EEG-89

A RATIONALE FOR MAINTAINING THE DOUBLE CONTAINMENT REQUIREMENT FOR PLUTONIUM SHIPMENTS

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New Mexico

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FOREWORD

The purpose of the New Mexico Environmental Evaluation Group (EEG) is to conduct an independent technical evaluation of the Waste Isolation Pilot Plant (WIPP) Project to ensure the protection of the public health and safety and the environment of New Mexico. The WIPP Project, located in southeastern New Mexico, became operational in March 1999 for the disposal of transuranic (TRU) radioactive wastes generated by the national defense programs. The EEG was established in 1978 with funds provided by the U.S. Department of Energy (DOE) to the State of New Mexico. Public Law 100-456, the National Defense Authorization Act, Fiscal Year 1989, Section 1433, assigned the EEG to the New Mexico Institute of Mining and Technology and continued the original contract DE-AC04-79AL10752 through DOE contract DE-AC04-89AL58309. The National Defense Authorization Act for Fiscal Year 1994, Public Law 103-160, and the National Defense Authorization Act for Fiscal Year 2000, Public Law 106-65, continued the authorization.

EEG performs independent technical analyses on a variety of issues. Now that the WIPP is operational, these issues include facility modifications and waste characterization for future receipt and emplacement of remote-handled waste, generator site audits, contact-handled waste characterization issues, the suitability and safety of transportation systems, mining of new panels, analysis of new information as part of the five year recertification cycles as mandated by the WIPP Land Withdrawal Act. Review and comment is also provided on the annual Safety Analysis Report and Proposed Modifications to the Hazardous Waste Facility Permit. The EEG also conducts an independent radiation surveillance program which includes a radiochemical laboratory.

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ACRONYMS AND SYMBOLS

A & R	Aeorosolized and Respirable
AEC	Atomic Energy Commission
ALARA	As Low As Reasonably Achieveable
C & C	Consultation and Cooperation [Agreement]
CERLA	Comprehensive Environmental Restoration, Compensation, and Liability Act
CFR	Code of Federal Regulations
CH TRU	Contact Handled Transuranic Waste
DOE	Department of Energy
DOT	Department of Transportation
EEG	Environmental Evaluation Group
EPA	Environmental Protection Agency
IAEA	International Atomic Energy Commission
ICV	Inner Containment Vessel
LWA	Land Withdrawal Act
NEPA	National Environmental Policy Act
NRC	Nuclear Regulatory Commission
OCV	Outer Containment Vessel
POC	Pipe Overpack Containers
PTA	Preliminary Transportation Analysis
RCT	Radiation Control Technician
RDD	Radiological Dispersal Device
RH TRU	Remote Handled Transuranic Waste
SAR	Safety Analysis Report
SARP	Safety Analysis Report for Packaging
SEIS-II	Waste Isolation Pilot Plant Disposal Phase Supplemental Environmental Impact Statement
SNL	Sandia National Laboratories
SWB	Standard Waste Box

WGA	Western Governors' Association
WH	Waste Handlers
WIPP	Waste Isolation Pilot Plant
WRAP	[Hanford's] Waste Receiving and Processing Facility

SYMBOLS

Bq	Becquerel
Ci	Curie
KeV	Thousand electron volts
kg	Kilogram
km	Kilometer
mrem	millirem
PE-Ci	Plutonium Equivalent Curies
TBq	Terra Becquerel (10^{12})

EXECUTIVE SUMMARY

Current U.S. Nuclear Regulatory Commission (NRC) transportation regulations (10 CFR 71.63 (b)) require that all shipments containing more than 20 curies of plutonium must be transported in packages that provide double containment. On April 30, 2002 the NRC issued a proposed rule that would eliminate §71.63(b) and the double containment requirement.

NRC's reasons for proposing elimination of §71.63(b) are: (1) compatibility with International Atomic Energy Agency Transportation Safety Standards (which do not have the requirement); (2) the current rule is inconsistent with the A_1/A_2 system since it applies only to plutonium; (3) double containment causes a heavier package and results in higher transportation costs; (4) the separate inner containment results in additional radiation exposure; and (5) while there would be additional protection from a separate inner container in an accident; this type of approach is not "risk informed nor performance based."

The Environmental Evaluation Group (EEG) has been a proponent of the double containment requirement for the Waste Isolation Pilot Plant (WIPP) shipments for twenty years. This requirement affects shipments to WIPP much more than any other current or planned shipping campaign because reactor fuel elements, metal or metal alloy, and vitrified high-level waste are exempt from §71.63(b). EEG submitted comments on the Proposed Rule on July 26, 2002 (Appendix C). This report is an update and expansion of the July 26, 2002 comments. Actual WIPP experience with shipments in the double contained TRUPACT-II package is used to respond to NRC arguments for deletion of §71.63(b) and offers a rationale for maintaining the current requirement.

Both the NRC and the U.S. Department of Energy (DOE) claim that additional worker doses will occur from the extra handling required in loading and unloading a double contained package. Analyses in this report lead to exactly the opposite conclusion because of three reasons: (1) total doses at WIPP from unloading wastes from TRUPACT-II are lower than assumed by DOE; (2) the extra time to load a TRUPACT-II was observed to be small; and (3) the 0.25 inch steel Inner Containment Vessel (ICV) attenuates more than 50% of the gamma radiation from transuranic wastes. This attenuation reduces doses from a closed TRUPACT-II to workers, truck drivers, and the public. That reduction more than offsets any increased dose incurred during the limited time that the package is open.

Any given package will weigh more if it also includes an ICV to provide double containment. This extra weight will reduce the payload and increase the ton-miles that must be transported and could increase the number of required shipments. However, two existing package designs with single containment are either similar in weight (TRUPACT-I) or heavier (TRUPACT-III) than TRUPACT-II. Also, DOE shipping practices for WIPP indicate that minimizing the number of shipments is not a high priority.

Both NRC staff and DOE agree there would be less probability of a radionuclide release from a severe accident with a double contained package, but conclude the risk is small enough with single containment. Analyses in Chapter 4 using methodology and assumptions made by others came to the conclusion that a radionuclide release during the (approximately 30,000 shipment) WIPP shipping campaign was unlikely from a double contained package and likely from a single contained package. Transportation disruption, public perception problems, and economic costs of decontamination lead to the conclusion it is important to try to avoid even a single release accident.

A double contained package would be more likely than a single contained package to maintain its integrity or minimize releases from a terrorist attack. It would be inconsistent to reduce the integrity of shipping packages containing high-risk radioactive material at a time of increased terrorist threats.

The Q-system in 10 CFR 71 provides A_1 and A_2 values that normalize the risk of about 390 radionuclides. The NRC staff contends that it is inconsistent to apply §71.63(b) to only plutonium, especially since there are several radionuclide with lower A_2 values. However, none of the radionuclides with lower A_2 values are likely to be shipped in large quantities. The primary "practical" inconsistency for the WIPP inventory is that the rule includes ^{241}Pu which has an A_2 value 50 times that of ^{239}Pu and does not include ^{241}Am which has the same A_2 value as ^{239}Pu. The "practical" inconsistency could be corrected by having §71.62(b) apply to all radionuclides that have A_2 values equal to or less than ^{239}Pu.

Section 71.63(b) should be retained. The A_1/A_2 inconsistency can be easily corrected if considered important.

1.0 INTRODUCTION

1.1 Statement of Issue

Current U.S. Nuclear Regulatory Commission (NRC) transportation regulations require that all shipments of plutonium containing more than 20 curies (Ci) must be transported in packages that provide double containment. Special requirements for plutonium shipments are specified in 10 CFR 71.63. Section 71.63(a) specifies that "Plutonium in excess of 0.74 TBq (20 Ci) per package must be shipped as a solid." Section 71.63(b) specifies that "plutonium in excess of 0.74 Bq (20 Ci) per package must be packaged in a separate inner container that meets the requirements of Subpart E and F of this part for packaging of material in normal form..."

The entire text of §71.63(a) and (b) is included in Appendix A. The term "normal form" is defined in 10 CFR 71.4 as radioactive material that has not been demonstrated to qualify as "special form radioactive material."

Section 10 CFR 71.63(b) specifically exempts solid plutonium in (1) reactor fuel elements; (2) metal or metal alloy; and (3) vitrified high-level waste from this requirement. The NRC may also exempt other plutonium bearing solids from this requirement.

On April 30, 2002 the NRC issued a proposed rule. Issue 17 (out of a total of 19 issues) proposed that §71.63(b) be eliminated. Section 71.63(a), prohibiting shipments of plutonium in liquid form would be retained (NRC 2002, p 21421). The Environmental Evaluation Group (EEG) submitted comments on this proposed rule on July 26, 2002 (Appendix C).

EEG in its role of conducting independent technical evaluations of the Waste Isolation Pilot Plant (WIPP) project has included transuranic waste transportation evaluations. Since 1983 EEG has expressed reservations about the use of single contained packages for shipments to WIPP. EEG's current position continues to be that the double containment requirement in §71.63(b) should be retained.

This report (an update and expansion of our July 26, 2002 comments) addresses assertions made by the NRC staff and others that are recommending deletion of §71.63(b) and offers our rationale for recommending that the current requirement be maintained. Actual WIPP experience with shipments in the double contained TRUPACT-II is considered where appropriate.

1.2 Regulatory History

A condensed history and supporting rationale for the initial adoption of §71.63 in 1974 as well as the 2002 proposal is provided in the Federal Register (NRC 2002). The impetus for adoption of §71.63 was the Atomic Energy Commission's (AEC) (predecessor to NRC) expectation that the U.S. commercial nuclear power industry would incorporate spent fuel reprocessing and recycle large quantities of plutonium into mixed oxide fuel.

1.2.1 Adoption of §71.63(a)

There was an expectation that the industry might want to ship this plutonium in liquid form as plutonium nitrate. The AEC decided that shipments of liquids were an unnecessary risk and prohibited this in §71.63(a). Part of the rationale for this decision was:

> 4. The probability of human error with the packaging for liquid, anticipated to be more complex in design, is probably greater than with the packaging for solid. Furthermore, should a human error occur in package preparation or closure, the probability of liquid escaping from the improperly prepared package is greater than for most solids and particularly for solid plutonium materials expected to be shipped (NRC 2002, p 21421).

The NRC staff considered proposing the elimination of the prohibition against shipments in liquid form in §71.63(a), but decided against it because the solid form requirement impacts only the contents of the package. Also the NRC staff did not believe any cost or dose savings would accrue from removal of §71.63(a).

