatory position cannot be taken. Thus the only viable alternative is to issue a rule following very closely the letter of PL 94-79.

Cost Effectiveness

An estimate of staff resources required for the effective rule is 4 man-months in SD and 12 man-months for all NRC. A lull in the demand for Task Leader involvement in TP 610-2 (Urban Transport Generic Environmental Impact Statement) is expected during the time period when the primary effort will be preparation of the 1st Draft Assessment by Sandia; that period is expected to end late in January or early in February. However, if unanticipated problems do arise in TP 610-2 and Task Leader involvement is required, this task (TP 714-1) may be delayed. No contractual resources are required. No direct support is required; however, the considerable research effort to develop a certifiable package for air transport of plutonium is closely related to this rule. Issuance of this rule could have a significant effect on the licensing process in that: (1) it requires that licensees transport plutonium by air in a certified package, without explicitly stating in the regulations what criteria a package must meet to be certified, (2) it may allow either a monopoly on the design of certifiable packages or lead to a multiplicity of certification criteria, (3) it establishes a precedent of implementing Congressionally mandated regulatory actions, without following normal regulatory procedures established by law. Impact on employment and labor interest is estimated to be minimal. Cost to licensees is estimated to be about $3000 additional for each certified package. The current packages used for plutonium transport cost in the region of $100 to $300 depending on quantity purchased, while the certifiable container (PAT) has been estimated to cost $3500 in production (cost has been about $8000 per package for the small quantities required for package development). During the air crash resistant package development program, emphasis was placed on (1) development of appropriate certification criteria and (2) rapid development of a crash resistant package; consequently the package design developed may not have been optimized for low cost, so that other, newer designs may be cheaper.

APPENDIX II

LEGAL MEMORANDUM PREPARED BY THE

OFFICE OF THE EXECUTIVE LEGAL DIRECTOR

November 10, 1980

LEGAL ANALYSIS: PROPOSED AMENDMENTS TO NRC REGULATIONS
REGARDING AIR TRANSPORT OF PLUTONIUM

Issues

1. Does the Scheuer Amendment permit air transportation of A_2 quantities[1/] or less of plutonium in containers meeting NRC or DOT packaging requirements, even though the containers may not be crash-proof?

2. Does the Scheuer Amendment permit air transportation of plutonium samples in larger than A_2 quantities to the IAEA in non-crash-proof containers?

Conclusions

1. A reasonable interpretation of the Scheuer Amendment would permit A_2 quantities or less of plutonium to be transported by air in containers meeting NRC or DOT packaging requirements, even though the containers may not be crash-proof.

2. A reasonable interpretation of the Scheuer Amendment would not permit air transportation of plutonium samples in larger than A_2 quantities to the IAEA in non-crash-proof containers.

The Scheuer Amendment

The so-called "Scheuer Amendment," part of Public Law 94-79 and appearing as a footnote to section 201 of the Energy Reorganization Act of 1974, provides that:

> The Nuclear Regulatory Commission shall not license any shipments by air transport of plutonium in any form, whether exports, imports or domestic shipments: Provided, however, that any plutonium in any form contained in a medical device designed for individual human application is not subject to this restriction. This restriction shall be in force until the Nuclear Regulatory Commission has certified to the Joint Committee on Atomic Energy of the Congress that a safe container has been developed and tested which will not rupture under crash and blast-testing equivalent to the crash and explosion of a high-flying aircraft.

1/ An A_2 quantity of plutonium is defined in Table VII of the International Atomic Energy Agency's "Regulations for the Safe Transport of Radioactive Materials, IAEA Safety Series No. 6 (1973 Revised Edition)." An A_2 quantity of any radioactive isotope is the quantity of that isotope in normal form permitted in a Type A package under IAEA regulations (and proposed DOT and NRC regulations). For Pu-238 or Pu-242, A_2 is 3 mCi; for Pu-239 and Pu-240, A_2 is 2 mCi; for Pu-241, A_2 is 100 mCi.

The Legislative History of the Scheuer Amendment

NRC's 1976 authorizing legislation was considered and passed by the Senate on June 17, 1975. This bill was then considered by the House of Representatives on June 20, 1975. It was during this debate in the House that Representative Scheuer's amendment was offered and agreed to by the House. (The floor debate in the House is attached as Enclosure "A". 121 Cong. Rec. H 5895-96 (daily ed. June 20, 1975)).

The Joint Committee on Atomic Energy of Congress requested the Commission's views on Representatives Scheuer's amendment. Acting Chairman Marcus Rowden transmitted these views in a June 24, 1975, letter to Mr. George Murphy, Executive Director of the Joint Committee. (Enclosure "B"). The letter to the Committee stated, in part:

> The NRC is opposed to this amendment for two basic reasons: ... (2) the amendment would require an absolute guarantee of safety which is undesirable from both a practical and social standpoint.
>
> * * * * *
>
> With respect to our second ground of objection to the amendment, we strongly question the certification criterion which this amendment would establish. As we read the amendment, it is tantamount to a requirement that the agency vouch for absolute container safety. Such an "absolute safety" criterion is not desirable from either a practical or social standpoint. The Congress itself has recognized that the peaceful development of atomic energy carries with it an element of risk. We note, for example, that section 57 c. (2) of the Atomic Energy Act prohibits licensing of special nuclear material if the licensing action would constitute an "unreasonable risk to the public health and safety."

In response to this letter and the Commission's June 25, 1975, testimony before the Joint Committee on his amendment, Representative Scheuer asked, and was given, permission to extend his remarks for publication in the Congressional Record. 121 Cong. Rec. H 7497-7501 (daily ed. July 25, 1975). (Enclosure "C".) Representative Scheuer's response to the Commission's interpretation of his amendment is summarized by the following excerpts from his extended remarks:

> The second Commission argument against my amendment is that it calls for absolute safety which the Commission feels is "undesirable from both a practical and social standpoint.". There is not a shred of evidence on the record or elsewhere that anyone in the House, least of all myself, wished to impose such a standard on the NRC. Indeed, the word absolute appears nowhere on the record. All my amendment requires is that the Nuclear Regulatory

> Commission test and develop a container which they can certify as being safe while using the one restriction in the amendment--that it will not rupture upon the crash of a high-flying aircraft.
>
> ... Indeed, legislative drafting counsel, representatives of the New York State Attorney General's Office, and a Congressional Research Service legislative attorney assure me that my amendment legislates flexibility and discretion on the part of the Joint Committee and the NRC. The testimony before the Joint Committee clearly illustrates that members of that body also interpret the amendment in this way.
>
> * * * * *
>
> ... No rational scrutiny of the record can show that absolute safety was the criterion legislated by the House;....

On July 31, 1975, the Senate reconsidered the bill as amended by the House and concurred in it.

Analysis

Issue 1

The text of the Scheuer Amendment is not clear and unambiguous. Nowhere in the statute is there any provision that after NRC has certified the "crash-proof" container to Congress, NRC licensees must use it for the air transport of plutonium. A reasonable interpretation of the Scheuer Amendment, in light of the considerations which led to the amendment's passage, would, however, impose such a restriction. Similarly, though the amendment does not specify any quantity or activity limits below which the air transport of plutonium would be permitted in containers that are not "crash-proof" but do meet NRC or DOT packaging requirements, reliance on packaging criteria developed by NRC under its health and safety authority or those developed by DOT under its health and safety authority (see 49 CFR Parts 170-179) would permit transportation in containers meeting NRC or DOT requirements. See, for example, 10 CFR § 71.5.

The Congress' position with respect to NRC's certification of the container is also ambiguous. It is fair to say, in light of Representative Scheuer's remarks, that his amendment does not require absolute safety for crash-proof containers used for air transport of plutonium. Thus, container acceptance standards for qualification criteria were developed under subsections 53b. and 57c.(2) of the Atomic Energy Act with respect to health and safety

risks, among other things.[2] These criteria, used in the development of the crash-proof container and certified by the Commission to Congress as meeting the requirements of the Scheuer Amendment, allowed for leakage of not more than an A_2 quantity of plutonium from the container "under crash and blast-testing equivalent to the crash and explosion of a high-flying aircraft." More specifically, the first of the three acceptance standards contained in the qualification criteria provides:

> Containment - The containment vessel must not be ruptured in its post-tested condition and the package must provide a sufficient degree of containment to restrict accumulated loss of plutonium contents to not more than an A_2 quantity in a period of one week.[3]

Although Congress was not obligated to approve or take any other affirmative action after NRC certified to it the existence of a crash-proof container for the air transport of plutonium, Congress could have refused (by further legislative act) to acquiesce in the certification if it believed that the qualification criteria (contained in NUREG-0360) were inadequate. The certification to Congress made on August 4, 1978, has been followed by subsequent Congressional inaction.

Using Congressional inaction as evidence for or against an interpretation of a statute does not provide a solid foundation for legal analysis. Nonetheless, it does provide support for a reasonable interpretation, and a number of decisions have held that the acquiesence of the legislature through inaction following a contemporaneous interpretation of the legislation and its practical application[4] is that the legislature intends to adopt such an

---

2/ Subsection 53b. provides that "the Commission shall establish, by rule, minimum criteria for the issuance of specific or general licenses for the distribution of special nuclear material depending upon the degree of importance to the common defense and security or to the health and safety of the public of (1) the physical characteristics of the special nuclear material to be distributed; (2) the quantities of special nuclear material to be distributed; and (3) the intended use of the special nuclear material to be distributed." Subsection 57c.(2) does not allow issuance of any license under section 53 which "would be inimical to the common defense and security or would constitute an unreasonable risk to the health and safety of the public."

3/ NUREG-0360, "Qualification Criteria To Certify a Package for Air Transport of Plutonium," at p.8.

4/ In this instance, the "contemporaneous interpretation" and "practical application" of the legislation is NRC's development of qualification criteria used for the design and construction of the crash-proof container certified by NRC to Congress as meeting the requirements of the Scheuer Amendment.

interpretation and application.[5] Therefore, consistent with the container acceptance standards in NRC's qualification criteria, a reasonable interpretation of the Scheuer Amendment would permit air transportation of A_2 quantities or less of plutonium in containers which are not crash-proof but which meet NRC's or DOT's packaging requirements pursuant to a health and safety assessment of the risks involved. Thus, the Commission would determine whether the potential maximum consequences that could result from transportation of an A_2 quantity or less of plutonium in a non-crash-proof container are equal to or less than the potential maximum consequences that would result from transportation of a fully loaded crash-proof container.

Issue 2

We are aware that some NRC licensees want to transport plutonium samples (safeguard samples) by air to the IAEA. The samples would be in gram quantities, possibly 100 grams or more. Such quantities, compared to A_2 quantities, would be extraordinarily large. A reasonable interpretation of the Scheuer Amendment and the health and safety assessments made under the Atomic Energy Act would not permit such quantities of plutonium to be transproted by air in a package other than a crash-proof container, because such quantities far exceed the container acceptance standards in the qualification criteria.

This interpretation is reinforced by the three exemptions for the air transport of plutonium contained in ERDA's 1976 authorizing legislation,[6] two of which are not contained in NRC's 1976 authorizing legislation.[7] The Senate

5/ Canada Packers, Ltd. v. Atchison, T. & S. F. Ry., 385 U.S. 182 (1966); United States v. Shreveport Grain & Elevator Co., 287 U.S. 77 (1932).

6/ Section 502 (1) through (3) of Public Law 94-187. The three exemptions include:

> "(1) Plutonium shipments in any form designed for medical application;
>
> (2) Plutonium shipments which pursuant to rules promulgated by the Administrator of the Energy Research and Development Administration are determined to be made for purposes of national security, public health and safety, or emergency maintenance operations; and
>
> (3) Shipments of small amounts of plutonium deemed by the Administrator of the Energy Research and Development Administration to require rapid shipment of air in order to preserve the chemical, physical, or isotopic properties of the transported item or material."

7/ Public Law 94-79. The one exemption similar to ERDA's (see exemption 1 in footnote 6) is: "plutonium in any form contained in a medical device designed for individual human application."

considered NRC's authorizing legislation, which included the Scheuer Amendment, and ERDA's authorizing legislation on the same day. It could be reasonably inferred that Congress intended the NRC legislation to be more restrictive.

Sections 501 and 502 of the ERDA authorizing legislation contained provisions similar to the Scheuer Amendment and designed to achieve the same purpose with respect to ERDA shipments of plutonium. These sections are significant in interpreting the Scheuer Amendment, since they address the same subject. In terms of legislative intent, it is usually assumed that whenever the legislature enacts a provision it has in mind previous or contemporaneous legislation (in this case, NRC's authorizing legislation) relating to the same subject matter.[8/] Thus, it is generally held that, in the absence of any express repeal or amendment contained in the new legislation, the new provision was enacted in accord with the legislative policy embodied in the prior legislation,[9/] and all the legislation should be construed together.[10/]

There can be no doubt that Congress was aware of the Scheuer Amendment when it approved ERDA's authorizing legislation. Section 501 and 502 were added to the bill during the Senate Floor debates on July 31, 1975,[11/] less than one week after the extended remarks were inserted into the Congressional Record by Representative Scheuer. The Senate amendment was cosponsored by Senators Jackson and Pastore, and the same arguments used by Representative Scheuer to support his amendment were advanced in support of the Senate amendment. During the debate, Senator Ribicoff (in support of the amendment) remarked:

> The House has already passed a similar amendment banning non-essential shipments of commercially owned plutonium by the Nuclear Regulatory Commission on any kind of aircraft, pending NRC's certification of a crash-proof container.[12/]

It is reasonable to assume from consideration of the ERDA legislation that Congress was well aware of both how to grant exemptions and the particular exemptions it had granted to ERDA, because it gave contemporaneously to ERDA more leeway than it gave NRC. Therefore, NRC's authority as modified by the Scheuer Amendment should be considered strictly limited, and it would be overreaching to go beyond the A_2 quantity provided for in the NRC's container acceptance standards in the qualification criteria.

8/ Allen v. Grand Central Aircraft Co., 347 U.S. 535 (1954).

9/ Id.

10/ Sanford v. Commissioner of Internal Revenue, 308 U.S. 39 (1939).

11/ 121 Cong. Rec. 25414-15 (daily ed. July 31, 1975).

12/ Id. at 26415.

In sum a reasonable interpretation of the Scheuer Amendment would permit A_2 quantities or less of plutonium to be transported by air in containers meeting NRC or DOT packaging requirements, even though the containers may not be crash-proof. However, a reasonable interpretation of the Scheuer Amendment would not permit air transportation of plutonium safeguard samples in larger than A_2 quantities to the IAEA in non-crash-proof containers.

APPENDIX III

Estimate of Consequences of the Dispersal in an Air Crash of the Plutonium in a Cardiac Pacemaker

Because of the rigid requirements placed on the sealed plutonium source used in pacemakers, it is extremely unlikely that these devices would rupture in the event of the crash and explosion of a high flying aircraft, itself an unlikely occurrence. The Final Environmental Statement* on plutonium powered cardiac pacemakers indicates that the plutonium fuel capsules must survive, without breaching, impact at 50m/sec on an essentially an yielding surface; furthermore that Final Environmental Statement concludes that loss of plutonium from an implanted pacemaker involved in a severe air crash is very unlikely. The following analysis is believed to be very conservative, because no credit is taken for the substantially stronger encapsulation of plutonium fuel cells used in pacemakers compared to the packaging proposed to be used for small quantities of plutonium, for which the analysis below was developed.

