

PROPOSED RULES

[4910-60-M]

DEPARTMENT OF TRANSPORTATION

Materials Transportation Bureau

[49 CFR Parts 127, 171, 172, 173, 174, 175,
176, 177]

[Docket No. HM-169; Notice No. 79-11]

RESEARCH AND SPECIAL PROGRAMS
ADMINISTRATIONRequirements for Transportation of Radioactive
MaterialsAGENCY: Materials Transportation
Bureau, DOT.ACTION: Notice of Proposed Rule-
making.

SUMMARY: This notice proposes to change the requirements of the Hazardous Materials Regulations concerning radioactive materials to make them compatible with the latest revised international standards for transport of radioactive materials as promulgated by the International Atomic Energy Agency (IAEA). A parallel proposal by the U.S. Nuclear Regulatory Commission (NRC), to its Title 10 CFR Part 71, "Packaging of Radioactive Materials for Transport and Transportation of Radioactive Materials Under Certain Conditions," will be published at a later date in the FEDERAL REGISTER.

DATE: Comments must be received on or before April 5, 1979.

ADDRESS COMMENTS TO: Dockets Branch, Information Services Division, Materials Transportation Bureau, U.S. Department of Transportation, Washington, D.C. 20590. It is requested that five copies be submitted.

FOR FURTHER INFORMATION
CONTACT:

R. R. Rawl, Office of Hazardous Materials Regulation, Materials Transportation Bureau, U.S. Department of Transportation, 2100 Second Street, SW., Washington, D.C. 20590, telephone 202-426-2311.

SUPPLEMENTARY INFORMATION:
I. *Background:* In 1959, at the request of the Economic and Social Council of the United Nations, the International Atomic Energy Agency (IAEA) undertook the development of international regulations for the safe transportation of radioactive materials. The initial regulations published by the Agency in 1961 were recommended to member states as the basis for national regulations and for application to international transportation. As a result of extensive revision in 1963 and 1964, and further effort in 1966, a version of the IAEA "Regulations for Safe Transport of Radioactive Materials, Safety Series No. 6" was published in 1967. The IAEA regulations have since

been adopted generally by most of the nations of the world as a basis for their own national regulations governing the transportation of radioactive materials.

Since 1966, the U.S. Nuclear Regulatory Commission (USNRC) (formerly the Atomic Energy Commission (AEC)) has issued regulations which are substantially in conformance with IAEA standards for fissile radioactive materials and large quantities of radioactive materials. On October 4, 1968, the Hazardous Materials Regulations Board of the Department of Transportation (DOT) published amendments which were also in substantial conformance with the 1967 IAEA standards (Docket HM-2, 33 FR 14918).

In February 1969, recognizing that the international standards should be revised from time-to-time on the basis of scientific and technical advances, as well as accumulated experience in their application, the IAEA invited all of its member states to submit comments and suggested changes to the regulations. Another aim was to remove any ambiguities and to simplify the presentation of the text of the regulations.

Comments and suggested revisions to the IAEA regulations were then collected by DOT from the AEC, the American National Standards Institute (ANSI), Atomic Industrial Forum, and others. As a result of that effort a compilation of some 40 comments was then forwarded by DOT to the IAEA in July 1969. Some of these suggested changes were intended to make a more positive alignment of the U.S. regulations with the IAEA regulations possible.

In all, the IAEA received more than 300 pages of comments from the member states. During the period of February 2-13, 1970, the IAEA convened a panel of experts to review the regulations and consider the comments which had been submitted by member states. The U.S. Delegation on this review panel consisted of a three-man team, headed by the DOT representative, with one adviser from the AEC and another from private industry. At this panel, 14 countries and 10 international organizations were represented.

As a result of this review panel's efforts, a first working draft of a revision of the regulations was developed. It was circulated to the chairmen of the working groups of the review panel in April 1970. Subsequently, a second revision draft was prepared and issued in June 1970 to all of the review panel participants for their review. The second draft was also circulated by the AEC to many interested persons. On December 3, 1970, the Secretary General transmitted a third revision draft to all IAEA member states

and to interested international organizations.