1.2.2 Adoption of Section 71.63(b)

The proposed rule in 1974 included a requirement that plutonium be contained in a special form capsule and made no mention of double containment. Adoption of double containment came from:

> However, in response to comments from the AEC General Manager, the final rule changed the requirement to a separate inner container (i.e. the double containment requirement). The AEC staff indicated in a response to a public comment in Enclosure B (to SECY-R-74-172) that "[t]he need for the inner containment is based on the desire to provide a substitute for not requiring the plutonium to be in a 'nonrespirable' form" (NRC 2002, p 21422).

Another reason for requiring both solid form and double containment involved the expected large number of shipments:

> Because of the expectation of a significant increase in the number of liquid plutonium nitrate shipments, the AEC used a defense-in-depth philosophy (i.e. the double containment and solid form requirements) to ensure that respirable plutonium would not be released to the environment during a transportation accident (NRC 2002, p 21422).

1.2.3 Proposed Deletion of §71.63(b)

The current proposal to delete the double containment requirement came from two initiatives: (1) a September 25, 1997 petition from International Energy Consultants (NRC 1998); and (2) a desire to increase the compatibility of 10 CFR 71 with International Atomic Energy Agency (IAEA) Transportation Safety Standards (the IAEA does not have a double containment requirement).

The arguments raised by either the Petitioners and/or the NRC staff involved several different issues. These included: (1) limiting the double containment requirement to only plutonium was inconsistent with the Q-system for calculating A_1 and A_2 values that is contained in 10 CFR 71;

(2) double containment results in higher costs without a clearly measurable net safety benefit; (3) the separate inner containment results in additional radiation exposure because of the extra handling involved; and (4) while the NRC staff still believes a separate inner container would provide an additional barrier in an accident, this type of approach is not "risk informed nor performance based."

Each of these arguments are addressed in detail later in this report.

1.3 Relevance to the WIPP Project

1.3.1 Importance to WIPP

It is important to recognize that the double containment issue is for all practical purposes a WIPP issue only. The WIPP shipping campaign has already included over 2,100 shipments of transuranic waste and the lifetime total will probably be in excess of 25,000 shipments. All of these shipments have normal form material in exclusive use vehicles and most include Highway Route Controlled Quantities (49 CFR 173.403) of radioactive material (WWIS). There are no restrictions on shipments of respirable wastes to WIPP and many of the waste containers include respirable material. Most non-WIPP shipments of plutonium will be special form material and exempt from §71.63(b).

Since the WIPP project will receive almost all of the benefits or detriments from deleting 71.63(b) the decision should be based on WIPP specific evaluations rather than on general theoretical or philosophical arguments.

1.3.2 WIPP History with Double Containment

The DOE's initial intent was to have WIPP transportation packages certified by the NRC. The TRUPACT-I package was developed by Sandia National Laboratories (SNL) with the intent of having it certified by the NRC via an exemption. An exemption would have been necessary because the package contained two features that NRC prohibited: (1) it provided only single containment; and (2) it was continuously vented.

The EEG expressed concern about TRUPACT-I's lack of double containment in EEG-24 in August 1983 (Neill and Channell 1983) and questioned whether the package could be certified by NRC. In a July 28, 1985 letter commenting on the TRUPACT-I Draft Safety Analysis Report for Packaging (SARP) (SAND 83-7077) the EEG stated that the TRUPACT-I design was unacceptable for use in New Mexico (EEG 1985).

When it became apparent that TRUPACT-I would not be certifiable by NRC the DOE petitioned (DOE 1987) the U. S. Department of Transportation (DOT) to approve the package. The DOT responded to this petition (Roberts 1987) with a number of questions and the observation that 49 CFR 173.417 authorizes the NRC to approve Type B packaging.

The attempt by DOE to circumvent NRC certification came to the attention of the Governor and the New Mexico Congressional Delegation and letters were sent to DOT by Governor Garrey Carruthers (April 20, 1987 to A. I. Roberts) and on March 16, 1987 to Cynthia Douglas by four members of New Mexico's Congressional Delegation (Senators Domenici and Bingaman and Representatives Richardson and Skeen) urging DOT to reject the petition.

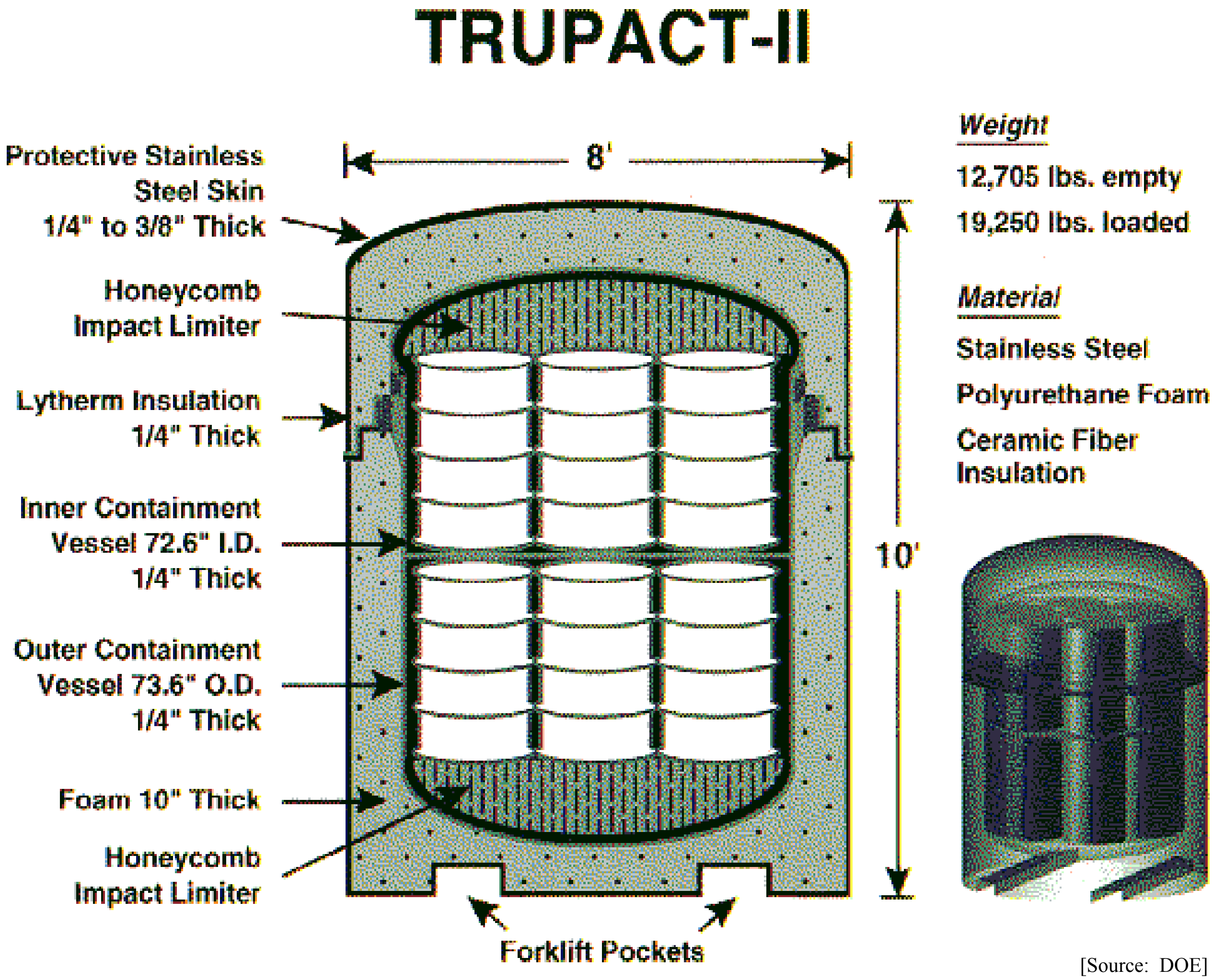
The second Modification to the July 1, 1981 "Agreement for Consultation and Cooperation" on WIPP by the State of New Mexico and U.S. Department of Energy (C&C 1987) specified that, "All waste shipped to WIPP will be shipped in packages which the Nuclear Regulatory Commission has certified for use." This stipulation was later included in the Land Withdrawal Act (LWA). Note that the C&C Agreement and the LWA require that the package be certified by the NRC, not necessarily double contained.

Problems with the TRUPACT-I design led to the design, testing, and NRC certification of the double contained TRUPACT-II. A full scale TRUPACT-II prototype was extensively tested with multiple 30-foot drops, 3-foot puncture tests, and a 30+ minute fully engulfing fire test prior to NRC certification. The NRC certification also had rigid payload requirements in order to control potential gas generation, waste stability, and criticality problems from the waste contents. All waste shipments to WIPP to date have been in TRUPACT-II packages. Three other NRC certified packages are available for use: (1) the HalfPACT, a slightly smaller TRUPACT-II for carrying fewer and heavier waste packages; (2) the RH-72B cask for remote handled transuranic wastes (RH TRU); and (3) the 10-160B cask for RH TRU wastes. The HalfPACT and RH-72B are double contained. The 10-160B cask is single contained (limited to 20 Ci plutonium per shipment) and requires an overweight permit for highway transportation. All three packages have payload requirements similar to those of TRUPACT-II.

EEG has always been a strong proponent of the TRUPACT-II and its usage is also acceptable to the Western Governors' Association (WGA) whose member states have had considerable experience in monitoring shipments since 1999. We believe this acceptance is due to three factors: (1) the full scale testing of TRUPACT-II before certification; (2) the double containment feature; and (3) the safe shipping record to date. The WGA coordinated a July 29, 2002 letter to NRC Chairman Richard Meserve signed by six Western Governors that objected to the April 30, 2002 proposal to remove the double containment requirement.

Figure 1-1 shows a cross section of TRUPACT-II including the double containment feature. Figure 1-2 shows three TRUPACT-IIs on a trailer being transported to the WIPP site (in the background).

Figure 1-1. TRUPACT-II Packaging Components



[Source: DOE]

Figure 1-2. TRUPACT-IIs on a Trailer

[Source: DOE]

2.0 EFFECT OF DOUBLE CONTAINMENT ON ACCIDENT FREE RADIATION DOSES

2.1 Occupational Doses

2.1.1 Claims of Increased Occupational Doses

In the preamble to the proposed rule, it was stated, "The NRC expects that cost and dose savings would accrue from the removal of §71.63(b)" (NRC 2002, p 21425). The 1997 petition from International Energy Consultants asserted there would be additional radiation exposure from "additional handling required for the separate inner container," but did not provide an analysis.