The consequences of the release in an air crash of the plutonium contained in a plutonium-powered cardiac pacemaker is estimated using the information developed in the Environmental Impact Appraisal. The release and dispersion assumptions stated on page 15 are used; i.e.,

Percent released	=	100%
Percent aerosolized	=	50%
Percent respirable	=	50%
Percent inhaled by human population	=	1%

*Final Generic Environmental Statement on the Routine Use of Plutonium-Powered Cardiac Pacemakers, U.S. Nuclear Regulatory Commission, July 1976, NUREG-0060.

The value obtained for latent cancer fatalities per curie inhaled for Pu-238 (the isotope commonly used in pacemakers), as stated in Table A-2 of the Environmental Impact Appraisal, is 1.2×10^4 LCF's/Ci inhaled. The consequences are calculated as follows:

Consequences = 4 Ci (typical Pu contents of a pacemaker) x 1.0 (fraction released) x 0.5 (fraction aerosolized) x 0.5 (fraction respirable) x 0.01 (fraction inhaled by humans) x 1.2×10^4 LFC's/Ci inhaled = 121 LFC's.

APPENDIX IV

Transportation of Radioactive Material by Passenger Aircraft

September 17, 1979

A Joint Committee on Atomic Energy Print

93d Congress
2d Session } JOINT COMMITTEE PRINT

TRANSPORTATION OF RADIOACTIVE MATERIAL BY PASSENGER AIRCRAFT

REPORT NO. 1

OF THE

SPECIAL PANEL TO STUDY TRANSPORTATION OF NUCLEAR MATERIALS

TO THE

JOINT COMMITTEE ON ATOMIC ENERGY
CONGRESS OF THE UNITED STATES

NINETY-THIRD CONGRESS

SECOND SESSION

SEPTEMBER 17, 1974

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MEMORANDUM OF THE CHAIRMAN AND VICE CHAIRMAN

On May 17,[1] we announced the selection of a special panel to study the transportation of nuclear materials from the standpoint of health and safety and the safeguarding of nuclear materials from the standpoint of loss and diversion. The first portion of this study which covers the transportation of radioactive material by passenger aircraft has been completed, submitted to the Joint Committee and is hereby published.

This effort was initiated to determine the adequacy of current regulatory provisions and practices to protect health and safety and to prevent diversion. The greatly increasing use of radioactive isotopes in medicine and industry makes such a review a matter of current importance. The increasing use of nuclear fuel for electric power generation will in a few years result in a significant increase in the flow of enriched uranium and plutonium in the commerce of our Nation which will require special efforts to assure protection against diversion and losses. Both the increasing use of such materials and the increased prevalence of terrorist activities which may become directed at the acquisition of enriched uranium and plutonium make it specially important that the proper safeguarding of such material be given attention.

The Joint Committee was most pleased to obtain the services of the following panel members:

Mr. John T. Conway (Chairman of the Panel) Executive Assistant to the Chairman of the Board of Consolidated Edison Company. Formerly Special Agent of the FBI and Executive Director of the Joint Committee on Atomic Energy. Mr. Conway is a lawyer and engineer.

Mr. Carmine S. Bellino, formerly Administrative Assistant to J. Edgar Hoover and in charge of the FBI's Accounting Unit. Mr. Bellino is a certified public accountant. He has performed a special survey of the safeguarding of nuclear materials for the AEC.

Dr. K. Z. Morgan, Professor, Nuclear Engineering Department, Georgia Institute of Technology, formerly Director of Oak Ridge National Laboratory, Health Physics Division (1943–72) and Cosmic Ray Physicist.

Mr. John G. Palfrey, Professor of Law at Columbia, formerly Dean, Columbia College, Atomic Energy Commissioner, Fellow Kennedy Institute of Politics at Harvard, and Chairman of the AEC's Advisory Committee on Nuclear Materials Safeguards.

Dr. Theodore B. Taylor, Chairman of International Research and Technology Corporation. Formerly consultant to International Atomic Energy Agency on international safeguards of

[1] Joint Committee on Atomic Energy Press Release No. 761, May 17, 1971.

nuclear materials, Deputy Director, Defense Atomic Support Agency, and staff member of the Los Alamos Scientific Laboratory.

Mr. William Wegner, Deputy Director of Naval Reactors Division of AEC with special responsibilities in regard to nuclear materials.

Reports on other areas of the study will be published as they are completed. The Joint Committee thanks the panel for its dedicated efforts to date and looks forward to the receipt of their findings and recommendations in the remaining areas of their study.

The publication of this report at this time does not signify the Joint Committee's endorsement of the panel's findings and recommendations. The Joint Committee has not had an opportunity to study the report nor explore the areas and findings. Although the committee plans to review the panel's report in detail and explore the various factors involved in Joint Committee hearings, it did not wish to delay making available the panel's findings. Accordingly, the report is being published in advance of such a review to assure that the panel's independent study be made available without delay to all interested Members of Congress, Government, industry, and the public.

MELVIN PRICE, *Chairman.*
JOHN O. PASTORE, *Vice Chairman.*

LETTER OF TRANSMITTAL

SEPTEMBER 17, 1974.

Representative MELVIN PRICE, *Chairman,*
Senator JOHN O. PASTORE, *Vice Chairman,*
Joint Committee on Atomic Energy,
U.S. Congress, Washington, D.C.

DEAR MR. CHAIRMAN and MR. VICE CHAIRMAN: Transmitted herewith is Report Number One from the Special Panel to Study the Transportation of Nuclear Materials pertaining to *Transportation of Radioactive Material By Passenger Aircraft.*

In your letter of May 30, 1974 to me, you advised that the Joint Committee was particularly anxious to know if any changes are needed at the present time and that you wished the panel to concentrate its efforts on determining what, if anything, is now being done incorrectly. You pointed out, that to be of greatest value, the results of our deliberations should be made available at an early date so that legislative action, if necessary, could be taken this congressional session.

As the panel delved into the current regulations and practices pertaining to the transportation of radioactive materials, it recognized that many problems are particular to the specific mode of transportation used and type of material being shipped. The use of passenger aircraft for transporting radioactive material appeared to be of particular importance at this time since it had become the subject of great concern to many, including aircarrier personnel, and strong efforts were being made by some concerned individuals to totally ban such shipments. As discussed with the committee, it was agreed that the panel should initially concentrate its efforts in reviewing the use of passenger aircraft for transporting radioactive material.

The enclosed report, while it does touch upon some other areas of concern, primarily pertains to the transportation of radioactive material by passenger aircraft. Further reports by the panel will discuss other areas of transporting radioactive material and will be submitted to you as completed.

Respectfully yours,

JOHN T. CONWAY,
Chairman, Special Panel to Study the Transportation of Nuclear Materials.

CONTENTS

I. INTRODUCTION*

In 1973, an estimated 800,000 shipments of radioactive material were made in the United States, of which two-thirds—600,000—were made on passenger aircraft. Total shipments of radioactive materials are projected to reach 1 million for the year 1974 and to continue to increase significantly each year for the foreseeable future with passenger aircraft the predominant carrier.

Although some of the radioactive material in transit is related to industrial or research uses, the majority—more than 95 percent—of these shipped by air, are used in the medical profession. These medical isotopes mostly have short half-lives and to be effective must be transported relatively fast from pharmaceutical suppliers to hospitals and other locations for use by medical doctors. Because of their short half-lives, they must be regularly replenished, usually on a weekly basis.

The increasing use of radioisotopes—particularly by the medical profession—and the corresponding increase in the use of passenger aircraft for their transportation has caused some concern for the health and safety of the passengers and crew of the carrier aircraft as well as for the airline personnel who handle the cargo in transit. A number of known incidents—although very few in relation to total shipments—have occurred in which the transported radioactive material has breeched its container or has been improperly shielded by the shipper. These occurrences, some of which were not discovered until after receipt by the consignee, justifiably raise questions as to the adequacy of existing Government standards and enforcement of regulations for packaging and monitoring radioactive material in transit.

But beyond the concern over the potential hazard to the public and airline personnel from accidental release of radioactive material, infrequent as it may be, there is concern as to the radiation effects of this increasing amount of radioactive material being carried on passenger aircraft under normal conditions, i.e., where existing regulations have not been violated. This raises the question whether or not standards set by the Department of Transportation (DOT) and the Atomic Energy Commission (AEC) to regulate radioactive material in transit are sufficiently conservative in light of the growing number of such shipments and the increasing probability passengers and airline personnel will be exposed to low levels of radiation from these shipments. In other words, assuming full compliance with present regulations—which in actual practice the panel found one could not assume—are present regulations adequate to protect the public and transportation workers from radiation external to the package?

In assessing the problems associated with transporting radioactive material by passenger aircraft, the panel thought it best to obtain first hand information from persons and organizations engaged in the process and to witness the various separate activities that make up the entire process. Accordingly, the panel visited four different manufac-

*For a brief glossary of nuclear terms see Appendix A.

turing facilities where radiopharmaceutical products are manufactured and observed the methods by which these radioactive materials were packaged for shipment, including the monitoring to assure the packages meet Federal standards.

We visited cargo handling areas at the airport to talk with cargo handling personnel and observe the packages being loaded aboard planes. We talked with representatives from the Department of Transportation, including the Federal Aviation Authority and the Office of Hazardous Material and with representatives of the AEC from both the Regulatory and General Managers area. Also, we met with representatives of the Airline Pilots Association, and others who have been critical of the present situation as well as representatives from industry and the medical profession who use radioisotopes and who would be seriously hampered if the transportation of these products were severely curtailed.[1] In addition, we met with representatives of the Environmental Protection Agency (EPA) who are concerned with the general problems of population exposure to ionizing radiation.

One person, a biophysicist, was of the opinion that the shipment of all radioactive material, including medical radioisotopes, should be prohibited from airline passenger vehicles, unless the medical profession demonstrated proof to his satisfaction that radioisotopes were as essential as their increasing utilization would suggest. Another person interviewed, a biologist, suggested that the solution to the problem should be left to the public; that no technical or scientific body of experts has the right to determine what levels of manmade radiation is acceptable to the public. All others with whom we conferred, recognized the necessity to use scheduled passenger aircraft, at least for some short-lived radioisotopes, otherwise we would deprive some areas of the country of an effective diagnostic and therapeutic medical tool and the need to adopt enforceable rules and regulations. As might be expected, there were divergent viewpoints as to what, if any additional restrictions or limitations should be placed on the types and amounts of radioactive material permitted on passenger aircraft. In a few instances, knowledgeable persons were of the opinion no changes were necessary to present AEC and DOT regulations.

By and large, the consensus was that a more conservative approach should be adopted for the future and that greater restrictions than heretofore mandated by DOT and AEC were needed. These changes are considered necessary due to the increasing number of shipments and the mounting evidence that population exposure should be kept as low as practicable because of the increasing risks of genetic and somatic damage that relate to the accumulated exposure.

It should be noted that while the panel was in the process of considering this matter, and formalizing its recommendations, the AEC on July 30, 1974, formally submitted to the FAA recommendations for revising present regulations governing the transportation of radioactive material in passenger aircraft which are more restrictive than existing regulations. The panel has reviewed and considered those recommendations in arriving at the recommendations contained in this report.

[1] See Appendix A for a list of persons and organizations with whom the panel members conferred.

Although radioactive material is only one of numerous types of material that by DOT regulations are classified as hazardous, the shipments of which are specifically prescribed, the panel limited its review only to radioactive material and thus did not consider it within its purview to make recommendations concerning the other hazardous material.

However, since many of the individuals conferred with are familiar with the transportation of all types of hazardous material such as flammables, unstable chemicals, acids, and explosives, the panel did obtain some perspective as to the relative dangers between radioactive material and various other types of hazardous materials.

Without doubt, the potential danger to passengers and airline personnel from many other hazardous materials being carried on passenger aircraft today is far greater than from radioactive material shipments, and this should be borne in mind when reading this report and considering the recommendations contained herein.

Notwithstanding the apparent need for improvement in the regulation and control of other hazardous material—possibly a greater need than for radioactive material—the panel believes that the established national policy of exposing individuals to manmade radiation to a level as "low as practicable" should be adopted for each phase of the nuclear industry including the transportation field. The panel's recommendations as set forth in this report have been made in consonance with that policy which the panel believes to be the proper policy in that it is in the best interest of all concerned—the users and direct beneficiaries of nuclear material as well as the public at large.

II. DEVELOPMENT OF PRESENT REGULATIONS

The transportation of radioactive material by common carrier, including passenger aircraft, is regulated by DOT. Detailed regulations are issued by DOT as to packaging, labeling, and loading as well as to the maximum permissible level of radiation emitted external to the package. These regulations have been developed for the most part in cooperation with, and after review by, the AEC.

Present regulations limit the maximum external radiation levels of a package in routine commerce to 200 millirem per hour at the surface of the package and 10 millirem per hour 3 feet from the surface of packages. The level of radiation in millirem per hour at 3 feet from the surface of the package is called the package transport index (TI) and by current regulation may not exceed 10. By regulation a common carrier such as aircraft, truck, or rail car is not permitted to carry any single package with a TI greater than 10 nor any number of packages whose total TI will exceed 50. Minimum distances are supposed to be maintained between packages and airline passenger compartments to minimize radiation exposure to personnel and passengers.

The present DOT regulations governing the shipment of radioactive materials by aircraft originated in shipping regulations adopted on August 24, 1947, by the Interstate Commerce Commission based upon the technical specifications formulated by a seven-man National Research Council Committee of experts. At the time, the only official exposure limits to personnel were the March 17, 1934 occupational

levels of 100 millirem per day or 500 millirem per week which had been recommended by the Advisory Committee on X-Ray and Radium, the predecessor to the National Council on Radiation Protection and Measurement (NCRP). Since then, the NCRP, the International Commission on Radiological Protection (ICRP), the AEC, and the Federal Radiation Council (FRC) have lowered these levels by a factor of 5 for occupational workers, and by a factor of 50 for individual members of the public.

At the time the regulations were first being formulated in 1947, passenger airline transportation was not as common as it is today and the principal concern was not radiation exposure to passengers and crew but prevention of exposure to undeveloped photographic film to more than 14 millirem per hour at a distance of 30 feet in aircraft such as the DC-3 or Lockheed Lodestar.

Since the National Research Council first made its recommendations using the 1934 Advisory Committee on X-ray and Radium guide, the FRC and the AEC in addition to setting more conservative exposure levels for occupational workers and the public, have adopted the "as low as practicable" principle to conform with the basic concept that even the slightest amount of radiation exposure can be expected to do damage and hence a human being should not be exposed to any unnecessary radiation. The recent Report of the Advisory Committee on the Biological Effects of Ionizing Radiations (BEIR) of the National Research Council and the National Academy of Sciences also subscribes to and strongly supports the concept of keeping exposures as low as practicable. Although the AEC has proposed a guide of 5 millirem per year as being as low as practicable for limiting radiation to the general public for effluents from present civilian nuclear power plants, no such guide has been formulated for common carrier shipments of radioactive material.