On January 27, 1971 (36 F.R. 1280), the Office of Hazardous Materials of the DOT published a public notice in the form of a "Request for Public Advice on Revisions of International Regulations." Interested persons were thereby informed of the issuance and availability of this third revised draft, identified as IAEA Document No. PL-383, entitled "Regulations for the Safe Transport of Radioactive Materials, Third Revised Draft, November 1970."

In cooperation with the AEC, the DOT solicited comments on this third draft. Copies were distributed to all AEC operating contractors, as well as the Atomic Industrial Forum and ANSI Subcommittee N-14 (Transportation of Fissile and Radioactive Materials) for redistribution to their members and other interested persons. As a result of the above notice, copies were distributed to a large number of requesters.

Formal U.S. comments on the third draft were forwarded by DOT to the IAEA through the State Department in July 1971.

A final Review Panel of experts was convened by the IAEA in October 1971, to finalize the revisions. As a result of that Panel, the IAEA subsequently issued its "Safety Series No. 6, Regulations for the Safe Transport of Radioactive Materials 1973 Revised Edition," in late 1973. Since that time most major countries and international transport organizations, i.e., International Maritime Consultative Organization (IMCO), International Air Transport Association (IATA), European Agreement for the Carriage of Dangerous Goods by Rail (RID); European Agreement Concerning International Carriage of Dangerous Goods by Road (ADR), have completed revising their own regulations to achieve conformity with the 1973 IAEA Standards.

With respect to efforts by the United States to achieve conformity with IAEA Standards, the involvement of two agencies, DOT and NRC, makes it necessary to revise certain parts of two distinct bodies of regulations—49 CFR and 10 CFR Part 71. The publication of this Notice by the DOT has been held in abeyance until after the reissuance of the Hazardous Materials Regulations (Docket HM-103/112, "Consolidation of Title 14, Part 103, and Title 46, Part 146, in Title 49" 41 F.R. 15972, April 14, 1976, Part II as amended). As mentioned in the preamble to those amendments, the MTB was completing its first major phase of its continuing effort to improve, update, and simplify the regulations governing the shipment and transportation of hazardous materials. The

next phase was therein stated to be a recodification of the entire body of hazardous materials regulations, the purpose of which would be to rearrange and revise the language of the regulations in more comprehensible and accessible form to reduce inconsistency, redundancy and obsolescence. This notice incorporates the new overall future plan of the regulations to the extent that the new Part 127 proposed herein is a redesign and editorial rearrangement of the major sections applicable to the radioactive materials classification, which previously had been located in § 173.389 through 173.399, with the rearrangements already promulgated in HM-103/112 applicable to Parts 171, 172, 173, 174, 175, 176, and 177.

Subsequent to the issuance of the 1973 Edition of IAEA Safety Series No. 6, the IAEA convened another Review Panel in December 1974. The purpose of this Panel was to consider any minor inconsistencies, omissions or errors that were being revealed in the course of national and international application to the IAEA's 1973 Revised Standards, and to recommend, among other things, any changes of detail that should be introduced into the regulations under the established procedures of the IAEA Board of Governors.

As a result of the work of the 1974 Review Panel, the IAEA developed a list of so-called "minor" drafting changes to the 1973 Revised Edition of Safety Series No. 6 (which were effective upon publication, May 1975), as well as a list of so-called substantive proposed "90-day" changes. The latter were adopted on December 16, 1977 by the IAEA. Essentially, both of the above sets of changes have been considered in preparing this Notice, as well as the basic content of 1973 Safety Series No. 6 itself.

II. Comparison with current regulations: The following table lists the paragraph numbers of the Part 127 changes proposed herein, indicating the existing Title 49 CFR paragraph number, and the most applicable corresponding paragraph number of IAEA Safety Series No. 6, 1973 Edition, as revised. It should be recognized that in many cases the cross references are to paragraphs which are similar to, but not identical with current 49 CFR Sections.