In section, 2.5.1.1 of an analysis authored by eleven consultants to DOE it is stated:

> Additional worker dose from extended exposure performing necessary work activities using the double-containment features could range from 1100 to 1600 person-rem depending on the shipping/receiving facility and crew size. The impact of dealing with the additional collective dose at WIPP, which has self-imposed an administrative worker dose limit of 1 rem/yr, would be to use more workers or develop more restrictive work processes…the additional radiation exposure would cause an incremental labor cost estimated to range from $17M to $25M (at $70/hr) for the shipments expected between now and 2012 (Kapoor and others 2002).

It is unclear how these doses and costs were derived. It was mentioned that the average exposure rate for TRUPACT-IIs handled to date was 1.4 mrem/hr, but could be as high as 10 mrem/hr. Also, that there would be 28,000 TRUPACT-II packages handled up to the year 2012 and for the entire WIPP life-cycle there could be 50,000 packages of CH-TRU waste and 7,000 packages of RH-TRU waste. There is no indication that actual radiation doses received in loading TRUPACT-IIs at generator sites or unloading them at WIPP were considered. Neither is there any indication that time-motion studies were performed of the additional time workers would be exposed due to the existence of double containment.

The DOE dose projection amounts to an average of 19.3 to 28.1 person-mrem per package handled over the WIPP life-cycle due only to double containment.

2.1.2 Doses Received to Date at WIPP

Doses received to date at WIPP have been low. From March 1999 through 2002 there were 3,180 TRUPACT-II packages received and the total dose to waste handlers (WHs) and Radiation Control Technicians (RCTs) was 2.226 person-rem. This averaged 0.70 person-mrem/package for all waste handling operations. Doses to "others" on site were 0.38 person-mrem/package and to truck drivers it was 0.13 person-mrem/package. The highest radiation dose received by any individual in a calendar year was 92 mrem. The highest average dose for a category (RCTs in 2002) was 40.1 mrem/year. The average surface dose rate for the 3,180 TRUPACT-IIs received through December 2002 has been 0.24 mrem/hr. A summary of the dose data, is in Appendix B (Gadbury 2003).

A 1988 time-motion study for CH-TRU waste handling at WIPP (DOE 1988) estimated that all doses received on the TRUDOCK would be only about 25% of the total dose received by the WH and RCT categories. Those doses received on the TRUDOCK that may be due to the double containment features are 5%-10% of the total WH and RCT dose. The results of this study lead to an estimated total dose due to double containment of ≤ 0.07 person-mrem per TRUPACT-II. The extra double containment dose would be 3.2% - 6.4% of the total on-site dose.

2.1.3 Observed Loading of TRUPACT-II

Loading of a TRUPACT-II was observed by one of the authors at the Hanford Waste Receiving and Processing (WRAP) facility on June 17, 2003. The procedure involves lowering a 14 drum unit into the Inner Containment Vessel (ICV) by overhead crane. This took about seven minutes and a worker was approximately one foot from the TRUPACT-II during the first portion of this process. However, this operation would have been necessary if the drums were being lowered into an Outer Containment Vessel (OCV). The ICV lid was then placed on the ICV by the overhead crane. One person was near the ICV for several minutes while the lid was being transferred. Four persons were near the lid for about one minute while it was being set and locked. This operation could have been done by two or three persons. Leak tests are then performed on the ICV. This procedure involves installing and later removing sampling tools in two vent ports. The time to do all of these operations (which require the person to be next to the TRUPACT-II) was less than three worker-minutes. The person doing the leak testing was about five feet from the TRUPACT-II during the approximately 15 minutes it took to do the leak test. His station could have been farther away from the TRUPACT-II. The next steps involve the placement and locking of the OCV lid and leak testing of the OCV cavity. So, the only steps involving the ICV are placing the ICV lid and the leak testing described above. Also, workers performing leak tests for both the ICV and OCV had the benefit of shielding from both the ICV and OCV. This would, at least partially, offset the additional small dose that occurred from having to perform two sets of leak tests.

Other portions of the loading procedure involved much more exposure to radiation. The two most significant ones were: (1) checking radiation levels and labels on each drum; and (2) assembling the 14 drums onto slip sheets and binding with stretch wrap. In procedure (1), the 14 drums are spread out about two feet apart. Two RCTs were adjacent to the drums for about one-half hour each. Others workers spent perhaps 20 worker-minutes checking labels and serial numbers. Procedure (2) required over 50 minutes and one waste handler was within two feet of the drums about 90% of the time. These Pipe Overpack Container (POC) drums had surface radiation levels that averaged about 2.8 mrem/hr. The ambient radiation level was less than 0.5 mrem/hr.

According to the TRUPACT-II Operations Manager, doses are very low during TRUPACT-II waste handling and loading operations. An administrative limit of 500 mrem per year is used. The Operations Manager doubts that anyone has yet received over 100 mrem/y and the higher doses would be for a worker involved mostly with handling and moving about individual drums.

Doses received during loading dock operations are considered to be trivial. The Manager and crew expressed no concerns about the radiation exposure being received. From personal observation of this loading operation, it was apparent that doses could have been reduced substantially in procedure (1) above and on the loading dock where several uninvolved workers often linger around the TRUPACT-II. At the present shipping rate (about eight TRUPACT-IIs per month) dose reduction from As Low As Reasonably Achievable (ALARA) procedures may not result in significant dose saving. However, ALARA procedures should be implemented because of planned higher shipping rates and perhaps higher radiation levels.

2.1.4 Discussion

DOE's projection of possible doses at WIPP and the $17-25 million cost are completely inconsistent with the history at WIPP to date. A straight extrapolation of historical doses would lead to a maximum annual dose of about 200 mrem (because the receiving rate could be up to about double the 2002 rate), but even this is conservative because there will be more WHs or RCTs with the higher receiving rate. There could be a several fold increase in the surface dose rate of containers which would further increase the collective dose at WIPP. Even so, it is concluded that maintaining a maximum individual dose of less than one rem per year (from all operations) should not be a problem. Extrapolation of the historical data leads to a collective life-cycle dose to WH and RCT personnel at WIPP of about 40 person-rem from all operations. The total dose received on the TRUDOCK would be about 10 person-rem and that due to double containment #4 person-rem. The total dose for all workers at WIPP would be about 69 person-rem. Doses received by workers at generating site loading docks are not available, but should be similar to those received by workers unloading at WIPP.

The claims of excessive individual and collective doses at WIPP due to double containment are without merit and should be rejected. The alleged associated costs should also be rejected.

2.2 Dose to Truck Drivers and the Public

2.2.1 Reduced Doses from Double Containment

A sealed TRUPACT-II with double containment would have a lower external dose rate because the 0.25 inch (0.64 cm) thick stainless steel ICV would provide additional shielding. All radiation exposure by truck drivers, occupational persons (such as security guards) other than WHs and RCTs, and the public along transportation routes would receive lower doses due to the presence of an ICV.

The NRC proposed rule did not recognize that there would be reduced external radiation doses from a closed package with double containment. Kapoor and others (2002) did recognize this fact, stating in Section 2.6.1:

> The risk incurred by the public in incident-free transport relates principally to exposure to radiation from the package. Double containment has an impact on this source of risk because the extra boundary shields some small fraction of the radiation. However, the reduction is likely to be relatively small.

The transuranic radionuclides emit a number of different energy gamma rays between 100 and 665 keV with a very low frequency (#10^{-4} total gamma emissions per nuclear transformation). These result in a measurable radiation dose when dealing with curie quantities of radionuclides. Attenuation of these relatively soft gamma rays from transuranic radionuclides would be significant in the 0.25 inch thick ICV. It would involve a number of assumptions (especially the energy spectrum incident upon the ICV) and complex calculations to estimate the average attenuation caused by the ICV. However, an indication of the probable level of attenuation can be obtained from Table 2-1. It appears that attenuations of greater than 50% could occur for gamma radiation $100 keV. Attenuation of the 60 keV ^{241}Am gamma ray is ignored because it would probably be negligible after attenuation in the waste, the 0.25 inch outer containment vessel, and the 0.25 - 0.37 inch outer stainless steel shell.

Table 2-1. Attenuation of Gamma Radiation by 0.25 Inch Steel

Nuclide	Energy keV[a]	% of Initial Dose	Attenuation[c]
^{239}Pu	99	5.1	0.16
	129	31.9	0.26
	204	4.6	0.48
	336	1.5	0.59
	345	7.6	0.60
	375	23.3	0.61
	414	24.0	0.63
^{241}Am			
	60	(-)	0.0025
	125	44.9[b]	0.24
	208	14.4	0.49
	335	14.2	0.59
	377	4.5	0.61
	662	21.4	0.69

[a] Source of energies and abundance: Clark and Decman 1998
[b] Initial dose does not include 60 keV radiation
[c] Final intensity (I)) Initial Intensity (Io)

The weighted average attenuation (I/Io) of these dominant gamma emissions is about 0.46 for ^{239}Pu and 0.44 for ^{241}Am. Assumptions in the following sections assume that I/Io will be # 0.5.

2.2.2 Reduced Doses On-Site

The time-motion study (DOE 1988) reported that doses to all categories of WIPP workers from handling shipments before TRUPACT-IIs are opened is 6.8% of the total. If the TRUPACT-II was single contained, the doses to these persons would increase the total by about 6.8%. This 6.8% on-site reduction in dose due to double containment is similar to the 3.2%-6.4% possible increased dose on the TRUDOCK due to double containment.

2.2.3 Doses to Truck Drivers

Truck drivers have received 425 person-mrem dose through the year 2002. This is 11% of the total dose to badged workers and amounts to 0.13 person-mrem/TRUPACT-II. For the WIPP life-cycle with 50,000 TRUPACT-II and 7,000 RH-72B packages received, this would extrapolate to a collective dose of 7.4 person-rem. The dose received with single containment would be at least double the recorded dose for a double contained package due to attenuation in the ICV. Because all reported driver doses since 1999 have been only in the range of 10-18 mrem/quarter and doses below 10 mrem are not recorded (due to the sensitivity of the dosimeters used), it is likely the recorded dose increase would be even greater. This dose reduction of ≥7.4 person-rem to the drivers is greater than the increase of #4 person-rem expected from unloading a double-containment package.

2.2.4 Doses to the Public Enroute

Various studies over the years have estimated population doses along the WIPP route from incident-free shipments. The 1997 Supplemental Environmental Impact Statement (SEIS-II) estimated that the non-occupational collective dose to persons along the route would be five to seven times the collective dose received by the waste truck drivers (DOE 1997). Since the dose to the public is from the same radiation source term that is exposing the drivers, it is reasonable to extrapolate the dose reduction to drivers to the dose reduction to the public. The reduced collective dose to members of the public would be 37-52 person-rem.