III. BASIS OF PANEL'S RECOMMENDATION

It was obvious to the panel that with increasing numbers of radioactive material shipments, 200 millirem per hour at the package surface is too high and should be set at a lower limit to protect the cargo handlers who load and unload the shipments. Similarly the panel concluded that 10 TI—10 millirem per hour at 3 feet—is not as low as practicable and should be lowered for the better protection of passengers and crew. It was equally obvious that what may be as low as practicable for civilian nuclear power plants—the 5 millirem per year—is not practicable for shipping radioactive material and the same guide limit may not be appropriate in the transportation industry.

In attempting to formulate its recommendation, the panel was guided primarily by two key general principles contained in the November 1972 report of the Advisory Committee on the Biological Effects of Ionizing Radiations (BEIR report):

(*a*) No exposure to ionizing radiation should be permitted without expectation of a commensurate benefit.

(*b*) The public must be protected from radiation but not to the extent that the degree of protection provided results in the substitution of a worse hazard for the radiation avoided. Additionally, there should not be attempted the reduction of small risks even further at the cost of large sums of money that spent otherwise, would clearly produce greater benefit.

It was noted that in recent public hearings before a subcommittee of the Senate Commerce Committee, recommendations were made to ban the shipment of all radioactive material by passenger aircraft including short-lived radiopharmaceuticals.

One witness at those hearings, a biophysicist, voiced the belief that 75 percent of all medical isotope used was unnecessary. In contrast however, medical doctors, hospital physicists and other representatives of nuclear medicine, point to the growing use of radioisotopes in the early diagnosis of serious diseases with resulting savings of lives. According to the Society of Nuclear Medicine, approximately one patient out of every three admitted to hospitals today is directly benefitting from the use of medical isotopes, particularly the short-lived technetium-99m which has a half-life of 6 hours and which is a decay product of molybdenum-99. The latter has a half-life of 2.8 days. Hospitals that are not in the immediate area of a radiopharmaceutical supplier must generate their own technetium-99m from molybdenum-99 generators.

According to the AEC, a majority of all radioactive material transported by passenger aircraft is the radiopharmaceutical molybdenum-99 and the only practical way today of transporting this radioisotope to many areas of the country is by scheduled passenger aircraft. A somewhat similar situation pertains to such radionuclides as I-123 (13.2 hr.) and I-131 (8 days), components of nuclear medicines used for both therapeutic and diagnostic purposes.

To ban the shipment of all radioactive material by passenger aircraft would in effect deprive significant geographic areas of the United States of the use of these important nuclear medicines. In some cases it would force the medical profession to substitute longer-lived isotopes, as for example Iodine 131 for Iodine 123 resulting in significantly higher radiation exposures to the patient. Obviously there are significant benefits being derived from shipping short-lived isotopes by passenger aircraft particularly for those one-in-three hospital patients being serviced. The question is to what extent are these benefits commensurate with the undesirable effects of airline personnel and passengers being exposed to additional radiation from these shipments?

It should be noted that levels of radiation external to the individual packages of radioactive material in transit can be lowered as additional shielding is placed between the radiation source and the passenger and airline employees. Additional shielding could be used to lower and even eliminate, for all practical purposes, any measurable radiation external to the radioactive material package. However, the added shielding increases the weight and causes logistic problems associated with moving heavy packages and results in cost increases for the product which in the final analysis, in the case of nuclear medicines, will be borne by the patient. It becomes a matter of judgment then, at what point these added costs associated with the additional shielding are excessive and not commensurate with the benefits to be derived. As the BEIR report points out ". . . there should not be attempted

the reduction of small risks even further at the cost of large sums of money that spent otherwise would clearly produce greater benefit."

The main increase in cost, however would occur from the need for the pharmaceutical supplier to make major changes in its production line to accommodate the heavier and larger shipping casks. That need along with the necessity to design and manufacture the new casks would entail increased costs and leadtime. The panel learned from its visits and discussions with the nuclear pharmaceutical industry, that because the industry is rapidly developing and quick changing, production equipment is being depreciated in short periods of 2 to 5 years. Even without new more stringent regulations, technical improvements and competition is causing the suppliers to limit the useful life of much of their production equipment to less than 5 years.

A recent study by Dr. Gordon Brownell, Professor, Department of Nuclear Engineering, MIT, calculates the varying dollar cost increases associated with lowering the permissible radiation emanating from packages of radioactive material by means of adding increasing amounts of shielding.[2] The Brownell report concluded that one could, by adding lead shielding, lower the TI (Millirems per hour at 3 feet) from the present maximum of 10 down to 1 but in the case of the large 500 millicurie molybdenum-99 generators[3] this would nearly double the cost of shipping. However, shipping costs represent a very small portion of the total cost of this product to the patients—approximately 100 patients or more are treated from one 500 millicurie generator. A doubling of the shipping cost would represent approximately 25 cents to 50 cents per patient whose bill is usually about $100 per treatment.

IV. DISCUSSION OF FINDINGS AND RECOMMENDATIONS

A. Permissible Radiation Level to Airline Passengers and Crew Due to Shipment of Radioactive Material in Cargo Spaces

Observation:

The present standards permit passengers of U.S. commercial aircraft to receive a maximum radiation dose rate of 10 millirem per hour at the passenger compartment floor level. This standard was arrived at over twenty years ago on the basis that it would be unlikely for any one individual of the overall U.S. population to make more than one or two flights per year. On this basis the 10 millirem per hour was established more on its possible effect on photographic film which might be on the aircraft than its possible effect on people.

The panel considers that the 10 millirem per hour allowable rate is too high and should be reduced. In establishing the new rate it must be assumed that a large and increasing segment of the population will be using commercial aircraft for public transportation and that a substantial number of them will be making numerous flights per year.

[2] Impact on the Cost of Shipping Radiopharmaceuticals of varying the Package External Radiation Levels—A report to the U.S. Atomic Energy Commission by Gordon L. Brownell, Ph. D., Professor, Dept. of Nuclear Engineering, MIT, and Director, Physics Research Laboratory, Massachusetts General Hospital, with the Assistance of John A. Correlia, Ph. D., Research Fellow, Physics Research Laboratory, Massachusetts General Hospital—July 8, 1974.

[3] The 500 millicurie generator today is the largest sized unit being produced and shipped by radiopharmaceutical producers.

Consideration must also be given to airline stewards and stewardesses who are and will continue spending many hours per year in the passenger compartment of commercial aircraft. Tests have shown that pilots and crew members normally stationed in the flight control forward area are much less affected by radioactive material stowed in the baggage compartments and thus would be amply covered by any acceptable dose rate established for the passenger compartment.

The panel considered at length the determination of the proper radiation dose rate for passengers and flight crews. On one hand the panel agreed that 10 millirem per hour was too high a level to be acceptable. However, on the other hand, it was recognized that establishing a level of 0.1 millirem per hour would effectively preclude the shipment of radioactive material by passenger aircraft. The panel considers, for reasons discussed elsewhere in this report, that there is an overall benefit and requirement that radioactive material particularly for medical purposes be permitted to be shipped by passenger aircraft and that there is no reasonable alternative method of shipping.

Recommendation:

With regard to the permissible level of radiation the question of what is "as low as practicable" was reviewed taking into account the considerations previously discussed. Based on this review the panel considers that the applicable regulations should be revised to limit the radiation exposure to aircraft passengers and crew to 1 millirem per hour at the floor level. This limit was selected on the following basis:

1. It is in conformance with the concept of "as low as practicable." If it is assumed that the maximum amount of time a passenger or crew member is subject to such radiation would be for 20 hours per week for 50 weeks a year, then that person would receive one rem per year on the lower extremities. If translated to the more critical vital organs of the body this dosage would be in the order of 300 millirem per year—a figure generally accepted as being below that which might cause a detectable effect on the human body. It is also recognized that not all passenger aircraft flights carry radioactive material and even in those that do, very few of the passenger seats are directly above the area where radioactive material is stowed.

2. One millirem per hour is in conformance with the current Code of Federal Regulations (Title 10, Part 20, Atomic Energy) (10CFR20) which defines permissible levels of radiation in unrestricted areas as:

   (*a*) Radiation levels which, if an individual were continuously present in the area, could result in his receiving a dose in excess of two millirems in any one hour, or

   (*b*) Radiation levels which, if an individual were continuously present in the area, a dose in excess of 100 millirems in any seven consecutive days.

This regulation further defines a "Radiation Area" as any area, accessible to personnel, in which there exists radiation, originating in whole or in part within licensed material, at such levels that a major portion of the body could receive in any one hour a dose in excess of 5 millirems, or in any 5 consecutive days a dose in excess of 100 millirems.

3. It is considered feasible and reasonable to apply this more restrictive level insofar as the shipment of radioactive isotopes are concerned. The panel investigated the effect of reducing the Transport Index necessary to achieve this level and even though increased shielding would be required which in turn causes a weight increase and ultimately results in higher shipping costs, it is concluded that it can be done with a relatively small increase in cost to the ultimate consumer.

B. Recommended Modification in Regulations for the Shipment of Radioactive Material by Passenger-Carrying Aircraft To Reduce Exposures to Members of the Public and to Occupational Workers

Observation:

As previously indicated, the levels of radiation exposure permitted by present regulations for the shipment of radioactive materials by passenger carrying aircraft are based on very early radiation protection standards that have long since been outdated. They are insufficiently conservative in terms of present radiation protection standards. Furthermore, a vast amount of research data has accumulated over the past three decades which strongly suggests that, contrary to early concepts, there is no safe threshold radiation dose below which there is no consequential radiation damage; that the risk of radiation damage such as cancer induction or genetic malformations increases more or less linearly with the accumulated population dose. Today there are far more members of the public exposed to radiation from the shipment of radioactive material than when the present shipping regulations were established. This has come about because there has been an increase by orders of magnitude both in the number of packages of radioactive material shipped by passenger aircraft and in the number of persons traveling by passenger aircraft.

The present practices in the shipment of radioactive materials by passenger carrying aircraft permit passengers to receive a maximum exposure of about 10 millirem per hour. This is accomplished primarily by limiting the transport index of any package to no more than 10 (TI=10), by an upper limit of transport indices on any one passenger aircraft of no more than 50 (total TI=50) and by requiring that there be spacing of the packages in the baggage compartment in accordance with minimum separation distances listed in a table published in the shipping regulations. As would be expected, however, this method of control has been less than satisfactory because in the rush of loading packages on aircraft, too often little attention is given to the spacing and separation distances of packages of radioactive materials in the cargo holds. The panel believes that there is need both to reduce this dose rate of 10 millirem per hour to an airline passenger or member of the crew and to simplify the required loading procedure by which this can be accomplished (i.e., eliminate the use of the table for spacing of the packages).

The present regulations tend to limit occupational exposure to airline employees who load and unload the packages of radioactive materials on aircraft by setting an upper limit of 200 millirem per hour at the surface of the package. The panel believes there is need to reduce occupational exposure received by the cargo handling personnel who load and unload these radionuclides. This can be accomplished by reducing the maximum permitted surface dose on a package of radioactive material. The exposure rate for stewards and stewardesses, on the average, is about the same as that received by some of the passengers. The pilots and the other flight crew in the pilot's quarters are sufficiently distant from the baggage compartments so that the cargo contributes essentially no radiation to these personnel.

Recommendations:

1. In order to reduce the maximum rate of radiation exposure received by passengers and crew of passenger carrying aircraft to approximately 1 millirem per hour the panel recommends the following:

   a. The transport index (TI) limit of a package be reduced from 10 to 1.

   b. The transport indices permitted on a passenger carrying aircraft be reduced from 50. The panel considers a limit of approximately 10 be set, however it recommends that the DOT and AEC determine such level in order to meet the 1 millirem per hour limit to passengers.

   c. The radioactive packages of Category III * should be placed on the floor of a baggage compartment of the aircraft (i.e., they should not be stacked).

2. In order to reduce the occupational radiation exposure received by airline employees who handle the packages of radioactive materials the panel recommends that the present maximum dose rate limits of 200 millirem per hour at the surface of packages of Category III be reduced by 25% to 50%. The panel believes a maximum level between a limit 50 and 100 millirem per hour should be established, and recommends that the DOT and AEC determine the lowest practicable limit within those limits.

TABLE I.—RADIOACTIVE MATERIAL CATEGORIES—DOSE RATE LIMITS

[In MR/hr]

Category	Label	At any point on accessible surface of package	At 3 ft from external surface of package (transport index)
I	Radioactive—White I [1]	0.5	0
II	Radioactive—Yellow II	10.0	0.5
III	Radioactive—Yellow III [1]	200.0	10.0

[1] Requires vehicle placarding. (This label mandatory for any fissile class III (173.389A) or large quantity package (173.389B), regardless of dose rate levels.)

C. Reducing the Risks of Radiation Exposure and of Environmental Contamination

Observations:

Under present DOT and AEC regulations radioactive material may be transported by common carrier, including passenger aircraft, if the shipments conform to specific limitations as to type, and quantity of material, and to specifically designed packages.

*See Table 1.

The types of packaging are specified in the DOT and AEC regulations according to the types and quantities of radioactive materials being shipped and the degree of containment the packaging is designed to provide under normal and accident conditions in transport.

Radioactive materials are divided into two broad classes: (1) "Special form" which is a massive, solid material, or material confined in a high integrity capsule of inert material, and (2) "Normal form" which applies to all radioactive materials which are not "special form." Normal form radioactive materials are classified into seven groups of radionuclides based primarily on radiotoxicity of the radionuclides. Package limits for the seven transport groups and "special form" are shown in Table 2.

Small quantities of radioactive materials, certain concentrations, small quantities of radioactive materials in manufactured goods, and low specific activity materials are exempt from specification packaging, marking and labeling.

TABLE 2.—TRANSPORTATION OF RADIOACTIVE MATERIALS—QUANTITY LIMITS AS RELATED TO PACKAGE REQUIREMENTS

Transport group: Examples	Exempt quantity (curies)	Type A package (curies)	Type B[1] package (curies)
I: Pu^{239}, Cf^{253}	10^{-9}	10^{-3}	20
II: Sr^{90}, Po^{210}	10^{-4}	5×10^{-3}	20
III: Cs^{137}, Ir^{192}	10^{-3}	3	200
IV: Cm, Ca^{45}	10^{-3}	20	200
V: Noble gases	10^{-6}	20	5,000
VI: Noble gases, uncompressed	10^{-6}	1,000	50,000
VII: Tritium—as a gas or in luminous paint	25	1,000	50,000
Spec. form: Co^{60} for radiography, Pu-Be	10^{-3}	20	5,000

[1] A large quantity is defined as any quantity in excess of a type B quantity.

Type A quantities of radioactive materials must be shipped in packages, identified as Type A packaging, designed to prevent loss or dispersal of the radioactive contents and retain shielding efficiency and effectiveness of other safety features under normal conditions of transport.

