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 a 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 Scheme 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 small 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.

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 prohibid 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.

VIRONMENTAL 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	1.9×10^3

*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	2810

* 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 assume (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.

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.

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).