The collective dose increases and reductions resulting from using double containment are summarized in Table 2.2. These values are based on current dose history at WIPP. The values would change in the same ratio if the average dose per TRUPACT-II received changed in the future.

Table 2-2. Lifetime Collective Doses at WIPP Due to Double Containment (Person-Rem)

Group	Change Due to Double Containment
WH & RCT	+2.2 to 4.4
Other WIPP	- ($ 4.7)
Truck Drivers	- ($ 7.4)
Public Along Route	- 37 to - 52
TOTAL	- 45 to - 62

3.0 WEIGHT PENALTY FROM DOUBLE CONTAINMENT

3.1 NRC and DOE Positions

Any given package design will weigh more if it also includes an ICV to provide double containment. Both the NRC staff (NRC 2002) and the DOE (1987) addressed this "weight penalty" in their arguments for deleting §71.63(b).

3.1.1 NRC Statement

The proposed rule stated:

> The TRUPACT-II SAR indicates that the weight of the inner container and its lid is approximately 2,620 lbs. Hypothetically, elimination of the separate inner container would increase the available payload for the TRUPACT-II package from the current 7,265 to 9,885 lbs. Thus, removal of the double containment requirement would potentially increase the TRUPACT-II's available payload by 36 percent. Further, the removal of the inner container from the TRUPACT-II would also potentially increase the available volume. The NRC believes that the proposed rule would not invalidate the existing TRUPACT-II design and thus, DOE could continue to use the TRUPACT-II to ship waste to and from WIPP, or DOE could consider an alternate Type B package (NRC 2002, p 21424).

It is not clear from the last sentence whether the NRC staff is referring to the existing TRUPACT-II design with double containment or with the ICV removed. Also, implicit in the statement about increasing the payload to 9,885 lb is that a TRUPACT-II without the ICV could pass the full-scale hypothetical accident test conditions specified in §71.73 without any design changes that increase the weight of the packages. We believe it would be unacceptable to certify a TRUPACT-II without the ICV by analysis rather than full scale testing.

The removal of the ICV from TRUPACT-II would increase the diameter of the payload cavity from about 73 inches to about 74 inches. This would provide no practical increase in waste disposal volume.

3.1.2 DOE Statement

In section 2.5.2.1 of Kapoor and others it is stated:

> The net weight of the TRUPACT-II is 12,000 pounds, of which about 2,620 pounds is the separate inner containment. The HalfPACT and RH-72B separate containment weighs about 1,000 pounds. Because of the constraints of the drum configuration in the TRUPACT-II, removal of the separate inner container would not increase the number of drums carried, but would allow somewhat greater mass to be contained in the drums carried in a single TRUPACT or in the total carried in a two or three TRUPACT trailer-load.
>
> Without increased mass in the drums, the cost penalty of the inner containment is in the ton-mile tariff for shipments and additional trips. Based on typical tariffs cost range from $0.10 to $0.40 per ton-mile. Using a value of $0.20/ton-mile suggests that, for the 2002 to 2012 time period in which 321,500 CH and RH-TRU round trip shipments of about 1,400 mile average length might be made, the extra costs could amount to about $19.7M. While this extra cost is not visible in the cost per trip that DOE pays, it was a component in bidding the contract and could be potential future saving. Another way to look at the cost of double containment is its effect on shipment efficiency. Currently most shipments to WIPP use two TRUPACTs rather than three because heavier drums reach carload weight limit before the volume in all three TRUPACTS can be used. With increased cargo capacity attained from single containment more three TRUPACT shipments could be made. Fewer trips would be required made, resulting in decreased costs and risks. The cost reduction does not take into account the cost of certification (testing of the single containment package), additional documentation, and modification of hardware (Kapoor and others 2002).

The statement correctly notes that removal of the ICV would not increase the number of drums carried.

The 321,500 value quoted for round trip shipments is obviously incorrect. The number of CH and RH packages from 2002-2012 is given elsewhere as (28,000 + 960) 28,960 (Kapoor and others, §2.4.1). The one-way distances from SEIS-II, Tables E-5 and E-6 average about 1,350 mile for CH and 1,200 mile for RH (DOE 1997). It is necessary to use round trip mileage for this calculation. At $0.2/ton-mile the total would be about $20M for transporting the weight of the ICV, which is in agreement with the quoted value of $19.7M.

The report acknowledges that "this extra cost is not visible in the cost per trip that DOE pays..." (Kapoor and others 2002, §2.5.21). No information is provided on how the cost to DOE is determined. This makes the report's calculation of the costs of double containment to be hypothetical.

EEG believes that the best way to estimate a cost for double containment is to estimate the number of additional shipments that might be required in a TRUPACT-II in comparison to that in an alternate NRC certified package that has only single containment. In the past the DOE has regarded reduction in the number of shipments to be important because it reduces the risk of accidents (and probably the public visibility of waste shipments). The cost of designing, certifying, and building this alternative fleet needs to also be included.

3.2 Alternate Packages

We are not aware of any NRC certified single containment packages large enough to carry 36 or more 55-gallon drums of CH TRU waste. There are two packages to consider as a comparison:

(a) TRUPACT-I

(b) Proposed TRUPACT-III (modified Gemini package)

3.2.1 TRUPACT-I

TRUPACT-I was a package designed and tested by Sandia National Laboratory during the late 1970s to mid 1980s. TRUPACT-I was intended to be the primary package for transportation of CH-TRU wastes to WIPP. The package was eventually abandoned since it would not have been certifiable by the NRC because (1) it provided only single containment and (2) it was continuously vented. A principal argument for the single containment design was the same one being used today; i.e. the required extra weight for double containment would reduce the payload and would thus be inefficient.

The TRUPACT-I had an empty weight of about 15,695 kg (34,600 lb) and a payload of up to 6,985 kg (15,400 lb) (SNL 1986). The plan was to transport six, 6-packs of 55-gallon drums (a total of 36 drums) in the TRUPACT-I. Because of its rectangular cavity the TRUPACT-I could also transport assorted sizes of boxes.

The payload of TRUPACT-I for highway travel would have been only slightly larger than that of TRUPACT-II (6,985 kg vs. a theoretical payload of 6,920 kg) and was less efficient for transporting packages of 55-gallon drums (36 vs. 42). The TRUPACT-II is a more efficient design because while containing 3,570 kg of ICVs per 3-TRUPACT-II trailer-load the payload is only reduced by 65 kg.

3.2.2 TRUPACT-III

The DOE is presently developing a TRUPACT-III container with single containment and will be seeking NRC certification in 2003-2004. This package will be a modification of the Gemini package which is certified in France. The primary advantage of the TRUPACT-III is that its rectangular shaped cavity would be more efficient than the cylindrical cavity in a TRUPACT-II for carrying boxes of various shapes.

The proposed TRUPACT-III has an empty weight of 24,200 kg (53,300 lb) and a payload of 5,800 kg (12,800 lb). Thus, the empty package is heavier than three TRUPACT-II packages and the payload is less. Also, because of this weight the TRUPACT-III would be too heavy to use for normal highway shipments (where the limit of 80,000 lbs includes about 28,000 lbs of tractor plus trailer).

It is apparent from the TRUPACT-I and TRUPACT-III designs that one cannot automatically assume that a single containment package will have an advantage in payload capacity. The specific design is what is meaningful.

3.3 WIPP Project Procurement and Shipping Practice

The history of the WIPP project procurement of transportation packages and current practices in shipments to WIPP suggest that minimizing a weight penalty for packages and maximizing the amount of waste that can be carried in a shipment are not a high priority.

3.3.1 Package Procurement

Design of TRUPACT-I in the 1970s was for single containment. However, the payload of the package was only slightly greater than TRUPACT-II and was less efficient for transporting 55-gallon drums.

Present plans to certify a modified Gemini package as TRUPACT-III indicate that weight and volume efficiency is a low priority. The package cannot be used for legal-limit truck transportation and for rail transportation, the package has a payload to empty weigh ratio of 0.24, compared to that of 0.61 for TRUPACT-II.

The WIPP project should seek the design of a new package with a rectangular cavity if weight efficiency is important. It is likely that a new package with double containment could be designed with a higher payload to empty weight ratio than TRUPACT-III. This would require greater up front costs and perhaps some increase in the time required to obtain certification, but would save many ton-miles (if this is a cost that is of concern to the project).

3.3.2 Shipments to WIPP

The statement in Kapoor and others, "currently most shipments to WIPP use two TRUPACTs rather than three because heavier drums reach carload weight limit before the volume in all three TRUPACTs can be used," is misleading.

It is correct that most shipments to WIPP have used only two TRUPACTs. The average TRUPACT-IIs per shipment through December 31, 2002 has been 2.22 (WWIS). However, an examination of shipments indicates that considerations other than weight have been the principal reason for using only two TRUPACT-IIs. Examples are:

3.3.2.1 Rocky Flats Shipments in Pipe Overpack Containers (POCs). Thirty six percent of the shipments to WIPP as of June 1, 2003 contained POCs with two TRUPACT-IIs per trailer (WWIS). The weight of a loaded 55-gallon POC drum varies from 154 to 165 kg. Theoretically, three TRUPACT-IIs can carry a payload of up to 6,920 kg. The highest noted shipment was 6,549 kg (WWIS: IN020364). All of the POC shipments could have contained five 7-packs of POCs (35 drums) and one 7-pack of dunnage drums. This would have eliminated 125 shipments (20% of the total). If the WIPP project had been willing to emplace dunnage drums in these 7-packs (1.7% of the drums emplaced in the repository to date are dunnage drums) the shipments could have carried 38-40 drums of TRU waste[1].

3.3.2.2 Savannah River Ten Drum Overpacks. The DOE has chosen to ship 55-gallon drums to WIPP in Ten Drum Overpacks (TDOPs). This reduces the number of drums shippable on a TRUPACT-II trailer from 42 to 30. Also, the weight of the TDOPs (725 kg each) is added to the shipment. To date (10/01/03) there have been about 139 shipments. Shipping the drums without overpacking would have reduced the number of shipments from 139 to 100 and the weight of TDOP containers shipped by 302,000 kg (333 tons).

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[1] The present practice at WIPP is to not disassemble 7-packs. This is theoretically possible and if employed would allow more efficiency in shipping and provide additional space in the repository for waste drums (rather than dunnage drums).

3.3.2.3 Other Two TRUPACT-II Shipments. Many shipments to WIPP are not weight limited. Also, DOE regularly has other shipments where only two TRUPACT-IIs are used and weight is not limited. For example, of the 72 non-POC shipments received in May 2003, 59 had three TRUPACT-IIs, eleven could have carried a third full TRUPACT-II, and two additional shipments could have had an additional seven drums or one SWB of waste in a third TRUPACT-II (WWIS). The number of containers in a TRUPACT-II is often limited by payload requirements (such as Fissile Gram Equivalent, decay heat, and flammability limits) other than weight limits.