Quantities exceeding Type A quantities must be shipped in Type B packaging. Type B packaging must be designed to withstand normal transport conditions without loss of contents or shielding efficiency and to suffer no more than a specified loss of contents or shielding efficiency if subjected to a specified sequence of accident damage test conditions. Large quantities, exceeding Type B quantities, are not permitted to be shipped aboard passenger aircraft.

The panel notes that the risks of radiation exposure and its effects and of environmental contamination to passengers and crew increase (1) with the quantities (curies) of radionuclides shipped on passenger carrying aircraft as specified in the shipping regulations for the various Transport Groups and (2) as the radioactive half life of the radionuclide increases from a few days or weeks to months or years.

Recommendation:

Because of the desirability of reducing all radiation exposure to the lowest practicable level and in consideration of the expanding number of air shipments of radioactive packages, the panel recommends that the shipping regulations be modified so that (1) the quantities (curies) of radionuclides of Transport Groups I through IV and including Special Forms be reduced by a factor of at least ten below the present limits for Type A Packages and Type B Packages, and (2) the shipment of quantities in excess of Exempt Quantities by passenger carrying aircraft be prohibited if the radioactive half life of the radionuclide is between 30 days and 10^8 years.

The exclusion of shipments of large quantities of radioactive materials and especially those of longer half lives from shipment by passenger carrying aircraft would greatly reduce the risk of exposure to the more dangerous radionuclides such as Sr^{90}, Cs^{137}, Ra^{226}, Pu^{239} and Pu^{240}, Am^{241} and Am^{243}, etc. Also, it would prohibit the shipment of neutron sources such as Ra–Be, Pu–Be, Cf^{249}, Cf^{248}, Cf^{252}, or Cf^{254}, where radiation risks are greater than those from gamma emitting radionuclides and the problems of shielding and radiation monitoring can be somewhat difficult.

In the case of leakage of the radionuclide from the shipping container, the risk of seriously contaminating the aircraft and baggage and of releasing significant quantities of airborne radioactive dust or fumes into the passenger section of the aircraft with consequential internal exposure of the passengers and crew would be reduced by an order of magnitude by recommendation (1) above and by many orders of magnitude by recommendation (2). (The upper limit of half-life of 10^8 years is specified in order not to needlessly restrict the shipment of natural thorium and of natural uranium and, of course, of stable isotopes whose half lives approach infinity.)

D. Monitoring Radioactive Shipments

Observation:

Under current AEC and DOT regulations, there is no requirement for radioactive material to be monitored by instrumentation to assure the package is complying with radiation standards, from the time the package leaves the facility in which the radioisotope was produced and packaged until it arrives in the hands of the addressee, the licensed user. In the interim period, it may have moved on a number of trucks and airplanes and have been loaded and unloaded by cargo handlers numerous times. It undoubtedly would have been stored for varying periods of time in interim cargo storage facilities as it passed from one location to another. If, the radioactive material has not been properly packaged, or if, for any reason, it began to leak, there would be no way of knowing this without some visible sign of the material coming from the package. Although the design of most packages used to transport radioactive material goes through a review process by AEC and DOT, and sufficient absorbent to prevent leakage is required, there have been occasions when material did leak, the source was not properly shielded or was transported in a position outside the shield, with resultant violations of radiation protection standards.

Concern for this problem, recently caused one airline—Delta—and one local agency—Minneapolis-St. Paul Metropolitan Airports Commission—each to establish its own personal monitoring system for radioactive material in transit. Delta Airline, as a result of two serious violations in the last three years in which material was not properly

packaged and as a consequence of a continuing series of minor incidents, is training cargo handlers to use radiation monitoring equipment to verify that all packages identified as carrying radioactive material meet Federal regulations at the time of acceptance by the airline. This involves an extensive training program to qualify Delta personnel in the use and care of the sensitive instruments needed to accomplish this task. It raises a question as to the cost and duplication of effort if all other airlines subsequently follow or are made to follow the same practice. The more serious question is whether or not adequate training can be provided and maintained for all the radiation monitors that will be required if all airlines adopt this monitoring procedure now being implemented by Delta.

On April 25, 1974, the FAA published for comment in the Federal Register new regulations, which would among other things, require airline companies to survey, by instrumentation, all radioactive material at the time it is received from the shipper to assure the radioactive measurements are not greater than what the shipper's documents claim and are within the DOT standards. The new regulations would also require the airlines to survey passenger and cargo space using radioactive detection instruments to assure compliance with Federal radiation standards. The panel has reviewed and taken into account this proposed new regulation in the recommendations contained in this report.

Recently, the Minneapolis-St. Paul Metropolitan Airports Commission (MAC), a local agency, assumed the responsibility for the monitoring of the radioactive material coming through airports within its jurisdiction, whether incoming or outgoing. In practice, the MAC is requiring the carrier to do the actual monitoring. One central monitoring station presumably could service all airlines within the Minneapolis-St. Paul International Airport. This would seem preferable to having each airline maintaining redundant capability at each airport. However, having local agencies assume the responsibility would not appear to be the most desirable approach unless it is done in conformity with national or international rules and regulations.

While the panel considers the action taken by Delta and MAC to be proper and timely, the panel has concern that if each local government or airline were to set up a monitoring system, the multiplicity of rules and regulations and standards, which might eventually develop in different sections of the United States, would cause confusion and unnecessarily hinder the interstate transportation of radioactive material. What is needed is an effective and standardized Federal program of enforceable regulations.

Recommendations:

To prevent the multiplicity of State and local regulations and the potential for varying standards as well as possible conflicting regulations, the Federal Government should assume the overall responsibility for establishing and enforcing the regulations incident to the transport of radioactive material on a preemptive basis. No local, State, or independent agency should be permitted to establish regulations which are not in conformance with these Federal regulations. A Federal agency (some branch of the DOT such as FAA, for example, or the

AEC) should be given the specific responsibility to monitor radioactive packages and certify them prior to being delivered to the carrier.

This function by the Federal Government would be similar to that function performed by the Food and Drug Administration in certifying Federal standards on meat and other food products requiring a Federal inspection. The panel recognizes that implementation of this recommendation will entail careful study and could require the addition of a large number of Federal employees. However, the panel also recognizes that there are a limited number of facilities that produce and ship radioactive isotopes. There is also a rather limited number of airports that receive these packages of radioactive material for shipment.

Initially, this program of Federal monitoring can be implemented by identifying the major airports through which the majority of radioactive material pass from the shipper to the air carrier. Based upon experience obtained and the continued growth of radioactive material shipments the Federal monitoring service could be expanded and eventually encompass ground transportation as well to the extent that no package carrying radioactive material other than exempted quantities, will be transported by common carrier without a Federal certification that it has been inspected and meets applicable standards for the health and safety of the public.

In addition to inspecting and certifying the individual packages, the Federal monitors should, by spot inspections, verify that the packages are being loaded aboard individual aircraft in accordance with prescribed rules and regulations to assure minimum radiation exposure to passengers and crew. All airport cargo ground storage space should have installed some gross (high level) instrumentation that would alert cargo handling personnel if radioactive material not properly identified is in the area.

As the standards for transporting radioactive material become more restrictive, it is important that some means be developed to detect attempts to circumvent the regulations by disguising the package or not properly identifying them as containing radioactive material. Surveillance of cargo storage and cargo loading areas with detecting instruments should also be the responsibility of the Federal monitoring agent, at the airport. The administration and operating cost of the monitoring service could be paid for by the individual shippers and the transportation industry, either through a fee based upon the number of packages certified for transportation and/or the licensing fee of the common carrier or shipper.

E. Transportation of Plutonium by Aircraft

Observation:

Under present AEC regulations, plutonium in quantities greater than 20 grams may not be shipped on passenger aircraft. This is a special limitation placed upon plutonium because the AEC properly is concerned that it not be diverted for illegal purposes. When a wave of airline "highjacking" occurred in the early 1970's, the AEC became concerned that one of the highjacked planes might have plutonium aboard and the highjackers knowingly or unknowingly transport this material out of the country.

Plutonium, in addition to being used in nuclear explosives, can be dangerous to the public health in that it is an alpha emitting radionuclide of long radioactive half-life and if inhaled even in small amounts—micrograms—can do serious harm. Therefore, in addition to safeguarding plutonium from possible diversion, it is important that it be safely controlled so as not to constitute a risk to the health and safety of the public. All the other actinide radionuclides present risks similar to those of Pu^{239} when taken into the body, so precautionary measures applicable to Pu^{239} should be applied also to Pu^{238} and Pu^{240}, Am^{241} and Am^{243}, Cf^{252}, etc.

Light water slightly enriched uranium reactors in operation in the United States today produce plutonium as a byproduct. When the fuel element is reprocessed, the plutonium is separated from the uranium fuel. Relatively little plutonium has been separated from civilian nuclear reactor fuel elements in the United States to date, so the problem of transporting plutonium currently is not as pressing as it is destined to become in the future. As more nuclear power plants come into operation—by 1980 AEC estimates over 100 larger plants will be in operation in the United States—reprocessing plutonium will be moving from reprocessing plants to fabrication facilities and elsewhere in the nuclear industry. The strict control of this material particularly in transit will be a major problem that requires careful attention and will be addressed in the panel's next report. In the meantime, however, it is essential that even the relatively small amounts of plutonium and other actinide radionuclides in the civilian market not be permitted to constitute an unreasonable health and safety threat to the public.

Recommendation:

In addition to the reevaluation of maximum amounts permitted by regulation for A and B type packages, and the reevaluation of the levels of exempt amounts as recommended elsewhere in this report, the panel recommends that the AEC and DOT prohibit the shipment by air—air cargo as well as passenger aircraft—of other than exempt quantities of plutonium and other Transport Group I material unless a determination is made that the air shipment is necessary for the security of the Nation. The danger of an aircraft accident and resulting risk of contamination from plutonium, other actinides and other Category I material is sufficiently grave as to warrant their total restriction to ground and water transportation.

The panel recognizes that such a prohibition will cause an increase in the time these materials will be in transit and that ground and water way shipments of hazardous materials constitute separate risks but is of the opinion these risks are not as grave as those incurred by air tranport. In a future report, the panel will be prepared to recommend improvements in the control and administration of ground shipments for radioactive materials including plutonium and other Transport Group I material from both a safeguards as well as health and safety viewpoint.

F. Radioactive Material Packaging Design Review and Approval

Observation:

In accordance with their memorandum of understanding and their respective regulations, the AEC reviews and issues approvals for the designs of packages used in shipping significant amounts of radioactive material including fissile materials which are authorized by DOT regulations for use by shippers. However, certain Type B containers and fissile material "Specification Containers" are authorized for shippers use even though they have not been reviewed and approved by the AEC, i.e., they have received what is referred to as a "grandfather exemption". These include certain containers authorized by special DOT permits issued prior to July, 1973. In addition, prior to 1969 when DOT published the standards for the Type B containers many containers were in use under a so called Specification 55 which permitted the use of metal-encased lead or uranium metal shielded containers. Under a "grandfather clause" DOT regulations permitted continued use of those "Spec 55" containers used prior to 1969, if the material is in special form and not more than 300 Curies.

The 1971 Delta aircraft incident involved one of the special permit packages in existence prior to July, 1973 and thus was not of the type required to be approved by the AEC. Also the container involved in the July 1974 Delta aircraft incident in which the iridium source was not properly contained was a DOT Spec 55 container, Type C10, not reviewed and approved by the AEC.

Recommendation:

The panel recommends that all special permits and "Spec 55" containers that otherwise would be subject to AEC review and approval prior to use should be canceled and the use of these containers for transporting radioactive material in interstate commerce should be prohibited until such time as the AEC has reviewed and approved their use.

VI. SUMMARY OF MAJOR CONCLUSIONS AND RECOMMENDATIONS

1. *The maximum permissible level of radiation exposure for persons on passenger aircraft due to shipment of radioactive material stored aboard the aircraft should be one millirem per hour as measured anywhere within the passenger and crew compartments.*

2. Present maximum levels of radiation permitted for radioactive material in transit aboard passenger aircraft should be lowered. The maximum permissible Transport Index of 10 (10 millirem per hour at 3 feet) should be lowered to a Transport Index of one (1 millirem per hour at 3 feet) and the maximum permissible level of 200 millirem per hour at the package surface should be lowered by a factor of ½ to ⅕ (50 to 100 millirem per hour). Total maximum permissible quantities of curies of radionuclides per package should be lowered by a factor of at least 10 below present limits.

3. Shipment by passenger carrying aircraft of radioactive material in excess of exempt quantities should be prohibited if radioactive half life of the radionuclide is between 30 days and 10^8 years. This would not apply to radioactive devices implanted in the human bodies of passengers, e.g., pacemakers.

4. The shipment by passenger and non-passenger aircraft of plutonium and other Transport Group I category material in excess of exempt quantities should be prohibited unless the air shipment is required for national security reasons.

5. All approvals or permits issued by DOT for shipping containers for radioactive material based upon "grandfather clauses" should be revoked pending review and approval by AEC.

6. The use of radium, accelerator products and certain other naturally occurring radioisotopes presently not being regulated by the AEC should be brought under AEC regulation.

7. Packages containing radioactive material for air shipment should be monitored subsequent to leaving the supplier and prior to being loaded aboard the aircraft to assure compliance with applicable Federal regulations. This responsibility should be assigned to a single Federal regulatory agency responsible for enforcement of the regulations and not upon the airline carrying the cargo. The responsible Federal agency should also be responsible for periodic inspections to assure all regulations pertaining to air transportation of radioactive materials are being complied with.

The panel believes that with the exception of No. 6 above, which will require congressional action—specifically amendment to the Atomic Energy Act of 1954—all of the above recommendations can be adopted through Administrative action as they would be within existing statutory authority. Recommendation No. 7 above, if adopted, would increase significantly the present level of monitoring and enforcing Federal regulations. It might be more appropriate if this were accomplished by legislative mandate rather than being left to Administrative determination.

VII. ADDITIONAL RECOMMENDATIONS

1. It is apparent that in some degree the heavy dependence on passenger aircraft for transporting radioisotopes for medical purposes is because of convenience rather than necessity. Even recognizing the need to transport short half-life isotopes without delay, the use of land transportation could be more effectively used particularly for relatively short haul distances. The panel recommends that shippers of radioactive isotopes make a greater effort to develop and use land transportation wherever possible.

2. Recognizing the need to continue the competitive nature of the production and sale of radiopharmaceuticals, the panel recommends that users such as hospitals and doctors, attempt to purchase their short half-life radioisotopes from the closest supplier. This would not only reduce the number of air shipments but would significantly reduce the amount in curies of radioactive shipments by passenger aircraft.

3. Information provided to the panel indicates that the current practice in the medical profession is to have the Mo^{99} generators available at the hospital beginning on each Monday morning for use through the following Friday. This provides the most effective use in the hospital because of the short half-life feature of the isotope. Because of this, most radiopharmaceutical producers manufacture their product on Thursday or Friday and ship late Friday or Saturday. In order to insure that the ordered quantity (in curies) is available on Monday morning, a sufficient excess quantity to compensate for the amount lost by radioactive decay must be produced and shipped. In some cases the hospital will request sufficient quantities of the radioisotope in order to have a full supply available on Friday rather than Monday. The panel was told, for example, that in order to insure that the hospital has 500 millicuries of Mo^{99} at the hospital on Friday morning, the producer ships approximately 2,500 millicuries on the previous Friday or Saturday. The panel considers that by properly revised scheduling the quantities (in cuies) of radioisotopes shipped by passenger aircraft can be reduced. The panel saw little evidence of any effort on the part of the producers or users to do this.