Proposed Section	Now shown in 49 CFR as	Comparable Section in 1973 IAEA SS No. 6
127.1(a)	(new)	102
127.19(b)(1)	(new)	104(a)
127.1(b)(2)	175.10(a)(8)	104(b)
127.1(b)(3)	175.10(a)(8)	104(b)
127.1(c)	(new)	108
127.3	(new)	109
	(new)	110
	173.389(q)	

Proposed Section	Now shown in 49 CFR as	Comparable Section in 1973 IAEA SS No. 6	Proposed Section	Now shown in 49 CFR as	Comparable Section in 1973 IAEA SS No. 6
127.115(a)(3)	173.394(b)(4), 173.395(b)(3)	No comparable section	127.115(a)(3)	173.394(b)(4), 173.395(b)(3)	No comparable section
127.115(a)(4)	173.394(b)(2), 173.395(b)(1)	No comparable section	127.115(a)(4)	173.394(b)(2), 173.395(b)(1)	No comparable section
127.115(a)(5)	173.394(b)(5), 173.395(b)(4)	No comparable section	127.115(a)(5)	173.394(b)(5), 173.395(b)(4)	No comparable section
127.115(a)(6)	173.394(c)(4)	No comparable section	127.115(a)(6)	173.394(c)(4)	No comparable section
127.115(a)(7)	173.394(c)(6)	No comparable section	127.115(a)(7)	173.394(c)(6)	No comparable section
127.117(a)(1)	173.396(b)(1)	No comparable section	127.117(a)(1)	173.396(b)(1)	No comparable section
127.117(a)(2)	173.396(b)(2)	No comparable section	127.117(a)(2)	173.396(b)(2)	No comparable section
127.117(a)(3)	173.396(b)(3)	No comparable section	127.117(a)(3)	173.396(b)(3)	No comparable section
127.117(a)(4)	173.396(b)(4)	No comparable section	127.117(a)(4)	173.396(b)(4)	No comparable section
127.117(a)(5)	173.396(b)(5)	No comparable section	127.117(a)(5)	173.396(b)(5)	No comparable section
127.117(a)(6)	173.396(b)(7)	No comparable section	127.117(a)(6)	173.396(b)(7)	No comparable section
127.117(a)(7)	173.396(b)(8)	No comparable section	127.117(a)(7)	173.396(b)(8)	No comparable section
127.117(b)(1)	173.396(c)(1)	No comparable section	127.117(b)(1)	173.396(c)(1)	No comparable section
127.117(b)(2)	173.396(c)(2)	No comparable section	127.117(b)(2)	173.396(c)(2)	No comparable section
127.117(b)(3)	173.396(c)(3)	No comparable section	127.117(b)(3)	173.396(c)(3)	No comparable section
127.117(b)(4)	173.396(c)(4)	No comparable section	127.117(b)(4)	173.396(c)(4)	No comparable section
127.117(b)(5)	173.396(c)(5)	No comparable section	127.117(b)(5)	173.396(c)(5)	No comparable section
127.119(a)(1)	(new)	No comparable section	127.119(a)(1)	(new)	No comparable section
127.119(a)(2)	(new)	No comparable section	127.119(a)(2)	(new)	No comparable section
127.119(a)(3)	(new)	No comparable section	127.119(a)(3)	(new)	No comparable section
127.119(b)(1)	(new)	No comparable section	127.119(b)(1)	(new)	No comparable section
127.119(b)(2)	(new)	No comparable section	127.119(b)(2)	(new)	No comparable section
127.119(b)(3)	(new)	No comparable section	127.119(b)(3)	(new)	No comparable section
127.119(b)(4)	(new)	No comparable section	127.119(b)(4)	(new)	No comparable section
127.121(a)	(new)	No comparable section	127.121(a)	(new)	No comparable section
127.203(a)(1)	173.391(a)(1)	306(b)	127.203(a)(1)	173.391(a)(1)	306(b)
127.203(a)(2)	173.391(a)(2)	302	127.203(a)(2)	173.391(a)(2)	302
127.203(a)(3)	173.391(a)(3)	303	127.203(a)(3)	173.391(a)(3)	303
127.203(a)(4)	173.391(a)(4)	306(c)	127.203(a)(4)	173.391(a)(4)	306(c)
127.203(a)(5)	173.391(a)	304	127.203(a)(5)	173.391(a)	304
127.203(a)(6)	(new)-see also 173.393(c)	304	127.203(a)(6)	(new)-see also 173.393(c)	304