4.0 EFFECT OF DOUBLE CONTAINMENT IN SEVERE ACCIDENTS

4.1 Reason for Double containment Requirement

Chapter 1 mentioned that the reason for incorporating the double containment requirement (rather than requiring plutonium to be in a special form capsule) in 10 CFR 71.63(b) was "the need for the inner containment is based on the desire to provide a substitute for not requiring the plutonium to be in a 'nonrespirable' form" (NRC 2002, p 21422).

None of the WIPP waste is in special form capsules and a considerable amount of it contains respirable material. So, this rule adopted thirty years ago specifically for the expectation of recycling of plutonium for the nuclear power industry, is relevant to the wastes being shipped to WIPP.

Implicit in the adoption of §71.63(b) was the assumption that double containment would provide additional assurance against a release of radioactive material in the event of a severe accident. There are some experimental data with drum sized packages, but none with larger packages that could be used to quantify the double containment benefit. However, both the NRC staff and the DOE believe the benefit could be substantial.

The NRC stated in the proposed rule:

> NRC continues to believe that a separate inner container provides an additional barrier to the release of plutonium in an accident, just as a package with triple containment would provide an even greater barrier to the release of plutonium in an accident. However, this type of approach is not risk informed or performance based (NRC 2002, p 21425).

Also in the report by Kapoor (attached to DOE's comments on §71.63(b)) the following is stated:

Achieving damage to two redundant containments is likely to be a factor of 10 (or more) less likely. Thus, one would expect as much as factor of 10 lower risk relative to the single containment case. While this might seem like a large benefit, the decrease in absolute risk will be very small because the risk of shipping singly contained plutonium is exceedingly small to start (Kapoor and others 2002, §2.6.2).

4.2 Accidental Release Methodology

The methodology developed in NUREG-0170 (NRC 1977) has been used to estimate the possible release from transportation accidents since 1976. The system described in NUREG-0170 uses data from transportation accident frequency and severity to estimate release and consequences. There are eight severity categories (I-VIII) assigned based on the crush force of the accident and whether a fire is also involved. There is a fractional occurrence based on accident data for each category. For each severity category there is a fractional occurrence assigned to areas of low, medium, and high population density. Low severity accidents are most likely in high population density areas because of lower driving speeds and high severity accidents are greater in low density areas. For example, NUREG-0170 uses a fractional occurrence of 0.8 for Severity Category I in high density areas and 0.9 for Severity Category VIII in low density areas.

This system can be used to estimate the number of accidents in each severity category for any shipping campaign (for example, to WIPP during its lifetime from all shipping sites) by using actual accident data, frequency of time in different population zones, and the total miles traveled. These are relatively realistic numbers because actual data exist. The next step is to calculate the number of these accidents that lead to radionuclide releases and to estimate the magnitude of the release. The release estimates are more speculative because there are limited data on responses of different types of packages to different severity categories.

4.2.1 Severity Category Release Estimates

Release fractions for various severity category accidents can be expressed either as the fraction of the total container contents released or as the fraction of the total contents that are released as particles that are aeorosolized and respirable (A & R). It is important to specify which fraction is being presented. Total releases are important because they give an indication of the amount of environmental contamination that may occur and have to be decontaminated and also may be a source of external dose to the public (not usually a problem for CH TRU wastes). The A & R fraction will be the portion that is used in estimating internal doses from inhalation which is the main public health concern from transuranic radionuclides. Respirable sized particles are those with an aerodynamic equivalent diameter of less than 10 micrometers (10 :m). The A & R fraction assumed in various analyses varies, but values of about 1% of the total releases are typical. The values in Table 4-1 are reported as A & R.

The most useful comparisons for releases from single contained and double contained packages are in NUREG-0170 which presents release fractions for a single contained plutonium package (1975 Pu) and a double contained package (1985 Pu). These data came from actual tests of drum sized packages. The 6M package is single contained and can be in containers that have a capacity of 38 to 417 liters. The 1985 double contained package has a volume of 133 liters. The TRUPACT-II volume is >5.4 m^3 (5400 liters), which creates a scaling uncertainty, but these are the only experimental data available. Other release estimate values have been used over the years for WIPP shipments. Estimates were made for releases from the single contained TRUPACT-I in a 1983 Preliminary Transportation Analysis (PTA) (Tappen and Daer 1983). EEG-33 used the PTA values for TRUPACT-I and the 1985 plutonium container values from NUREG-0170 for a double contained package (Channell and others 1986). There are also values from the RADTRAN IV code (Neuhauser and Kanipe1992) for Type B packages that were used in EEG-46 (Gallegos 1990). Both the PTA and RADTRAN IV calculations assume there will be releases from Severity Category III and above accidents. Finally, the SEIS-II (DOE 1997) used modified methodology that included separate considerations of releases from impact and from fires. The values from SEIS-II for the TRUPACT-II and RH-72B packages are also summarized in Table 4-1.

Table 4-1. Release Fractions Reported in the Literature

Severity[a] Category	Fractional Occurrence[b]	Release Fractions Aerosolized and Respirable			
		NUREG-0170		SEIS – II	
		1975 Pu[c]	1985 Pu[d]	Impact[e]	Thermal[f]
I	0.55	0	0	0	0
II	0.36	0	0	0	0
III	0.07	0	0	0	$6x10^{-9}$
IV	0.016	0	0	0	$2x10^{-7}$
V	0.0028	0	0	$8x10^{-5}$	$2x10^{-7}$
VI	0.0011	$1x10^{-4}$	0	$2x10^{-4}$	$2x10^{-7}$
VII	$5.5x10^{-5}$	$5x10^{-4}$	$1x10^{-4}$	$2x10^{-4}$	$2x10^{-7}$
VIII	$1.5x10^{-5}$	$1x10^{-3}$	$1x10^{-3}$	$2x10^{-4}$	$2x10^{-7}$

[a] Accident Severity Category
[b] Fraction of all accidents that occur in severity category (NUREG-0170)
[c] Single contained plutonium package (Total releases x.01 for A&R) from Table A-7
[d] Double contained plutonium package (Total releases x.01 for A & R) from Table A-7
[e] Release from impact
[f] Release from fire accompanying accident. Fire occurs in 2% of all accidents.

Values from the other studies are not included because they represent older methodology, more general packages, no direct comparison between single and double containment, and different assumptions.

4.2.2 Number of WIPP Releases

The ratio of number of releases from the 1975 Pu and 1985 Pu packages in NUREG-0170 can be obtained from summing the fractional occurrence for Severity Categories VI, VII, and VIII for the 1975 Pu package and the occurrences for Categories VII and VIII for the 1985 Pu package. The SEIS-II methodology (which is for double contained packages) leads to an assumption that releases will occur in 0.0057 of accidents and this is 81 times the NUREG-0170 estimate for

1985 Pu packages and 4.9 times the value for 1975 Pu packages. The PTA and RADTRAN IV assumptions for single contained Type B packages estimate releases in 0.09 of all accidents. These values are summarized in Table 4-2.

It is noted that both the PTA-RADTRAN/SEIS-II and the 1975 Pu to 1985 Pu release ratios are about 15 (15.8 and 16.7). This leads to a reasonable conclusion that various studies have led to an estimate that there is about 15 times the likelihood of a release from a single contained package as from a double contained package.

Table 4-2. Fraction of All Accidents Leading to a Release

Study	Applicable Severity Categories	Fraction of Accidents Leading to a Release	Number of Releases from WIPP Waste Shipments
PTA/RADTRAN	III – VIII	0.090	3.42
SEIS–II	V - VIII Impact		
	III - VIII Thermal[a]	0.00569	0.22
1975 Pu	VI – VIII	0.00117	0.044
1985 Pu	VII – VIII	0.00007	0.0007

SEIS-II calculations predict there will be 38 accidents with double contained packages carrying transuranic wastes during the lifetime of WIPP, (29 for CH TRU in TRUPACT-II and 9 for RH TRU in the RH-72B cask). Total estimated number of releases from WIPP waste shipments for each calculation are shown in Table 4-2.

These calculations indicate that a release from a double contained WIPP package is unlikely (only 0.22 for the SEIS-II estimates), but there could be one or more releases from a single contained package (3.42 for PTA/RADTRAN estimates).

4.2.3 Health Consequences of WIPP Releases

The consequences of a release from single and double contained packages can be compared from the ratio of accident fractional occurrences times the release fraction values shown in Table 4-1. This can be expressed as:

$$\text{Ratio single/double} = \frac{\sum \left(fo_i \quad RF_i \right) single}{\sum \left(fo_i \quad RF_i \right) double}$$

For the comparison between 1975 Pu and 1985 Pu packages the $\Sigma(fo_i \; RF_i)$ values are 1.52×10^{-7} for 1975 Pu and 2.05×10^{-8} for 1985 Pu. These values lead to a single containment to double containment release of 7.41.

The proposed WIPP Alternate in SEIS-II estimates an 850 person-rem life time dose expected from severe accidents (Table E-22) (DOE 1997). If the consequences of releases from single contained packages were 7.41 times this value, the extra population dose delivered would be 5450 person-rem. This extra population dose would result in a calculated 2.72 excess LCF (latent cancer fatalities) in the population receiving the dose.

4.3 Economic Consequences of Radionuclide Releases

4.3.1 Qualitative Considerations

There could be several detrimental consequences of an accident where radionuclides were released as a result of downgrading to single containment. These would occur even if the release was small with minimal exposures to the public. Most (or all) of the following consequences would be expected:

1. A cessation of shipments to WIPP while the accident was being investigated; this cessation could last several weeks.

2. Some (probably minor) contamination. This would cause quarantine of an area until the extent of contamination was determined. Some areas, including portions of a highway, may need to be quarantined until decontaminated.
3. A significant emergency response operation would probably result, even if the release was believed to be small.
4. Contamination would need to be cleaned up (discussed in more detail below);
5. Significant public perception problems would result. Much of the public, which has generally accepted that TRUPACT-II shipments were “safe” and releases were very unlikely to occur, would re-examine their acceptance. Shipping of waste other than WIPP could be affected.

Although we are going to explore possible costs only for item (4) (decontamination), it is clear that all the other consequences would also result in monetary costs.

The probability and consequences of a terrorist attack on a waste package is not predictable. A well executed attack with proper weapons could breach any container. Nevertheless, a double contained package would be more likely than a single contained package to maintain its integrity or minimize releases from many attacks and provide some incidental protection. Since Septemer 11, 2001 the NRC has taken steps to increase protection of high-risk radioactive sources that could be useful in a radiological dispersal device (RDD). Even though the transuranic wastes in WIPP shipments could be useful in an RDD, the NRC staff is proposing to reduce the robustness of these shipping packages. This is inconsistent.