4. The panel noted that in the packaging of liquid radioisotopes for shipment there is no requirement to place the bottle in a sealed plastic bag before insertion into the shielded container. This is an inexpensive step generally followed throughout the nuclear industry today and should be incorporated into the packaging requirements.

5. As an added precaution against gross mishaps or illegal shipments of radioactive material, the panel recommends the installation of high-level radiation monitors in cargo handling spaces and perhaps other areas of major airports. Such a device would have immediately detected the recent incident involving the air shipment of an unshielded industrial isotope.

6. The panel considers that the airlines should voluntarily assume a more active role in monitoring their operation with regard to shipping radioactive material. There appears to be a general feeling among the airline companies that the responsibility for safe shipment of radioactive material rests with the shipper and the Federal Government. Although the panel is not recommending the AEC licensing of air carriers, it does feel that the airlines can and should take a more active role. It would not be unreasonable to expect each airline to hire one or two persons trained and qualified in health physics to provide airline management with some surveillance capability. Such capability would provide the airline with some assurance that required procedures are being followed within their own operations.

7. Until and unless carriers become licensed to handle radioactive material, shippers must be held responsible for safe shipment of such material until it reaches its destination. The panel is of the opinion that some shippers of radioisotopes to a large degree consider their responsibility complete once they have packaged their product in accordance with the requirements and have turned it over to the carrier, even though he is not trained in the proper control of radio-

active material. Although unsubstantiated, it was reported to the panel that some shippers are aware and condone illegal practices followed by some land carriers once their shipments have been turned over to that carrier. However, the panel did observe one manufacturer who aggressively supervised all phases of the transportation cycle until the product was in the hands of the licensed user. The panel was unable to find any evidence where the Federal Government (AEC) inspected or regulated the operation of land carriers who transport radioisotopes from the shipper to the airports for air shipment. The panel recommends that this situation be corrected; that the enforcement of the shipper's license to handle radioactive material be extended to cover all truck or auto movement of the radioactive material until it is received by another licensed activity.

8. The requirement exists that pilots be advised in writing of the presence of radioactive shipments on their flights. The panel notes that this requirement is not consistently being followed in that cargo manifests do not always show the existence of such shipments. The panel recommends that airlines review their current procedures to ensure compliance with this requirement.

9. The panel recommends that airline passengers, if they ask, be told whether or not radioactive material is being carried on their particular flight. If, because of this, they chose not to fly on that flight, the choice is theirs. The panel does not consider that the airlines should, under such circumstances, be required to provide the passenger with so-called "bumping rights."

10. Although no requirement exists, the panel considers it prudent that a film badge or TLD be installed on selected aircraft, passenger and cargo. This monitor could be installed in an inconspicuous location in the passenger area and be read each thirty days. A monitor should also be placed in an appropriate location in the cargo handling spaces of major airports where radioactive material is stored. The individual airlines should conduct this surveillance and report their results to the FAA.

APPENDIX A

List of individuals with whom the Panel conferred in connection with the problems discussed in this report.

Dr. Calvin Brantly, *Chairman*, AIF Isotope Committee.

Capt. William H. Briner, Duke University Medical Center (Society of Nuclear Medicine-Transportation Committee).

Dr. Jerry Bruno, E. R. Squibb & Sons, Inc.

Mr. William J. Burns, *Director of Hazardous Materials*, Department of Transportation.

Dr. Barry Commoner, *Director*, Center for Biology, of National Systems, Washington University.

Mr. John F. Derr, Products and Systems Development, Director, E. R. Squibb & Sons, Inc.

Mr. Sam Edlow, Edlow International Associates.

Dr. Meril Eisenbud, NYU Environmental Health Laboratory.

Mr. Joseph A. Ferrarese, *Chief*, Flight Operations Division, Flight Standards Service, Federal Aviation Administration.

Mr. Ken George, *Senior Research Scientist*, E. R. Squibb & Sons, Inc.

Mrs. Margaret Glos, *Executive Director*, Society of Nuclear Medicine.

Mr. Kenneth J. Green, *Manager*, Radiopharmaceutical Distribution, Mallinckrodt Nuclear Corp.

Mr. Al Grella, Office of Hazardous Materials, U.S. Department of Transportation.

Mr. Saul Harris, *Chief*, Radiation Bureau, Department of Health, New York City.

Mr. Dean B. Holzgaf, *Manager*, Nucleonics Business, E. R. Squibb & Sons, Inc.

Miss Pat Kennedy, Aviation Consumer Action Project.

Mr. Peter M. Kirby, *Director*, Federal Legislation, Air Transport Association of America.

Mr. Clifford J. Konnerth, *Chief*, Health Physics, E. R. Squibb & Sons, Inc.

Mr. Sam Langford, Aviation Safety, Federal Aviation Administration.

Gerald M. Mayo, Esq., Legal Division, Delta Air Lines, Inc.

Dr. Gerald McDonald, Good Samaritan Hospital in California.

Mr. James J. McGovern, *Superintendent*, Nuclear Operations, E. R. Squibb & Sons, Inc.

Mr. Robert B. Minogue, *Deputy Director*, Directorate of Regulatory Standards, Atomic Energy Commission.

Kathleen O'Neill, Esq., Attorney, Air Transport Association of America.

Mr. Harold T. Raven, *Transportation Manager*, E. R. Squibb & Sons, Inc.

Mr. Harry Richardson, *President*, NSI, Baton Rouge, La.

Mr. William Robb, Quality Assurance–Radiopharmaceuticals, Mallinerodt Nuclear Corp.

Dr. William Rowe, Environmental Protection Administration.

Mr. Don Soldan, Radiation Safety, Mallinerodt Nuclear Corp.

J. G. Speth, Esq., Natural Resources Defense Council, Inc.

Dr. Arthur Tamplin, National Resources Defense Council, Inc.

Dr. Robert Zimmerman, Consultant to Delta Airlines.

APPENDIX B

JOINT COMMITTEE ON ATOMIC ENERGY,
UNITED STATES CONGRESS,
Washington, D.C., May 30, 1974.

Mr. JOHN T. CONWAY,
Executive Assistant to the Chairman of the Board, Consolidated Edison Co. of New York, N.Y.

DEAR JOHN: We want to thank you and your colleagues for taking on the difficult task of looking into the problems of transporting nuclear material to assure that it is properly safeguarded and that adequate safety and security precautions are taken.

The Joint Committee looks forward to the results of your deliberations. We are particularly anxious to know if any changes in present activities are needed at the present time. Accordingly, it would be appreciated if you would concentrate your efforts on determining what, if anything, is now being done incorrectly. We would also suggest that you inform the committee of impending problems you foresee in the future as our nuclear activities increase in order that they may be given attention in the future.

In order for your work to be of greatest value to the committee, it would be appreciated if results of your deliberations were made available in about two or three months. We then could, if deemed necessary, take any legislative action that is required in the present congressional session. Also, since the handling and transportation of nuclear weapons is significantly different from the procedures for other types of nuclear material, it would appear appropriate that you exclude the handling and transportation of weapons from the scope of your study. However, you are authorized to review the transportation and handling of nuclear weapons to whatever extent you believe necessary or helpful in arriving at your recommendations.

Sincerely,

MELVIN PRICE, *Chairman*,
JOHN O. PASTORE, *Vice Chairman*.

GLOSSARY

Absorbed dose. When ionizing radiation passes through matter, some of its energy is imparted to the matter. The amount absorbed per unit mass of irradiated material is called the absorbed dose, and is measured in *rems* and *rads*.

Actinide series. The series of elements beginning with actinium, Element No. 89, and continuing through lawrencium, Element No. 103, which together occupy one position in the *Periodic Table*. The series includes uranium, Element No. 92, and all the man-made transuranic elements. The group is also referred to as the "Actinides".

Alpha particle. A positively charged particle emitted by certain radioactive materials. It is made up of two neutrons and two protons bound together, hence is identical with the nucleus of a helium atom. It is the least penetrating of the three common types of *radiation* (alpha, beta, gamma) emitted by radioactive material, being stopped by a sheet of paper. It is not dangerous to plants, animals or man unless the alpha-emitting substance has entered the body.

Beta particle. An elementary particle emitted from a nucleus during radioactive decay, with a single electrical charge and a mass equal to $\frac{1}{1837}$ that of a proton. A negatively charged beta particle is identical to an electron. A positively charged beta particle is called a positron.

Curie. The basic unit to describe the intensity of radioactivity in a sample of material. The curie is equal to 37 billion disintegrations per second, which is approximately the rate of decay of 1 gram of radium. A curie is also a quantity of any nuclide having 1 curie of radioactivity.

Gamma rays. High-energy short-wavelength electromagnetic radiation. Gamma radiation frequently accompanies alpha and beta emissions and always accompanies fission. Gamma rays are very penetrating and are best stopped or shielded against by dense materials, such as lead or depleted uranium. Gamma rays are essentially similar to X rays, but are usually more energetic, and are nuclear in origin.

Genetic effects of radiation. Radiation effects that can be transferred from parent to offspring. Any radiation-caused changes in the genetic material of sex cells.

Isotope. One of two or more atoms with the same atomic number (the same chemical element) but with different atomic weights. An equivalent statement is that the nuclei of isotopes have the same number of protons but different numbers of neutrons. Thus, $^{12}_{6}C$, $^{13}_{6}C$, and $^{14}_{6}C$ are isotopes of the element carbon, the subscripts denoting their common atomic numbers, the superscripts denoting the differing mass numbers, or approximate atomic weights. Isotopes usually have very nearly the same chemical properties, but somewhat different physical properties.

Isotopic enrichment. A process by which the relative abundances of the isotopes of a given element are altered, thus producing a form of the element which has been enriched in one particular isotope. Example: enriching natural uranium in the uranium-235 isotope.

Maximum loading. The maximum number of packages of radioactive material that can be transported in a cargo compartment of an aircraft, in terms of the total of the transport indexes on those packages.

Millicurie (*see* curie). $\frac{1}{1000}$ of a curie.

Millirem (*see* rem). $\frac{1}{1000}$ of a rem.

Neutron. An uncharged elementary particle with a mass slightly greater than that of the proton, and found in the nucleus of every atom heavier than hydrogen. A free neutron is unstable and decays with a half-life of about 13 minutes into an electron, proton, and neutrino.

Radiation. The propagation of energy through matter or space in the forms of waves and fast-moving particles.

Radioactive labels. Labels bearing the unique trefoil radiation warning symbols which are required to be placed on two opposite sides of each package of radioactive material. Each radioactive label shows the contents, the amount of radioactivity in curies, and on radioactive yellow–II and radioactive yellow–III labels, the number of transport indexes. Labels are divided into:

(1) radioactive white–I label—for each package not exceeding 0.5 millirem per hour at any point on the external surface of the package, not authorized for Fissile Class II packages;

(2) radioactive yellow–II label—for each package exceeding limits of radioactive white–I label, but not exceeding 10 millirems per hour at surface and not exceeding TI of 0.5; and

(3) radioactive yellow–III label—for each package exceeding limits of radioactive yellow–II label, each Fissile Class III package, each large quantity package, and each package being transported under a DOT permit.

—Half-life. Time required for a radionuclide to lose 50 percent of its activity by decay. Each radionuclide has a unique half-life.

Radionuclide. An unstable isotope of an element that decays or disintegrates spontaneously, emitting ionizing radiation.

Rem (Acronym for roentgen equivalent man.) The unit of dose of any ionizing radiation which produces the same biological effect as a unit of absorbed dose of ordinary X-rays.

Roentgen [Abbreviation r] A unit of exposure to ionizing radiation. It is that amount of gamma or X-rays required to produce ions carrying 1 electrostatic unit of electrical charge (either positive or negative) in 1 cubic centimeter of dry air under standard conditions.

Separation distances. The distance between the passenger side of the floor or partition of the passenger compartment and the nearest surface of a package of radioactive material stowed in the cargo compartment.

Somatic effects of radiation. Effects of radiation limited to the exposed individual, as distinguished from genetic effects.

Spacing-out. A configuration for loading packages of radioactive materials in the cargo compartment of an aircraft which allows an aircraft to carry several groups of packages simultaneously; the spacing-out configuration limits the number of packages in each group and specifies minimum separation distances and distances between groups of packages.

TLD. Thermoluminescent dosimeter.

Transmission factor. The fraction of radiation passing through the aircraft structures between the radiation source and the dose point of interest.

Transport index (TI). The number placed on the label of a package of radioactive material to designate the degree of control to be exercised by the carrier during transportation. The transport index is equal to the larger of the following:

the highest radiation dose rate, in millirem per hour at three feet from any accessible external surface of the package; or for fissile material packages, the number 50 divided by the number of similar packages which may be transported together under AEC rules.

93d Congress
2d Session } JOINT COMMITTEE PRINT

TRANSPORTATION OF RADIOACTIVE MATERIAL BY PASSENGER AIRCRAFT

REPORT No. 1

OF THE

SPECIAL PANEL TO STUDY TRANSPORTATION OF NUCLEAR MATERIALS

TO THE

JOINT COMMITTEE ON ATOMIC ENERGY
CONGRESS OF THE UNITED STATES

NINETY-THIRD CONGRESS

SECOND SESSION

SEPTEMBER 17, 1974

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APPENDIX V

Letter, dated February 2, 1979, from A. Von Baeckmann,
Director, IAEA Safeguards, Division of Development and Technical Support,
to the U.S. IAEA Mission in Vienna

"Air shipments of small quantities of plutonium-containing materials" United States Public Law 94/7 [sic] (August, 1975) restricted the U.S. air transport of plutonium, except for small medical devices, until the approval of a crash-worthy shipping container. Although the law directly affected only U.S. licensees and contractors, it can have a major effect on air shipment of IAEA samples from other countries. Some countries might set legal conditions for air shipments of plutonium, using the U.S. law as an example.

The above restriction has been rescinded by the USNRC (August 4, 1978) based on requiring the use of a new container for air shipments of Pu. This new container is designed for up to 2 Kg of PuO_2 and the approved container weighs 500 lbs. I am unaware if the law or NRC regulation specifies an amount of Pu below which the new package need not be used and lighter-weight, less expensive (perhaps previously) approved containers could be used instead. If not, to ship a 1.0g sample would require a 500 lb container. The law as written might even apply to a resin bead bearing only milli- or micrograms of plutonium. The cost of containers, and especially air-freight charges, could be a large burden to the IAEA if the US persists and several countries impose the same conditions as the US for air shipments of plutonium.