4.3.2 Estimated Costs of Cleanup

A relevant report on cleanup costs is “Site Restoration: Estimation of Attributable Costs from Plutonium - Dispersal Accidents,” SAND 96-0957 (Chanin and others 1996). This report, which addresses accidents involving nuclear weapons, is relevant because it deals with the problems and legal/political considerations of plutonium contamination and site restoration.

SAND 96-0957 considered direct costs of both extended and expedited cleanup in areas of mixed-use urban land, Midwest farmland, arid Western range land, and forested areas. Expedited cleanup was assumed to be necessary in some cases of highway, airport runways, and average density urban land where the need for use of the land would allow waivers from National Environmental Policy Act (NEPA) and Comprehensive Environmental Restoration, Compensation, and Liability Act (CERCLA) requirements. Extended cleanup would occur in those cases where full NEPA and CERCLA requirements are applicable, and includes significant input from multiple state and federal agencies as well as the public. This process could take years. Since the report concluded that decontamination becomes progressively less effective with increased time of standing, the distinction between expedited and extended cleanup becomes significant.

The directly attributable costs included compensating property owners for loss or damage, decontamination, and waste disposal. Indirect costs not included were loss of production capacity, litigation, implementation of operational changes in response to an accident and societal impacts.

The method considered to be most effective and reliable for decontaminating "old contamination" in an extended cleanup includes acquisition of property, demolition of structures, removal of debris, and scraping of surface soil. For expedited cleanup it may be possible to use non-destructive cleaning or more intrusive decontamination rather than the full extended cleanup procedure. Examples of cleanup costs are shown in Table 4-3.

4.3.3 Possible Contamination Area and Cleanup Costs

The area contaminated from a release can be estimated by the methodology in TID-24190 (Slade 1968). Figure 5.5 in TID-24190 gives plume depletion (settling of particles on the ground surface) curves with distance for releases from variable heights for Pasquill Type A to F conditions. The curves assumed dry deposition, wind speed of 1.0 m/sec, and deposition velocity of 10^{-2} m/sec. The chosen assumptions can be used to determine the fraction depleted in a 22.5^{o} sector in various zones (for example, from 1 to 2 km from the point of release) and the average contamination for any given release. An appropriate screening level for contamination that needs be cleaned up is 0.2 :Ci/m^2. This value was proposed by EPA in 1977 (and never formally adopted) and is the value used by SAND 96-0957. The average concentration of transuranic wastes per TRUPACT-II emplaced in Panel 1 at WIPP is 93.3 Plutonium-Equivalent Curies (PE-Ci). The average total release fraction (0.0115) from SEIS-II assumptions from Severity Category V-VIII accidents was used for releases from a double contained package. This assumption does not assume greater releases from a single contained package because most of the increased releases would occur in category III or IV accidents (which have a lower fractional release). Pasquill Type C atmospheric conditions were used with a 10 meter release height. These conditions lead to an estimated depletion of 0.08 of the plume in a distance from 1 to 2 km. Other conditions lead to depletion values in the 1 to 2 km zone of ≥0.16 (for example, Type F with 10 m or 20 m release height and Type E with 10 m release height), but were not used because they are less likely to be present at the time of an accident.

The assumptions used led to a release of 1.07 PE-Ci and contamination level of ≥0.2 :Ci/m^2 out to a distance of 1.2 km. The contaminated area is 0.28 km^2. A contaminated area of >0.8 km^2 would result from a depletion of 0.16 in the 1 to 2 km zone. Estimated cleanup costs for a 0.28 km^2 are shown in Table 4-3.

Table 4-3. Attributable Cost from Transuranic Contamination

Cleanup Condition	Costs in Million Dollars	
	Per 1.0 km^2	For 0.28 km^2
Extended Cleanup		
Average Density Urban	400	112
Midwest Farmland	39	11
Expedited Cleanup		
Average Density Urban	130 - 180	36 - 50
Midwest Farmland	16 - 58	4 - 16
Vacant Land	74	21

Data Source: Chanin and others 1996

The evaluations developed in this chapter, with assumptions used by others, lead to a prediction that radionuclide releases from accidents involving WIPP shipments are unlikely to occur from double contained packages, but are likely from single contained packages. Also, that the additional radiation dose to the public and the decontamination costs from releases are significant and should be avoided if possible.

5.0 THE A_1/A_2 VALUE INCONSISTENCY

10 CFR 71 contains a Table A-1 which give A_1 and A_2 values for a large number (a total of about 390 in the current rule) of radionuclides. A_1 values are for special form material and A_2 values apply to normal form material. The A_1 or A_2 values of a radionuclide determine the maximum quantity (in curies) that can be transported in a Type A package. Type A packaging requirements are specified by DOT, while Type B packaging must be certified by the NRC.

The A_1/A_2 values are calculated to indicate an equivalent risk for each radionuclide. For example, a package containing an A_2 value for ^{137}Cs (13.5 Ci) would represent an equivalent risk to a package containing an A_2 value for ^{239}Pu (0.00541 Ci). The A_1/A_2 values are derived from calculations by international health physics experts using the latest dosimetric models and considering external photons, external beta particle, inhalation, skin, and ingestion doses from contamination and submersion in gaseous radionuclides. These values are updated periodically. Issue 3 of the April 30, 2002 proposed rule proposes to revise the current values to bring them in conformity with the latest IAEA values. The proposed Table A-1 list would include 16 fewer radionuclides than the current list. None of these 16 radionuclides are of practical significance for regulating transportation.

The petitioner's claim was that, since the A_1/A_2 values in Table A-1 were a relative hazard ranking, the singling out of plutonium for a double containment requirement cannot be supported technically or logically. The petitioner further stated that:

> If the NRC allows this failure of congruence to persist, the regulations will be vulnerable to the following challenges: (1) the logical foundation of the adequacy of A_2 values as a proper measure of the potential for damaging the environment and the human species, as set forth under the Q-System, is compromised; (2) the absence of a limit for every other radionuclide which, if exceeded, would require a separate inner container, is an inherently inconsistent safety practice; and (3) the performance requirements for Type B packages, as called for by 10 CFR Part 71, establish containment conditions under different levels of package trauma. The

> satisfaction of these Type B package standards should be a matter of proper design work by the package designer and proper evaluation of the design through regulatory review. The imposition of any specific package design feature such as that contained in 10 CFR 71.63(b) is gratuitous. The regulations are not, formulated as package design specifications, nor should they be (NRC 2002, p 21423).

The NRC staff observed that the current Table A-1 in 10 CFR 71 revealed five radionuclides (we found only four) that have A_2 Values lower than the value for ^{239}Pu and 11 radionuclides that have equal values. The four radionuclides with A_2 values lower than ^{239}Pu are ^{229}Th, ^{227}Ac, ^{231}Pa, and ^{248}Cm. The 11 (non-plutonium isotopes) radionuclides with values equal to ^{239}Pu are ^{237}Np, ^{230}Th, ^{241}Am, ^{242m}Am, ^{243}Am, ^{247}Bk, ^{249}Cf, ^{251}Cf, ^{245}Cm, ^{246}Cm and ^{247}Cm. The NRC staff agreed that requiring double containment for plutonium alone is not consistent with the relative hazards rankings in Table A-1 and that Part 71 regulations are not, formulated as package design standards.

The above arguments are theoretically logical, but are not practically important because there are (with one exception) no known plans to ship multi-curie quantities of any of these radionuclides in larger Type B packages. The proposed rule maintains an inconsistency by retaining §71.63(a) since this section deals only with plutonium. However, there are important, logical inconsistencies that have been overlooked by the petitioner and the NRC staff. The first inconsistency involves ^{241}Pu. The present rule counts a ^{241}Pu curie the same as curies of all the alpha – emitting plutonium radioisotopes (^{238}Pu, ^{239}Pu, ^{240}Pu, ^{242}Pu and ^{244}Pu) which have identical A_2 values. Plutonium–241 decays by beta emission with a half-life of only 14.4 years and its A_2 value is 50 times greater than ^{239}Pu. This is of tremendous practical significance to WIPP transuranic waste shipments. Final emplacement of wastes in Panel 1 at WIPP occurred in March 2003. There was 10,496 m^3 of waste containing 794,700 curies emplaced in Panel 1. The distribution of radioactivity is shown in Table 5-1.

Table 5-1. Curies Emplaced in Panel 1 at WIPP

		Percentage	
Radionuclide	Curies Emplaced	Total Activity	Pu Activity
^{238}Pu	6,186	0.8	0.9
^{239}Pu	152,000	19.1	22.5
^{240}Pu	34,290	4.3	5.1
^{241}Pu	482,024	60.7	71.5
$^{241}A_m$	120,200	15.1	_
TOTAL	794,700	100.0	100.0

It is apparent from Table 5-1 that counting of ^{241}Pu curies could have a great impact on the number of WIPP shipments that exceed 20 Ci. An average shipment of 20 Ci plutonium would contain only 5.7 Ci of the hazardous alpha-emitting plutonium isotopes. This is an unnecessary penalty on transuranic waste shipments because the ^{241}Pu has a negligible relative hazard.

The other practical inconsistency with WIPP waste is the double containment requirement does not apply to ^{241}Am. Americium-241 has the same A_2 value as ^{241}Pu and has represented 38% of the alpha-emitting transuranic waste coming to WIPP.

If the NRC staff feels a need to improve the "practical" inconsistency with A_1/A_2 values in §71.63(b) they could modify the rule to have the 0.74 TBq (20 Ci) value apply to all radionuclides that have A_2 values #$5.41x10^{-3}$ (current rule value for ^{239}Pu). This would delete ^{241}Pu from the calculation and include ^{241}Am.

EEG recommends that the final rule apply the 0.74 TBq (20 Ci) limit to only those actinides with A_2 values equal to or less than that of ^{239}Pu ($5.41x10^{-3}$ Ci in the current rule or $2.7x10^{-2}$ Ci in the proposed rule).

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

1. The double containment requirement specified in §71.63(b) has worked well for 30 years without being a significant burden.

2. A double contained package will result in less radiation dose to workers, truck drivers, and the public for routine transportation and handling operations. This is because the thickness of the inner containment vessel will provide additional shielding.

3. There is a weight penalty for providing double containment for similar designs. However, existing single contained packages are either similar (TRUPACT-I) or heavier (TRUPACT-III) than the double contained TRUPACT-II.

4. Shipping practices for transportation to WIPP indicate that minimizing the number of shipments is not a high priority.

5. A double contained package is much less likely to have a radionuclide release from a transportation accident or a terrorist attack than a single contained package. It would be inconsistent to reduce the robustness of shipping packages transporting radioactive material that could be useful in an RDD at the same time security is being increased for other high-risk radioactive sources.

6. It is important to try to avoid a radionuclide release accident because of the high costs of decontamination, as well as the transportation disruption and public perception problems created.

7. The A_1/A_2 values in 10 CFR 71 are intended to normalize risk from all radionuclides. The existing requirement is inconsistent because it treats plutonium differently than other radionuclides. However, the most significant inconsistencies are in treating ^{241}Pu equally

with the alpha emitting plutonium radioisotopes which have 50 times the hazard, and not including ^{241}Am which has the same hazard as ^{239}Pu.

6.2 Recommendations

1. The double containment requirement, §71.63(b), should be retained.

2. NRC could improve the “practical” A_1/A_2 inconsistency for WIPP shipments by modifying §71.63(b) to have the 20 Ci value apply to all radionuclides that have A_2 values equal to or less than the current value for ^{239}Pu. This would delete ^{241}Pu from the calculation and include ^{241}Am.

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[§71.63 Special requirements for plutonium shipments].
[Appendix A: Table A-1: Determination of A_1 and A_2].

49 CFR 173. Shippers-General requirements for shipments and packagings; Title 49, Transportation; Chapter I, Research and special programs administration, Department of Transportation; Subpart I, Radioactive materials.
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APPENDIX A

Current 10 CFR 71.63 Special Requirements for Plutonium Shipments (63 FR 32600)

APPENDIX A

Current 10 CFR 71.63 Special Requirements for Plutonium Shipments (63 FR 32600)

§71.63 Special Requirements for Plutonium Shipments.

(a) Plutonium in excess of 0.74 TBq (20 Ci) per package must be shipped as a solid.

(b) Plutonium in excess of 0.74 TBq (20 Ci) per package must be packaged in a separate inner container placed within outer packaging that meets the requirements of Subparts E and F of this part for packaging of material in normal form. If the entire package is subjected to the tests specified in § 71.71 ("Normal Conditions of Transport"), the separate inner container must not release plutonium as demonstrated to a sensitivity of 10^{-6} A_2/h. If the entire package is subjected to the tests specified in § 71.73 ("Hypothetical accident conditions"), the separate inner container must restrict the loss of plutonium to not more than A_2 in 1 week. Solid plutonium in the following forms is exempt from the requirements of this paragraph:

(1) Reactor fuel elements;

(2) Metal or metal alloy;

(3) Vitrified high-level waste

contained in a sealed canister designed to maintain waste containment during handling activities associated with transport. As one method of meeting these design requirements, the NRC will consider acceptable a canister which is designed in accordance with the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section VIII, 1995 Edition (earlier editions may be used in lieu of the 1995 Edition). However, this canister need not be designed in accordance with the requirements of Section VIII, Parts UG−46, UG−115 through UG−120, UG−125 through UG−136, UW−60, UW−65, UHA−60 and UHA−65 and the canister's final closure will need not be designed in accordance with the requirements of Section VIII, Parts UG−99 and UW− 11. The Director of the Federal Register approves this incorporation by reference in accordance with 5 U.S.C. 552(a) and 1 CFR Part 51. Copies of the ASME Boiler and Pressure Vessel Code, Section VIII, 1995 Edition, may be purchased from the American Society of Mechanical Engineers, Service Center 22 Law Drive, P. O. Box 2900, Fairfield, NJ 07007. It is also available for inspection at the NRC Library, 11545 Rockville Pike, Rockville, MD 20852-2738 or at the Office of the Federal Register, 800 North Capitol Street, NW, Suite 700, Washington, DC; and

(4) Other plutonium bearing solids that the Commission determines should be exempt from the requirements of this section.

APPENDIX B

WIPP CH TRU Shipments and Average Dose Rates

WIPP CH TRU Operational Dose

WIPP CH TRU Shipments and Average Dose Rates, 3/1999-12/2002
(WWIS data)

	1999	2000	2001	2002
#TRUPACT-II's/ #Shipments	105 /44	224 / 84	807 / 362	2044 / 942
TRUPACT Surface Dose Rate (mrem/h) -Average -Highest	 0.34 2.0	 0.19 1.0	 0.2 1.0	 0.25 1.9
Container Surface Dose Rate (mrem/h) -Average -Highest	 0.2 6.0	 0.9 46	 2.5 162	 4.1 154

WIPP CH TRU Operational Dose 3/1999-12/2002

	1999 (Dose / # of Workers with Positive Dose)	2000	2001	2002
Waste Handling	42 mrem/3	45 mrem/2 (highest 31 mrem)	162 mrem/6 (highest 55 mrem)	893 mrem/28 (highest 63 mrem)
Rad Con	14 mrem/1	11 mrem/1	217 mrem/8 (highest 42 mrem)	842 mrem/21 (highest 92 mrem)
Truck Drivers	96 mrem/3 (highest 39 mrem)	55 mrem/4	173 mrem/12 (highest 29 mrem)	101 mrem/8 (highest 18 mrem)
Others	179 mrem/13	21 mrem/1	551 mrem/34 (highest 65 mrem)	462 mrem/32 (highest 22 mrem)
Total	0.331 person-rem/20	0.132 person-rem/8	1.103 person-rem/60	2.298 person-rem/89

Source: Gadbury 2003

APPENDIX C

July 26, 2002 Comments of the
New Mexico Environmental Evaluation Group (EEG) on
10 CFR Part 171 Compatibility with IAEA Transportation Safety Standards
(TS-R-1) and Other Transportation Safety Amendments: Proposed Rule
(April 30, 2002)

ENVIRONMENTAL EVALUATION GROUP

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July 26, 2002

Secretary, U. S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Attention: Rulemaking & Adjudications Staff

Dear Secretary:

Attached are the comments of the New Mexico Environmental Evaluation Group (EEG) on "10 CFR part 71 Compatibility with IAEA Transportation Safety Standards (TS-R-1) and Other Transportation Safety Amendments: Proposed Rule (April 30, 2002). Our comments are restricted to Issue 17. Double Containment of Plutonium (PRM-71-12).

EEG is strongly opposed to the deletion of Section 71.63(b) for the reasons detailed in our comments. We believe that both sections 71.63(a) and 71.63(b) would be technically improved by having the 0.74 TBq (20 Ci) value apply to all actinides with A_2 values equal to or less than $1x10^{-3}$ TBq ($2.7x10^{-2}$ Ci).

Thank you for the opportunity to comment on this proposed rule.

Sincerely,

Matthew K. Silva
Director

MKS:JKC:pf

cc: InJs Triay, DOE/CBFO
Enclosure: (EEG-33)

Providing an independent technical analysis of the Waste Isolation Pilot Plant (WIPP), a federal transuranic nuclear waste repository.

Comments on 10 CFR Part 71 Compatibility with IAEATransportation Safety Standards (TS-R-1) and Other Transportation Safety Amendments: Proposed Rule (April 30, 2002)

Summary

These comments by the Environmental Evaluation Group (EEG) are restricted to Issue 17. Double Containment of Plutonium (PRM-71-12).

The proposal to delete existing section 71.63(b) will affect shipments of transuranic wastes to the Waste Isolation Pilot Plant (WIPP) more than any other activity. Therefore, our comments rely heavily on WIPP experience.

We believe that the NRC has erred in rejecting its historical qualitative judgment that double containment was a prudent requirement for the qualitative judgment of a 1997 petition. There is no indication from the proposed rule or background documents (NUREG/C12-6711, 6712, 6713) that any effort was made to verify the claims made in the 1997 petition.

The EEG has used its experience in WIPP transportation evaluations over the years, as well as operating data available from WIPP since first receipt of wastes in March 1999, in formulating our comments. Our major conclusions are:

(1) The conclusion that single containment will decrease radiation doses is incorrect for WIPP shipments. Radiation doses would increase, to both workers and the general public.

(2) There have been minor reductions in the volume of waste shipped to date (8-13%) due to weight restrictions caused by double containment. These penalties will be reduced in the future by the use of the NRC certified half PACT. Also, it is uncertain at this time what the allowable payload might be in a single-contained Type B package that can successfully pass full scale hypothetical accident condition tests. The total cost of certifying a new Type B package also needs to be included when considering possible economies from single containment. The possibility of significant net cost savings has not been demonstrated.

(3) If section 71.63(b) is deleted, there will very likely be some use of single-contained packages for future WIPP shipments.

(4) There is some inconsistency with the A_1/A_2 concept in the current sections 71.63(a) and 71.63(b). The proposed rule corrects only the inconsistency in 71.63(b). EEG believes the major inconsistency in the current rule for WIPP shipments is that ^{241}Pu is counted as a plutonium curie and that ^{241}Am curies are not counted. We recommend that the 0.74 TBq (20 Ci) value be applied to all actinides with A_2 values equal to or less than 1.0×10^{-3} TBq (2.7×10^{-2} Ci).

(5) EEG concurs with the qualitative judgment that a double contained package is less likely to have a radionuclide release in the event of a serious accident than is a single contained package. A release accident would have serious economic, shipping disruption, and public confidence implications. We believe this is the primary reason for retaining the double containment requirement.

Because of the above 5 conclusions, the EEG strongly opposes the deletion of Section 71.63(b). We believe that both sections 71.63(a) and 71.63(b) would be technically improved by having the 0.74 TBq(20 Ci)value apply to all actinides with A_2 values equal to or less than$1.0x10^{-3}$ TBq ($2.7x10^{-2}$ Ci).

Detailed Comments

Reduction of Radiation Dose from Single Containment

The following statement is made in the preamble to the Proposed Rule: "The NRC expects that cost and dose savings would accrue from the removal of '71.63(b)." The petitioner asserted there would be additional radiation exposure from "additional handling required for the separate inner container," but did not provide an analysis.

The EEG completely disagrees with these claims of extra radiation exposure in the case of TRUPACT-II shipments to WIPP. Also, we believe that at the present time, the double containment issue is, for all practical purposes, a WIPP issue. Therefore, WIPP experiences and the effect of the rule change on WIPP needs to be explicitly considered. Our rationale and supporting data are given below.

Enclosed is a copy of EEG-33 ("Adequacy of TRUPACT-I Design for Transporting Contact-Handled Transuranic Waste to WIPP," June 1986). This report was also sent to the NRC with our September 2000 comments. Despite the statement in the proposed rule, ("The NRC is unaware of any risk studies that would provide either a qualitative or quantitative indication of the risk reduction associated with the use of double containment in transportation of plutonium") the EEG believes that EEG-33 does provide a qualitative risk assessment relative to TRUPACT-I. It cannot be considered a quantitative study because the external radiation analysis is specific to the TRUPACT-I design.