The IAEA has need for rapid shipment of safeguards samples containing from less than 0.1 to about 10 grams of plutonium. Under average conditions, the number of samples to be transported at one time from one facility might be 12, and the total plutonium for average shipments might be about 20 grams of plutonium. There could be several such shipments each month, but from different facilities scattered over the world. Under peak conditions, the number and amount to be transported at one time from one facility might be 30 and 100 grams respectively. These are only first order estimates. It would be highly beneficial for international safeguards if the U.S. would provide a lead for other nations to follow in facilitating such air shipments.

Could you please find out whether U.S. law and regulations would permit air shipments of plutonium without use of the approved crash-worthy container if the amount of plutonium is less than a limited amount.

For example:

A. A resin bead bearing micrograms of Pu

B. An NBS standard of milligrams to 1 gram Pu

C. A standard sample of about 10 grams

D. Groups of samples totalling about 100 grams."

It would be highly desirable if the U.S. Mission could initiate steps to facilitate such shipments. There can also be difficulties about inner containers to be used within the outer container discussed above. Thus, it would also be highly beneficial if the U.S. could assist in establishing or maintaining an international agreement for air shipments which would be applicable

not only between nations but also within nations. This would minimize difficulties about one type of inner container being required up to the airport, another inner container being required by international carriers, and still another in the country of receipt. Inability e.g. to repack inner containers at airports would otherwise prevent air shipments.

Attention to the problem of Pu transport was raised in the ISPO review meeting 1978 which resulted in the submission of two new tasks: A.59 - International Air Shipment of Irradiated Plutonium on Resin Beads to Facilitate International Safeguards, and A.60 - Air Shipment of Plutonium Samples to Facilitate International Safeguards. We would be most grateful if the U.S. Mission could complement this ISPO effort by looking into the legal aspects of Pu air shipments."

APPENDIX VI

Memorandum of January 7, 1980 from G. H. Cunningham, OELD

to A. D. Palo, OMPA

JAN 7 1980

MEMORANDUM FOR: A. DiPalo
Office of Management and Program Analysis

FROM: Guy H. Cunningham, III
Chief Regulations Counsel
Office of the Executive Legal Director

SUBJECT: LEGISLATION PROPOSALS FOR 97TH CONGRESS

In response to Mr. Gossick's memorandum of December 19, 1979, requesting proposals for possible inclusion in an NRC Omnibus Legislation Package, OELD recommends that the Commission seek legislative authority to exempt shipment of plutonium in IAEA safeguards samples from the requirement for shipment in packages which have been certified by the Commission to be crash resistant, pursuant to the provisions in the "Scheuer Amendment" contained in P.L. 94-79. The Director of the Office of International Programs has expressed his support for this proposal.

In connection with implementation of the U.S./IAEA Safeguards Agreement, currently before the U.S. Senate for approval, rapid air shipment of quantities of plutonium in samples up to several hundred grams to the IAEA safeguards laboratory will be necessary. The IAEA need was defined in a letter dated February 2, 1979 from A. von Baeckmann, Director, IAEA Safeguards Division of Development and Technical Support to the U.S. IAEA Mission in Vienna.

> "The IAEA has need for rapid shipment of safeguards samples containing from less than 0.1 to about 10 grams of plutonium. Under average conditions, the number of samples to be transported at one time from one facility might be 12, and the total plutonium for average shipments might be about 20 grams of plutonium. There could be several such shipments each month, but from different facilities scattered over the world. Under peak conditions, the number and amount to be transported at one time from one facility might be 30 to 100 grams respectively. These are only first order estimates. It would be highly beneficial for international safeguards if the U.S. would provide a lead for other nations to follow in facilitating such air shipments.

Could you please find out whether U.S. law and regulations would permit air shipments of plutonium without use of the approved crash-worthy container if the amount of plutonium is less than a limited amount.

For example:

A. A resin bead bearing micrograms of Pu

B. An NBS standard of milligrams to 1 gram Pu

C. A standard sample of about 10 grams

D. Groups of samples totalling about 100 grams."

In the opinion of ELD the desired authority can only be obtained through legislation, though development of a regulation to exempt very small shipments of plutonium is underway. A non-statutory alternative is the development and certification of a smaller package for safeguards samples that would meet the NRC criteria used to certify the one existing package design that has been approved. While DOE is pursuing this option, we do not believe that the smaller package will be available in the near term.

The proposal has no budgetary implications for NRC, though its implementation would result in cost savings for licensees.

OELD has no specific comments on the nine tentative OGC proposals.

Original signed by
Guy H. Cunningham, III

Guy H. Cunningham, III
Chief Regulations Counsel
Office of the Executive

cc: J. Becker
N. Eisenberg

APPENDIX VII

Letter of May 31, 1979 from Senator John Glenn to Chairman Hendrie

United States Senate

COMMITTEE ON
GOVERNMENTAL AFFAIRS
SUBCOMMITTEE ON ENERGY, NUCLEAR
PROLIFERATION AND FEDERAL SERVICES
WASHINGTON, D.C. 20510

May 24, 1979

Honorable Joseph M.Hendrie
Chairman
Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Chairman Hendrie:

It has been brought to my attention that the International Atomic Energy Agency (IAEA) has a need for rapid shipment of safeguards samples containing less than 0.1 to about 10 grams of plutonium. Ordinarily, 10 samples containing some 20 grams of plutonium might be shipped from a single facility in one shipment. However, under conditions of maximum usage, shipment from an individual facility would be only as high as 30 to 100 grams.

As you know, these quantities fall well below the amounts envisioned for airshipment of radioactive materials when the regulations governing the crash-worthiness of containers were formulated. This means that shipments must either be delayed or they must be sent in containers the bulk and weight of which far exceed the necessity of the amounts being transported.

Given these circumstances and the exigencies of the IAEA's safeguards program, I believe that a review of the crash-worthiness requirements for containers in which small quantities of radioactive materials are shipped is in order. To accomplish this, I would suggest the Department of Transportation and the Nuclear Regulatory Commission meet without delay to form an ad hoc group on the matter.

Please notify me at your earliest convenience of the steps you have taken to arrange this meeting. Additionally, please keep me advised on the progress of the group.

In this regard, it would be most useful if an individual were designated to act as liaison with my staff. This individual should be in touch with Dr. Leonard Weiss, Staff Director of the Subcommittee on Energy, Nuclear Proliferation and Federal Services or his designee.

I am notifying the other involved agencies by means of a similar letter.

Many thanks for your cooperation.

Sincerely,

John Glenn

John Glenn

JG/mlp

APPENDIX VIII

Letter of July 6, 1979 from Chairman Hendrie to Senator John Glenn

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

CHAIRMAN

July 6, 1979

The Honorable John Glenn, Chairman
Subcommittee on Energy, Nuclear
Proliferation and Federal Services
Committee on Governmental Affairs
United States Senate
Washington, D.C. 20510

Dear Mr. Chairman:

This is in regard to your letter of May 31, 1979, suggesting the formation of an inter-agency group to review the crash-worthiness requirements for containers used to ship small quantities of plutonium by air.

On August 4, 1978, NRC certified to Congress that a safe shipping container for air transport of plutonium had been developed and tested and that the container would not rupture under crash and blast-testing equivalent to the crash and explosion of a high-flying aircraft. This certification was made in accordance with Public Law 94-79, enacted August 9, 1975, which prohibits the NRC from licensing any shipments of plutonium in any form other than within certain medical devices, by air transport whether exports, imports, or domestic shipments, except in certified containers. Before making the certification, the NRC evaluated the conditions that could be produced in aircraft accidents and developed qualification criteria for plutonium packages. As a result, the criteria address the requirements of P.L. 94-79 that testing be equivalent to the crash and explosion of a high-flying aircraft. The requirement of P.L. 94-79 for the container not to rupture is addressed in the criteria by specifying post-test acceptance standards equivalent to those of the International Atomic Energy Agency. The criteria also specify various engineering assessments to be made on plutonium package designs and require that certain operational controls be observed in transport. The operational controls are needed to prevent or mitigate certain accident conditions. The criteria, as well as the package design developed by the NRC to meet the criteria, were endorsed

by both the NRC Advisory Committee on Reactor Safeguards and the National Academy of Sciences.

On April 25, 1979, representatives of the Department of Energy (DOE), the Department of Transportation (DOT), and the Nuclear Regulatory Commission (NRC) met with your staff to discuss the IAEA sample shipment problem. Our representative pointed out that we are not aware of any new technical data which would support development of less stringent criteria for plutonium package certification under P.L. 94-79. Two alternatives were suggested at the meeting for solving the shipment problem. One alternative is to develop a small safeguards sample container that would meet the NRC qualification criteria for air transport of plutonium. The other alternative is to initiate legislative action to provide an exemption to Public Law 94-79 for the quantities of plutonium or types of shipments involved in the IAEA sample shipment program. We understood that DOE has agreed to initiate a program to develop a small safeguards container that would meet the NRC criteria. If this DOE program does not produce an appropriate container on a schedule consistent with the needs of the IAEA, we believe that the alternative involving legislative action should be pursued. Although we believe that certain very small quantities of plutonium could be exempted from the plutonium package requirements for air transport, not all the safeguards samples (up to 100 grams per shipment) could be exempted while still offering a level of public safety provided by Public Law 94-79.

I trust that this information is responsive to your request. If you have additional questions, please feel free to contact me.

Sincerely,

Original Signed by
Joseph M. Hendrie

Joseph M. Hendrie

Cleared with all Cmrs. by SECY C/R
Retyped in SECY to incorporate Cmr. comment

APPENDIX IX

Letter of June 4, 1979 from George Weisz, DOE to

Professor Johannes J. Gruemm, IAEA

ATTACHMENT II

JUN 4 1979

AIR MAIL

Professor Johannes J. Gruemm
Deputy Director for Safeguards
International Atomic Energy Agency
Karntner Ring 11
P. O. Box 590
A-1011 Vienna, Austria

Dear Professor Gruemm:

I am taking this opportunity to provide you with a brief status report on the steps we have taken to address the plutonium sample air transportation problem you described during your visit here in late March.

As you will recall, U.S. legislation requires a plutonium container certified by the Nuclear Regulatory Commission (NRC) as meeting certain safety performance requirements before any plutonium, regardless of quantity, may be shipped by air in the United States. You are also aware that only one container, the PAT-1, has to date been certified by NRC.

At this point in time the general consensus amongst the various concerned U.S. parties is that legislative relief is not feasible. Accordingly, we have initiated a three-pronged attack to provide the needed flexibility.

The first is to develop and obtain certification for a small container to accommodate shipments in the size range of 30 to a few hundred grams. Preliminary design of such a container, weighing 70 pounds, is now complete and Sandia is being tasked to proceed with a final design to be submitted to NRC for certification. Our estimate is that final design and test will take approximately 12 months and NRC certification will take another four to six months.

With respect to plutonium nitrate solution samples using the resin bead technique, we are in communication with NRC to explore an interpretation that such samples do not fall within the statutory prohibition. We believe such interpretation is possible within the intent and meaning of the U.S. statutory requirements in view of the miniscule amounts of plutonium involved.

Finally, with respect to the use of PAT-1 containers in cargo aircraft, we have initiated communication with the NRC and the U.S. Department of Transportation with a view toward arriving at a set of mutually-agreed, simplified requirements. We expect these to eliminate or reduce the open space requirement aft of the PAT container in the cargo bay of the aircraft, thereby significantly reducing the sample transportation costs.

We are aggressively pursuing each of these steps and will, as appropriate, continue to keep you informed of the progress made.

Sincerely,

George Weisz
Director
Office of Safeguards and Security

cc: Dr. Adolf von Baeckmann, IAEA
Hon. Roger Kirk, U. S. Mission to the IAEA

DP-311:LMBrenner:amd:353-5108:5/31/79

ENCLOSURE 4

ENVIRONMENTAL IMPACT APPRAISAL FOR PROPOSED AMENDMENTS TO 10 CFR PART 71 TO RESTRICT THE AIR TRANSPORT OF PLUTONIUM

Prepared by
Catherine R. Mattsen
and
Norman A. Eisenberg
December 1980

SUMMARY

The Nuclear Regulatory Commission has under consideration a proposed amendment to 10 CFR Part 71 that would restrict the air transport of plutonium in any form. This amendment implements the Scheuer Amendment, which is part of Public Law 94-79 and appears as a foonote to Section 201 of the Energy Reorganization Act of 1974. When effective, this amendment will replace orders to NRC licensees which have until now restricted the air shipment of plutonium. The proposed amendment differs from the currently effective order to licensees, in part, by allowing shipments of an A_2* quantity or less of plutonium to be shipped by air in other than a package certified to be air-crash resistant.

This environmental appraisal considers two types of regulatory change: 1) the imposition of restrictions on shipping pluontium by air as embodied in the currently effective order to licensees and 2) the incremental change in restrictions effected by implementing those features of the proposed rule which are different from the existing order to licensees. Since the proposed rule codifies the requirements of the existing order, it is necessary to perform an

*An A_2 quantity of plutonium is defined in Table VII of the International Atomic Energy Agency Regulations for the Safe Transport of Radioactive Materials, IAEA Safety Series No. 6. Table B-4 in Appendix B lists the A_2 quantities for various plutonium isotopes and some common mixtures.

environmental analysis of those requirements, as well as the requirements of the proposed rule which are different from the existing order to licensees. The major impacts to the environment of restricting air transport of plutonium is to reduce radiological risks to the population and to virtually eliminate the possibility that a public catastrophe could result from the release of plutonium in a severe air crash. The impact appraisal examines the environmental impacts associated with the transport of plutonium in air-crash-resistant packages and the impacts from allowing transport of an A_2 quantity or lower quantities without special packaging requirements. The appraisal concludes that the allowance of shipments of an A_2 quantity or less in other than air-crash-resistant packaging does not significantly affect the environment and that an environmental impact statement need not be prepared, since the estimated environmental impacts of the proposed action are negligible.

DESCRIPTION OF THE PROPOSED ACTION

The proposed action would adopt amendments to the regulations for transport of radioactive material (10 CFR Part 71) that would restrict the air transport of plutonium in all forms. Pursuant to the Scheuer Amendment, the Commission will require that shipments of plutonium by air be contained in a package specifically licensed as air-crash resistant. However, plutonium may be shipped in other packages if the plutonium is in a medical device for individual human use or if the plutonium is shipped in quantities or concentrations small enough to present no significant hazard to the public health and safety, even were the package containing the plutonium not to survive the crash and explosion of a high-flying aircraft.

PROBABLE IMPACTS OF PROPOSED ACTION

The amendment described above implements PL 94-79 (the Scheuer Amendment) by replacing, with a rule, the order to licensees which has been a temporary means of restricting air transport of plutonium in accordance with PL 94-79. Although restricting the air shipment of plutonium enhances the public health and safety, enforcing the restrictions by a rule instead of an order is primarily an administrative change and has no significant impact on the environment. However, the allowance to ship an A_2 quantity or less of plutonium in packaging other than that certified to be air-crash resistant is a provision not specifically set out in the Scheuer Amendment nor in the order to licensees restricting air transport of plutonium in the interim. This impact appraisal then primarily addresses the impact of this provision and demonstrates that the allowance to ship small amounts in other than air-crash-resistant packages would not cause a significant risk and that even the crash of a high-flying aircraft containing such small quantities in packages that are not air crash-resistant would have only minor radiological consequences. The impacts of requiring the shipment of plutonium in a package able to satisfy a set of qualification criteria, are also addressed, but in much less detail.