The EEG-33 methodology provides a more comprehensive evaluation of radiation doses received from accident-free operation of the TRUPACT because the radiation dose resulting from a sealed TRUPACT-I is also included. A single contained package would have less mass in container walls and thus less attenuation of radiation(for example the 0.25 inch thick inner containment vessel(ICV) of the TRUPACT-II would attenuate 0.1 Mev gamma radiation by about 84%). Removal of the ICV would result in greater radiation doses to workers, truck drivers, security personnel and members of the public along the route.

Table 1 is a summary of radiation doses received by WIPP workers from March 1999 through June 2002 from transporting, receiving, unloading, checking for contamination, transporting underground, and emplacing transuranic wastes received in the double contained TRUPACT-II.

TABLE I

GROUP	AVERAGE MILLIREM (COLLECTIVE) PER TRUPACT	PER SHIPMENT	TOTAL PERSON MILLIREM
Waste Handling	0.40	0.86	827
Rad Con	0.42	0.91	874
Truck Drivers	0.17	0.37	353
Others	0.48	1.04	1008
Total	**1.46**	**3.17**	**3062**

From 965 shipments containing 2093 TRUPACT-IIs (Presentation by Casey Gadbury, DOE/CBFO at 7/23/02 Quarterly Meeting).

There are several relevant observations from these data:

(1) The doses are low;

(2) the groups involved in opening the TRUPACT-IIs (Waste Handling and Rad Con) received only 56% of the collective dose;

(3) most of the Waste Handling and Rad Con group doses would be incurred during all the subsequent steps necessary to emplace waste in underground storage rooms. A time-motion study of CH-TRU waste handling at WIPP (Final Report for the WIPP CH TRU Preoperational Checkout , DOE/WIPP 88-012, July 1988) indicated that only about 11% of the total dose to these two groups would occur from all operations on the TRUDOCK. The remainder occurs handling waste containers away from the TRUPACT-II;

(4) truck drivers and others (which includes QA, management, training, and security personnel) are only exposed to unopened TRUPACT-IIs and would receive higher doses if the packaging was only single contained.

After evaluating these actual data, the EEG concludes that occupational doses from transporting, receiving, and emplacing transuranic wastes at WIPP would increase if the packaging had only single containment.

Population Exposure. Various studies over the years have estimated population doses along the WIPP route from incident-free shipments. The 1997 Supplemental EIS for WIPP (DOE/EIS-0026-S-2) estimated that the non-occupational collective doses to persons along the route would be five to seven times that of the drivers. This dose then would be 1.9 to 2.6 mrem/shipment. The non-occupational dose would increase with single containment because of less attenuation of gamma radiation. EEG concludes that non-occupational radiation doses along the WIPP route would increase if shipments were in single contained packages.

Cost of Double Containment

The proposed rule also uses cost as a justification for elimination of the double containment requirement.

Shipping transuranic waste in TRUPACT-IIs is clearly more expensive than in other packages used in the past. However, most of the cost is incurred by complying with the payload requirements in the Certificate of Compliance and not increased waste loading complexities. The renewed interest in shipping transuranic waste in the ATMX railcar in 2000 was not due to its single containment features but to payload restrictions (especially those concerning hydrogen gas generation). EEG strongly supports these payload requirements and the preamble to the proposed rule implies the payload requirements would not be affected by elimination of 71.63(b).

There clearly is some weight and volume penalty from requiring double containment in similar designs. In the case of TRUPACT-II (which was a much different and superior design) versus TRUPACT-I there was little difference. The package weight for 3 TRUPACT-IIs on a trailer was only about 1350 pounds greater than for TRUPACT-I and the number of drums that could be transported (in the absence of weight limitations) was 16.7% (42 drums versus 36) greater in TRUPACT-II. However, we agree that it should be possible to obtain more weight reduction and increase volume in a new state-of-the art single contained packaging.

A lighter weight, single contained, TYPE B package could have more problems in passing the full-scale hypothetical accident condition tests (section 71.73)that the TRUPACT-II (eventually) passed. The inability of a package to pass these tests would be proof that its integrity under severe accident conditions was less than the TRUPACT-II.

EEG believes that the comment in the preamble that assumes the ICV in TRUPACT-II could be removed and its 2,620 pounds could then become payload to be speculative. Until a single contained Type B package has successfully passed hypothetical accident tests there is no way to know what the payload would be in a certified container. Also, EEG is uncomfortable with the fact that the wording in the preamble did not state that a TRUPACT-II without the ICV would not longer be NRC certified.

Neither the petition, the proposed rule, or the Environmental Assessment provided any quantitative data from WIPP shipments or elsewhere on the extent of the weight penalty. The experience on shipments to date to the WIPP is summarized below:

(1) Weight restrictions for current shipments from the Rocky Flats Environmental Technology Site (RFETS) result in a volume reduction of zero to about 6%.

(2) Weight restrictions for current shipments from the Idaho National Engineering and Environmental Laboratory (INEEL) result in a volume reduction of 29-35%.

(3) None of the first 178 shipments (up to February 2001) to WIPP were weight limited. Twenty shipments from other sites since February 2001 have not been weight limited.

(4) For the approximately 1000 shipments to date to WIPP the overall weighted average volume reduction due to weight limitations has been approximately 8% to 13%.

(5) The NRC has already certified the half PACT for shipments to WIPP. The half PACT is a more efficient packaging for heavier weight containers. Its use should reduce the current volume reduction penalty.

An 8-13% volume reduction due to weight restrictions caused by double containment is not trivial but the benefits from reducing this weight penalty needs to be balanced against the resulting increase in radiation doses, the increased likelihood of a release in the event of a severe accident and the increased cost of certifying a new package.
EEG concludes that the likelihood of significant net cost savings has not been demonstrated in the proposed rule or background documents.

Possibility of New Packages for WIPP

The Draft Regulatory Analysis (NUREG/CR-6713) states that the DOE is unlikely to switch from using the TRUPACT-II because the fleet has been procured and "shipping fixtures are designed around these packages." This is probably true for most contact-handled waste shipments to WIPP. However, the DOE is seriously considering a TRUPACT-III, which would be a large packaging to transport waste containers that are too large to fit into the TRUPACT-II. If the NRC does eliminate 71.63(b), a TRUPACT-III would probably be designed for single containment. Also, the CNS 10-160B package, which is already certified for shipping remote handled transuranic waste (RH-TRU) shipments of less than 20 curies plutonium to WIPP would be available. So, it is prudent to assume that if 71.63(b) is deleted there may be single contained Type B packages transporting waste containing more than 20 curies of plutonium package to WIPP.

A_1/A_2 Values

The petition stated that the present rule violated the basis of the A_1/A_2 system by not requiring non-plutonium radionuclides which had A_2 values less than or equal to plutonium to meet the same requirement.

EEG agrees the current 71.63(b) is inconsistent. However, the main effect is different than suggested. All of the other radionuclides are actinides and, except for ^{241}Am, are unlikely to be shipped in large sized Type B packages.

Note that the current section 71.63(a) is also inconsistent with the A_1/A_2 concept since it deals only with plutonium. This section is being retained.

The most important inconsistencies in the current rule are in: (1) counting ^{241}Pu radioactivity in the 20 Ci limit; and (2) not counting ^{241}Am in the 20 Ci limit. This has significant implications for the WIPP inventory where the emplaced radioactivity (as of 6/4/02) is 60.6% ^{241}Pu, 15.3% ^{241}Am, and only 24.1% from the sum of ^{238}Pu + ^{239}Pu + ^{240}Pu. Since ^{241}Pu has an A_2 value that is 59 times greater than the other four radionuclides it should not be included in the 20 Ci limit. Americium-241 has the same A_2 value as ^{239}Pu and should be included.

EEG recommends that both 71.63(a) and 71.63(b) be retained but that the limit be expressed as 0.74 TBq (20 Ci) for the total of all actinides with A_2 values equal to or less than 1.0×10^{-3} TBq (2.7×10^{-2} Ci). Incidentally, the A_2 value (2.7×10^{-3} Ci) reported for ^{239}Pu in Table A-1 in the proposed rule is incorrect. It should be 2.7×10^{-2} Ci.

Releases From Severe Accidents.

It is acknowledged at several places in the preamble to the proposed rule that "a separate inner container provides an additional barrier to the release of plutonium in an accident,…". Later it is concluded that "this type of approach is not risk informed nor performance based." Also, the statement is made "The NRC is unaware of any risk studies that would provide either a qualitative or quantitative indication of the risk reduction associated with the use of double containment."

The enclosed report (EEG-33) presents a methodology for estimating the possible reduction in releases from severe transportation accidents. We submit that this is a qualitative study. It cannot be considered quantitative because there are no experimental data on accident releases with and without double containment.

Evaluations by others also estimate the probability of an accidental release during the lifetime of WIPP from TRUPACT –II and RH-72B packages. For example, in DOE/EIS – 0026-S-2, Appendix E, the calculated value is 0.3 releases. If single containment were to result in releases at one lower severity category (from III to II for thermal release and from V to IV for impact release) the estimate would be 1.5 releases. There is some respirable material in WIPP waste (which was one of the justifications for initially requiring double containment) and this would increase the likelihood of releases and doses in the event of a severe accident.

We do not believe it wise to increase the probability of a release for the sake of relatively minor economic benefits. Even a minor release is likely to result in extensive cleanup costs, delays in project shipping, possible societal costs from transportation or other economic disruptions. Perhaps the greatest impact would be a reduction in public confidence in the shipment of radioactive materials.

EEG believes that the primary justification for double containment is to decrease the probability of a release in the case of a severe accident. We believe this is also the principal concern of elected officials, state governmental organizations, and citizens.

We have received your recent correspondence regarding the subject referred to below. Please be advised that your correspondence has been forwarded for consideration by the Commission. Thank you for your interest.

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Compatibility with IAEA Transportation Safety Standards (TS-R-1) and other Transportation Safety Amendments

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APPENDIX D

List of EEG Reports

LIST OF EEG REPORTS

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EEG-2 Review Comments on Geological Characterization Report, Waste Isolation Pilot Plant (WIPP) Site, Southeastern New Mexico SAND 78-1596, Volume I and II, December 1978.

EEG-3 Neill, Robert H., et al., (eds.) Radiological Health Review of the Draft Environmental Impact Statement (DOE/EIS-0026-D) Waste Isolation Pilot Plant, U.S. Department of Energy, August 1979.

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