IMPACTS OF EXEMPT QUANTITIES

A. Health Consequences

The health consideration of transporting plutonium by air under incident-free conditions is the external radiation dose to persons near the package from gamma emissions. Since gamma rays represent only a small part of the disintegration energy of plutonium and since the gamma emissions are at low photon energies, the external radiation from packages of plutonium is at a low flux

level; thus, the doses associated with an A_2 quantity, a relatively small quantity of plutonium, would be very small. For most isotopes of plutonium, the A_2 quantity is 2 or 3 millicuries, but for Pu-241 the A_2 quantity is 1 curie (see Table B-4, Appendix B). Nevertheless, most of the energy from the disintegration of Pu-241 is in the form of a β emission, which is stopped by the container. Thus, even in that case the external radiation dose is expected to be small.

NUREG-0170 (Reference 1, p. 4-41) estimates the normal population dose from all plutonium shipments, by all modes, for the 1975 base year and under present regulations, to be 43.5 person-rem. This accounts for less than ½ percent (about 0.45%) of the total population dose of 9790 person-rem resulting from incident-free shipment of all radioactive material. Since the health effects resulting from all incident-free radioactive shipping is estimated to be 1.7 genetic effects and 1.2 latent cancer fatalities (Reference 1, p. iv), the health effects resulting from incident-free shipping of plutonium is proportionally less (about 5×10^{-3} latent cancer fatalities under present regulations) and definitely negligible. The impact from the plutonium shipment of interest here, shipments by air and shipments of quantities less than an A_2 quantity, is only a fraction of the impact from all plutonium shipments, which is negligible.

Another consideration in allowing small quantities of plutonium to be transported by air in other than an air-crash-resistant package is the possible release of the plutonium in the event of an air crash. Two aspects are of interest: (1) that the risk from all air crashes is acceptably small, and (2) that the consequences of a single, very severe air crash are not capable of causing large public health consequences. For the lower severity accidents, even normal packaging would not be expected to permit release of any of the plutonium, since that packaging is sufficiently strong to survive minor transport accidents (see Chapter 5, Ref. 1), therefore low severity accidents do not contribute to the

radiological risk. For a severe accident, e.g., the crash and explosion of a high-flying airplane, all of the plutonium in a package could be released. However, only a part of the released plutonium will be taken in (inhaled or ingested) by people and thus cause any health effects. Direct inhalation of released plutonium is considered to be the most significant exposure pathway; water and food chain routes and submersion doses are considered to be insignificant in comparison for releases like these that are not continuous or from a fixed site. Also, it can be shown (see Appendix A) that for a given amount of plutonium released, dispersed, and inhaled by a population at risk, more deaths result from distribution of small amounts of plutonium to many individuals, thereby causing latent cancer fatalities, than result from the distribution of larger amounts of plutonium to a lesser number of individuals, in quantities sufficient to cause prompt fatalities. To estimate what health effects would result from release of plutonium in an air crash, one must estimate the factors by which the activity reaching people's lungs would be reduced, namely: the percent released, the percent aerosolized, the percent which is of respirable particle size, and the percent actually deposited in the lungs of people (this last factor depends on the air dispersion, population distribution, breathing rate, and pulmonary retention rate).

If one makes very conservative estimates for these factors, one would estimate that the release of an A_2 quantity in a severe accident could result in at most 0.105 latent cancer fatalities (this is an upper bound value obtained by using the worst combination of radiotoxicity and A_2 quantity, viz. Pu-242). For purposes of comparison, if 10 μCi were used as the quantity limit instead of an A_2 quantity, 3.5×10^{-4} latent cancer fatalities would result. It is of course possible for a number of such packages to be on the same aircraft and thus involved in an accident; however, the estimated radiological consequences

of a crash involving multiple shipments (say, a conservatively large number of 100 packages containing an A_2 quantity potentially resulting in 10.5 latent cancer fatalities) would be of concern, but would not generally be considered to be an event involving large public health consequences. Taking some estimates from NUREG-0170 [1] for numbers of shipments, kilometers travelled, accident rates, etc., and using a conservative analysis, the number of latent cancer fatalities expected to result from all severities of air accidents involving transport of an A_2 quantity or smaller quantities not in the air-crash-resistant packaging, would be on the order of three ten thousandths annually; i.e., the total annual shipping activity of small quantities of plutonium in other than air-crash-resistant packages would be expected to cause far less than a single latent cancer fatality, as a result of release of plutonium in air crashes. The calculations supporting these estimates are included in Appendix B. The radiological risk from the plutonium permitted to be shipped in other than air-crash-resistant packaging is small, in comparison to the 6×10^{-3} latent cancer fatalities estimated to result from vehicular accidents in all modes involving all types of radioactive shipments under present regulations (Reference 1, pp. iv and vii). This small radiological risk resulting from allowing small quantities to be shipped in other than air-crash-resistant packages would not necessarily be reduced to zero were this allowance not made, since it is likely that these small quantities would be shipped by alternate transport modes. Since shipping small quantities of plutonium by alternative transportation modes is not without risk, the alternative of not permitting small quantities to be shipped by air in other than crash-resistant packaging may actually produce no decrease in radiological risk.

B. Economic Impacts

The primary economic impact of allowing an A_2 quantity or less of plutonium to be shipped in other than air-crash-resistant packaging is to reduce costs of shipping items containing small quantities of plutonium. In most cases of shipments equal to or below an A_2 quantity, the high costs of air-crash-resistant packages would make air transport too costly and thus impractical. Having to use ocean freight in most cases would be burdensome. Because plutonium is in a "special classification" the shipping companies must fill out special papers, and present them in advance to each port authority where the ship plans to dock. In each port the authorities can and very often do go aboard the ship to check on these "special classified packages." This causes delays of one day or more at each port. These delays also cause extra changes at each dock, (i.e., berth charges, etc.). In both land transport and ocean freight, the additional time required for shipment can cause a significant economic impact to the businesses involved. The economic impact of an airplane accident associated specifically with the presence of plutonium would be the cost of decontaminating the area. Assuming the complete release from a package containing an A_2 quantity or from several such packages as the result of an airplane crash, the area that would be contaminated to a level requiring cleanup probably would be confined to the area containing the debris from the crash. Contamination to a high enough level to require cleanup would probably not occur more than 150 meters downwind from the impact point. The additional costs of cleanup related to the presence of plutonium (on the order of $1,000's - see Figure 5-13, Ref. 1) would be insignificant compared to the cost of recovery from the air crash.

Impacts of Satisfying the Qualification Criteria

For the purpose of this appraisal, we assume that the test conditions listed in NUREG-0360 are equivalent to the crash and explosion of a high-flying aircraft.

The acceptance criteria in NUREG-0360 allow for the release of up to an A_2 quantity* per week subsequent to testing to the conditions stated in that report. Thus, the primary radiological impact of the transport of plutonium in air-crash-resistant packaging would be the possible release in one week of several millicuries of α emitting isotopes of plutonium or tens of millicuries of Pu-241 or mixtures containing that isotope. The possible hazard associated with this release is essentially the same as that from the A_2 quantities allowed to be shipped in other than an air-crash-resistant package; in other words, about a fraction of a latent cancer fatality.

To calculate the risk from these shipments, let us assume that the number of such packages would be of the same order of magnitude as the number of packages not required to be air-crash resistant. The test conditions would simulate primarily an accident of severity category VIII (see Reference 1 for the definition of accident severity categories) representing only 0.03% of all accidents; thus, the probability of such an occurrence is very small. Since the consequences are about the same, but the frequency of occurrence is so much smaller (55.3% of air crashes are estimated to cause releases from packages that are not air-crash resistant; 0.03% is about 1/1850 of that percent), the risk from the shipment of plutonium in air-crash-resistant package would be expected to be about three orders of magnitude less than the risk from the shipments of A_2 quantities in other than air-crash-resistant packaging. This risk is of negligible significance (0.0003×10^{-3} latent cancer fatalities per year $\cong 3 \times 10^{-7}$ LCF's per year).

The impact of the action to restrict air transport of plutonium to the air-crash-resistant package rather than allowing air transport of plutonium without such packaging is to reduce radiological risks. The air-crash-resistant packaging reduces only slightly the external population doses from the incident free transport of plutonium; however, it has been shown above that these doses are insignificant. The air-crash-resistant package greatly reduces the radiological risk from accidents during air transport of plutonium; it also virtually eliminates the possibility of large public health consequences under any circumstances. An additional impact of requiring use of the air-crash-resistant package that has been considered is the use of nonrenewable resources. Since the primary materials used to construct the package are relatively small quantities of stainless steel and redwood, the use of nonrenewable resources is minimal.

CONCLUSION

The analysis above uses rudimentary methods to estimate the following categories of environmental impacts associated with shipment of plutonium in accordance with the proposed rule: public health consequences from incident-free transport, public risk from air crashes, consequences of severe air crashes, decontamination costs resulting from severe air crashes, and use of nonrenewable resources. The major impacts to the environment of restricting air transport of plutonium is to reduce radiological risks to the population and to virtually eliminate the possibility that a public catastrophe could result from the release of plutonium in a severe air crash. The analysis also estimates that permitting the shipment of an A_2 quantity or less of plutonium in other than air-crash-resistant packaging causes an increased risk of about 3×10^{-4} (about 1/3000) latent cancer fatalities per year resulting from air crashes and therefore does not significantly affect the environment.

Above it is stated that the shipment of all plutonium by all modes of incident-free transport under present regulations results in a risk of 5×10^{-3} latent cancer fatalities. The risks as estimated here associated with accidents involving plutonium shipped in accordance with the proposed rule is small in comparison to that. Also, the total risk resulting from the proposed rule would then be smaller than the number above, 5×10^{-3} latent cancer fatalities. Other impacts considered are also negligible. Thus it is concluded that the proposed action produces no significant impact on the quality of the human environment; therefore an environmental impact statement need not be prepared.

APPENDIX A

ACUTE VS. LONG TERM EFFECTS OF PLUTONIUM INHALATION

This appendix considers acute health effects and concludes that calculating long-term health effects is more conservative (produces the most deaths) than calculating some acute and some long-term effects. This ignores the difference in public perception between the occurrence of long-term statistical deaths and the occurrence of short-term individual deaths.

Consideration of Acute Health Effects

From "An Estimate of Early Mortality and Morbidity Following Acute Inhalation of Plutonium" by Marvin Goldman (1976) [Reference 2] we have taken his estimate of the dose ranges that cause first year mortality from inhalation of Pu-239, in particular 67000 rem as the LD 50/365*. The effects of acute plutonium inhalation leading to death are primarily fibrosis and pulmonary insufficiency. If a curie of plutonium-239 were inhaled by people so that each received the estimated LD 50/365 of 67000 rem to the lung, 1791 people could receive this dose from the one curie:

$$\frac{1.2 \times 10^8 \text{ rem/Ci}}{67000 \text{ rem/person}} = 1791 \text{ people per curie}$$

The rem/Ci value in the numerator is the one-year lung dose from inhalation of Pu-239 as shown in Table A-1.

Presumably 50% or 896 of these would die from acute effects in the first year and those that survive the first year would be subject to risks of cancer fatality:

*The dose level corresponding to 50% fatality among the exposed population within one year from the time of exposure.

$$\frac{1791 \text{ people}}{\text{curie}} \times 67000 \text{ rem} = 1.2 \times 10^8 \text{ person-rem/Ci}$$

With a risk of 22.2 deaths per million person-rem (considering lung dose only), 1.2×10^8 person-rem could result in 2664 deaths:

$$\frac{22.2 \text{ deaths}}{10 \text{ person-rem}} \times 1.2 \times 10^8 \text{ person-rem} = 2664 \text{ deaths}$$

Of course, if only 896 people received this dose who had not succumbed to acute effects, the maximum number of deaths from cancer could not exceed 896, and from both effects the maximum number of deaths would be 1791 per curie.

TABLE A-1

One-year Lung Dose for Various Isotopes of Plutonium as Taken from WASH-1400 (Appendix VI)*[3]

Isotope	1-Year Lung Dose (rem/Ci)
Pu-238	1.2×10^8
Pu-239	1.2×10^8
Pu-240	1.2×10^8
Pu-241	6.4×10^4
Pu-242	1.9×10^8

*Pu-242 1-year dose is taken from the 50-year dose in NUREG-0170 and the proportionality of the 1- to 50-year doses for Pu-239 in WASH-1400, both being extremely long-lived nuclides of the same element.

If instead this curie were distributed such that each person received a dose of 9500 rem ($\cong$ the LD_{100}), although approximately all would die in the first year from acute lung effects, only 1263 could be affected:

$$\frac{1.2 \times 10^8 \text{ rem/Ci}}{95000 \text{ rem/person}} = 1263 \text{ people/CI}$$

As we lower the dose to each person more people would be involved, fewer acute deaths would be caused, and long-term cancer fatalities would be increased.

The maximum cancer fatalities per curie of Pu-239 is 1.24×10^4/Ci inhaled by a large population. So it can be seen that the most deaths would be caused if a larger number of people received the same total activity and these deaths would be a result of a cancer induction.

In Goldman's paper, it states that the reduction of dose in the first year was not considered in his calculations and this could change his estimate by a factor of 2 or 3 or 22000 to 33000 rem for the LD 50/365. Also, it might be argued that a quality factor of 20 instead of 10 should have been used. It is most likely that both these changes are valid but they would tend to cancel each other out. The greatest potential change, however, could be a threefold increase in the maximum acute deaths per curie but this would not change our conclusion at all.

For Pu-240, and Pu-242, we can use the same estimate for LD 50/365. Since they are all alpha emitters of very long half-life and similar α energy (and similar LET) to Pu-239, the LD 50/365 would be very similar. These calculations were repeated for these nuclides with similar results and the same conclusion, as shown in Table A-2.

For Pu-241, a beta emitter, the LD 50/365 of ^{90}Sr - ^{90}Y would give a better approximation: 43000 rem. In this case the number of acute fatalities is extremely low.

Since all these nuclides of plutonium give lower numbers of deaths/curie if distributed in doses high enough to give acute effects, the three mixtures under consideration would behave the same. For these reasons we will consider only latent cancer fatalities since the highest number of deaths could result from a distribution of the plutonium to a greater number of people.

TABLE A-2

Comparison of Maximum Acute and Long-Term Fatalities for Various Plutonium Isotopes

Isotope	Latent Cancer Deaths*/Ci (Inhaled by a large Population)	Maximum Acute Deaths/Ci Inhaled at LD 50/365 to Each Person
Pu-238	1.21×10^4	1790
Pu-239	1.24×10^4	1790
Pu-240	1.24×10^4	1790
Pu-241	1.30×10^2	2
Pu-242	1.40×10^4	2840

*From bone and lung doses.

APPENDIX B

BASIS FOR DETERMINING RADIOLOGICAL IMPACTS OF AIR TRANSPORT OF AN A_2 QUANTITY OF PLUTONIUM WITHOUT SPECIAL PACKAGING

The following shows the method of determining doses and latent cancer fatalities that could possibly result from the release of the various plutonium isotopes and some mixtures.

Although reactor fuel would generally not be shipped by air in quantities less than an A_2 quantity, which are proposed to be allowed to be shipped in other than air crash-resistant packaging, there may be items containing mixtures of plutonium isotopes (e.g., assay samples) so plutonium mixtures resulting from fuel reprocessing are included here as examples of how such mixtures might compare to the various isotopes of plutonium in regards to radiological impact.

Table B-1 describes these mixtures in terms of weight percent of the various nuclides and gives their specific activities. Table B-2 gives the rem per curie inhaled values used to calculate the doses; only bone and lung doses are calculated since these are by far the most significant organ doses contributing to health effects, i.e., latent cancer fatalities (LCF's). By using the risk factors 6.9 bone LCF's per 10^6 person-rem to the bone and 22.2 lung LCF's per 10^6 person-rem to the lung (which are BEIR coefficients for a 75-year lifetime of potential cancer development as used in NUREG-0170), Table B-3 is obtained from Table B-2 and shows the latent cancer fatalities per curie inhaled by a large population.

From this table one can see that the maximum number of LCF's for any nuclide or mixture of nuclides of plutonium is 1.4×10^4 LCF's per curie inhaled by a large population for plutonium-242. This is an unrealistically high value obtained by assuming that all the plutonium is retained in the lungs of the exposed population. In order to determine in a more realistic fashion the number

of LCF's that could result from the release of an A_2 quantity, one must estimate what quantity of plutonium in the package will in fact be retained in the lungs by members of the exposed population. Table B-4 lists the A_1 and A_2 quantities for various isotopes and common mixtures of plutonium. The largest product of A_2 quantity and LCF's/Ci (Tables B-4 and B-3) is obtained for Pu-242. Thus, analysis of an accident involving an A_2 quantity (3 mCi) of Pu-242 represents a bounding case. Of the plutonium present in a package involved in an accident, a fraction is released, a fraction of that is aerosolized, a fraction of that is in respirable-sized particles, and a small fraction of that is actually inhaled by members of the public. This last fraction depends on the dispersion in the air and the population distribution. With some rough, conservative estimates for these factors, it is easy to show that the consequences from the release of an A_2 quantity of Pu-242 is insignificant. If one assumes the following:

Percent	Quantity
100 released	3 mCi
50 aerosolized	1.5 mCi
50 respirable	0.75 mCi
1 inhaled by a population	7.5 μCi

For Pu-242 with the highest rem/curie inhaled value this amount inhaled would cause an estimated 0.105 latent cancer fatalities from the involvement of 3 millicuries of Pu-242 in a severe accident. For Pu-238 the most common isotope which would be involved, the number would be .091 latent cancer fatalities. Thus even for an air crash obliterating multiple shipments, no sizeable impact would occur, much less a catastrophe.

To estimate the radiological risk of allowing up to an A_2 quantity of plutonium to be shipped in other than air crash-resistant packaging, one needs to estimate the likelihood of such an accident, as well as the consequences. In order to do this we use some of the analysis in the Final Environmental Statement

on the Transportation of Radioactive Material by Air and Other Modes NUREG-0170. For the purposes of this appraisal, the release fractions for type A packages of Model II (the more realistic, less conservative package release fraction model) have been assumed (p. 5-23, Table 5-8) and the fractional occurrences per severity category are taken from p. 5-8, Table 5-2. From these data one calculates an average release of 0.0717 or 7.17% of the contents of each package involved in an accident (use of an average release fraction based on the fractional occurrence of the various release fraction values is equivalent to calculating consequences and determining average risk on the basis of fractional occurrence of each accident severity). It was also assumed that as many as 5200 shipments are made annually, of one package each, of plutonium in A_2 quantities or less. Page A-22, Table A-8 of NUREG-0170 estimates approximately this number of type A packages shipped by air in 1985 (based on an extrapolation of 1975 shipping activity); many of these would actually be special form material in quantities exceeding the A_2 quantity for normal form, so the value of 5200 shipments is a conservative estimate. These shipments are assumed to average 594 km/shipment (ref. 1, p. A-13). The overall accident rate of 1.44×10^{-8} accidents/kilometer was also taken from NUREG-0170 (p. 5-8 and elsewhere). If one conservatively assumed the maximum contents of 3 mCi of Pu-242 for all packages, the result is as follows:

$$5200 \frac{\text{pkgs}}{\text{yr}} \times 1 \frac{\text{shipment}}{\text{pkg}} \times \frac{594 \text{ km}}{\text{shipment}} \times 1.44 \times 10^{-8} \frac{\text{accidents}}{\text{km}} \times$$

$$\times 0.0717 \frac{\text{of contents released}}{\text{accident}} \times 3 \text{ mCi} \times 0.105 \frac{\text{latent cancer fatalities}}{3 \text{ mCi release}}$$

$= 3.35 \times 10^{-4}$ LCF or approx. 3×10^{-4} LCF annually from allowing an A_2 quantity of plutonium to be transported by air in other than crash-resistant packaging.

(For purposes of comparison, if 10 μCi instead of an A_2 quantity were used as the limit for shipments in packaging not certified to be air-crash resistant, the risk would be 1.12×10^{-6} LCF annually.)

TABLE B-1

Isotopic Content (Weight Percent) and Dosimetric Impact of Various Mixtures of Plutonium Associated with Light Water Reactors (ref. 1, p. C-4)

Isotope	High-burnup LWR fuel*	Predicted 1990 industry avg.	Predicted Equilibrium recycle
Pu-238	1.9	1.2	3.4
Pu-239	63.0	53.0	41.7
Pu-240	19.0	25.8	27.1
Pu-241	12.0	13.5	15.4
Pu-242	3.8	6.0	11.7
Am-241	0.6	0.7	0.7
Specific Activity (ci/gm)**	12.3 (0.4)	13.68 (0.32)	15.93 (0.69)

* 35,000 MWD/tonne-Yankee fuel.

** Values for the alpha component of activity are shown in parentheses.

TABLE B-2

Specific Activity and Dose Commitment from Some Isotopes of Plutonium and Mixtures of Plutonium
(Plutonium doses from ref. 1, p. C-3)

Isotope	Specific Activity (ci/gm)	Type of Radiation	50-Year Bone Dose (rem/ci inhaled)	50-Year Lung Dose (rem/ci inhaled)
Pu-238	17.1	α	7.6×10^8	3.1×10^8
Pu-239	0.06	α	8.7×10^8	2.9×10^8
Pu-240	0.228	α	8.7×10^8	2.9×10^8
Pu-241	98.98	β	1.7×10^7	5.9×10^5
Pu-242	0.00382	α	5.5×10^8	4.6×10^8
High Burnup LWR Fuel	12.3	α,β	3.47×10^7	1.06×10^7
Predicted 1990 Industry Average	13.68	α,β	3.50×10^7	7.13×10^6
Predicted Equilibrium Recycle	15.93	α,β	5.03×10^7	1.85×10^7

TABLE B-3

Maximum Latent Cancer Fatalities Per Curie of Inhaled Material for Various Plutonium Isotopes and Mixtures

	LCF's (Latent Cancer Fatalities/Ci inhaled by a large population)		
Isotope	Bone	Lung	Total
Pu-238	5.24×10^{3}	6.88×10^{3}	1.21×10^{4}
Pu-239	6.00×10^{3}	6.44×10^{3}	1.24×10^{4}
Pu-240	6.00×10^{3}	6.44×10^{3}	1.24×10^{4}
Pu-241	1.17×10^{2}	13.1	1.30×10^{2}
Pu-242	3.80×10^{3}	1.02×10^{4}	1.40×10^{4}
High Burnup LWR Fuel	2.39×10^{2}	2.35×10^{2}	4.75×10^{2}
Predicted 1990 Industry Average	2.42×10^{2}	1.58×10^{2}	4.00×10^{2}
Predicted Equilibrium Recycle	3.47×10^{2}	4.11×10^{2}	7.58×10^{2}

TABLE B-4

A_1 and A_2 quantities for various plutonium isotopes and some common mixtures

Isotope	A_1 (Ci)	A_2 (Ci)	Specific Activity (Ci/g)
Pu-238	3	0.003	17
Pu-239	2	0.002	6.2×10^{-2}
Pu-240	2	0.002	2.3×10^{-1}
Pu-241	1000	0.1	1.1×10^{2}
Pu-242	3	0.003	3.9×10^{-3}
High Burnup LWR Fuel	75.34	0.0455	12.3
Predicted 1990 Industry Average	105.1	0.0546	13.68
Predicted Equilibrium Recycle	62.32	0.0406	15.93

REFERENCES

1. U.S. Nuclear Regulatory Commission, Office of Standards Development, "Final Environmental Statement on the Transportation of Radioactive Material by Air and Other Modes," Volume 1, December 1977, NUREG-0170.

2. M. Goldman, "An Estimate of Early Mortality and Morbidity Following Acute Inhalation of Plutonium," University of California (Davis), October 1976.

3. U.S. Nuclear Regulatory Commission, "Reactor Safety Study," Appendix VI, October 1975, WASH-1400.

4. U.S. Nuclear Regulatory Commission, Office of Nuclear Material Safety and Safeguards, "Qualification Criteria to Certify a Package for Air Transport of Plutonium," January 1978, NUREG-0360.

ENCLOSURE 5

INFORMATION SUMMARY FOR REGULATION DETERMINATION

This summarizes information to assist the Commission in making the determination required for compliance with the Regulatory Flexibility Act.

The Requirement:

The Regulatory Flexibility Act in § 605(b) indicates that the requirements to prepare a regulatory flexibility analysis do "not apply to any proposed or final rule if the head of the agency certifies that the rule will not, if promulgated, have a significant economic impact on a substantial number of small entities. If the head of the agency makes a certification under the preceding sentence, the agency shall publish such certification in the Federal Register, at the time of publication of general notice of proposed rulemaking for the rule or at the time of publication of the final rule, along with a succinct statement explaining the reasons for such certfication, and provide such certification and statement to the Chief Counsel for Advocacy of the Small Business Administration."

NRC Compliance:

The preamble to the proposed rule (under the heading "Regulatory Flexibility Certification") states:

> "In accordance with the Regulatory Flexibility Act of 1980, 5 U.S.C. 605(b), the Commission hereby certifies that this rule will not, if promulgated, have a significant economic impact on a substantial number of small entities. The proposed regulation, if promulgated, will relieve the restrictions on the air shipment of plutonium imposed by the current NRC order to licensees by permitting the air shipment of small quantities of plutonium in packaging other than that certified to be air-crash resistant. Currently

the schedules and work routine principally of small organizations, are disrupted by the inability to acquire small calibration sources containing plutonium in a timely fashion by air shipment. Because the proposed regulation reduces the regulatory burden imposed by the NRC's current order to licensees, the proposed rule does not have a significant economic impact within the context of the Regulatory Flexibility Act."

Since a certification and a succinct statement explaining the reasons for the certification are included in the preamble to the proposed rule, a regulatory flexibility analysis need not be prepared. At the time the proposed rule is sent forward to the Office of the Federal Register, the Division of Rules and Records will provide a copy of the certification and accompanying statement to the Chief Counsel for Advocacy of the Small Business Administration. Thus, the requirements of the Regulatory Flexibility Act are fully met for this stage of rulemaking.

The principal reason for making the determination of "no significant impact on a substantial number of small entities," is that the proposed regulation reduces the regulatory burden imposed by the NRC's current order to licensees. Based on the usage of the term "impact" in the Regulatory Flexibility Act and based on the purpose of this Act as revealed by its legislative history, the staff concludes that negative impacts, i.e., additional regulatory burdens, were intended to be subjected to the requirements of a regulatory analysis. The Value/Impact Statement (Enclosure 3 to the Commission paper) evaluates the effect of this regulation on government agencies other than NRC (Section 1.3.2), industry (Section 1.3.3), and the public (Section 1.3.4). This evaluation shows that the regulation will reduce the current regulatory burden. It should also be

noted that the relief provided by the regulation will be disproportionately to the advantage of small entities, since it is primarily small organizations whose schedules and work routines are disrupted by the inability to acquire small calibration sources (containing plutonium) in a timely fashion by air shipment. Larger organizations have the logistic and financial resources to more readily surmount such difficulties. For example, a large organization has the financial resources to acquire and use an air-crash-resistant package for the air shipment of small and large quantities of plutonium, while a small organization would probably find it ill advised to acquire an air-crash-resistant package to ship a limited number of small calibration sources.

ENCLOSURE 6

ANALYSIS WITH RESPECT TO PERIODIC SYSTEMATIC REVIEW OF REGULATIONS
(TMI ACTION PLAN TASK IV.G.2)

SUBJECT: 10 CFR Part 71

Criteria for Periodic and Systematic Review of Regulations	NRC Compliance
1. The proposed regulations are needed	The need for this regulation is discussed in Section 1.2 of the Value/Impact Statement. The principal need stems from the requirement to restrict the air transport of plutonium as mandated by Congress in Public Law 94-79 (the Scheuer Amendment).
2. The direct and indirect effects of the regulations have been adequately considered.	The direct and indirect effects of this proposed regulation are considered in Section 1.3 of the Value/Impact Statement and in the Environmental Impact Appraisal.
3. Alternative approaches have been considered and the least burdensome of the acceptable alternatives has been chosen.	Two sets of technical alternatives and two sets of procedural alternatives are discussed in Sections 2 and 3, respectively of the Value/Impact Statement. The least burdensome of the alternatives, acceptable from the point of view of public health and safety and of legal requirements, were chosen.
4. Public comments have been considered and an adequate response has been prepared.	Commission action on this rule will define NRC policy and constitute a definitive response to a petition for rule-making (PRM 70-6). This petition to permit shipment of small quantities of plutonium by air and comments received upon public notice of the petition were considered in formulating this proposed regulations.

Enclosure 6

SUBJECT: 10 CFR Part 71

Criteria for Periodic and Systematic Review of Regulations	NRC Compliance
5. The regulation is written in plain English and is understandable to those who must comply with it.	The language of this regulation is consistent with that currently used in 10 CFR Part 71. The citation by reference to "an A_2 quantity of plutonium" will be unnecessary, when the proposed changes to Part 71 are made final, which is anticipated to be before this proposed rule is issued in final form (i.e., within a month or two).
6. An estimate has been made of the new reporting burdens or recordkeeping requirements necessary for compliance with the regulation.	In general, no new reporting or recordkeeping requirements are imposed by this regulation. Licensing and use of air-crash-resistant packaging will involve compliance with the license application, recordkeeping, and reporting requirements already in place in Part 71.
7. The name, address, and telephone number of a knowledgeable agency official is included in the publication.	The Federal Register notice for this proposed rule cites the OSD Task Leader as a contact for further information.
8. A plan for evaluating the regulation after its issuance has been developed.	Public comments on this proposed rule will be evaluated to formulate the final rule. After issuance as a final rule, licensee and staff experience with the regulation will be used to evaluate the regulation. In addition, this regulation will be reviewed in the second cycle of NRC's periodic and systematic review process (1986-1991).