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Proposed Section	Now shown in 49 CFR as	Comparable Section in 1973 IAEA SS No. 6
127.205(a)(1)	173.391(b)(5)	306
127.205(a)(2)	173.391(b)(5)	306
127.205(a)(3)	173.391(b)(2)	308
127.205(a)(4)	173.391(b)(3)	302
127.205(a)(5)	173.391(b)(4)	303
127.205(a)(6)	173.391(b)(6)	304
127.205(a)(7)	See also 173.393(a)	304
127.205(a)(8)		311
127.207	173.391(a) & 173.391(b)(5)	306(a)
127.209	173.391(c)	312
127.211(a)	173.392(a)	314(b)
127.211(b)	173.392(a)	314(b)
127.211(c)(1)	173.392(b)	314(c)
127.211(c)(2)	173.392(c)(8)	314(c)(ii)
127.211(c)(3)	173.392(c)(2)	No comparable section
127.211(c)(4)	173.392(c)(3)	No comparable section
127.211(c)(5)	173.392(c)(7)	No comparable section
127.211(c)(6)	(new)	Para 314 Table VI
127.211(c)(7)	173.392(c)(4)	No comparable section
127.211(c)(8)	173.392(c)(9)	No comparable section
127.211(c)(9)	173.392(c)(6)	No comparable section
127.211(d)(1)	173.392(d)(1)	No comparable section
127.211(d)(2)	173.392(d)(3)	No comparable section
127.211(d)(3)	173.392(d)(5)	No comparable section
127.211(d)(4)	173.392(d)(4)	No comparable section
127.211(d)(5)	173.392(d)(7)	No comparable section
127.213(a)	(new)	317
(b)	(new)	317
127.301(a)	173.394(a) & 173.395(a)	401
(b)	173.395(b) & (c)	402
127.303-305	(new)	403-411, Inc. Tables VII, VIII, IX & X
127.401(a)	173.393(d)	504, 508, 508
127.401(b)	173.393(j)	532(a), 534, 537
127.401(c)		
127.403	173.393(e)	231, 240
127.405(a)	173.393(b), 173.397(a)	502 incl. Table IX
127.405(b)	173.397(a)(1)	
127.405(c)	173.397(b)	
127.405(d)	173.397(c)	
127.405(e)	(new)	
127.407	173.403(a)	301
127.411	Part 173	533, 536
127.413(a)	174.700(b), 177.842	522
127.413(b)	(new)	523
127.413(c)	(new)	524
127.413(d)	173.396(e)	525
127.415(a)	(new)	526
127.415(b)	(new)	527
127.415(c)	178.700(a)	529
127.415(d)	173.396(e)	530
127.415(e)	(new)	531, 532
127.415(f)	(new)	532
127.501(a)	(new)	601

Proposed Section	Now shown in 49 CFR as	Comparable Section in 1973 IAEA SS No. 6
127.503(a)	173.396(a)	601
127.505(a)	173.389(a)	604
127.505(b)	173.396(e)	525
127.507(a)	173.396(g)	621
127.601(a)	(new)	701
127.601(b)	(new)	702
127.605(a)	(new)	704
127.605(b)	(new)	705
127.605(c)	(new)	706
127.607	(new)	707
127.611(a)	173.398(b)	709
127.611(a)(1)	173.398(b)	710, 711
127.611(a)(2)	173.398(b) & (new)	712
127.611(a)(3)	173.398(b)	713
127.611(a)(4)	173.398(b)	714
127.613(a)	173.398(g)	715, 716, 717
127.615(a)	173.398(c)	718
127.617	173.398(c)	724
127.619(a)	173.398(a)	726-731
127.619(b)(1)	173.398(a)(1)	732
127.619(b)(2)	173.398(2)	733
127.619(b)(3)	(new)	734
127.619(b)(4)	173.398(a)(3)	735
127.619(c)(1)	173.398(a)(4)	736
127.619(c)(2)	173.398	737
127.701(a)	173.393(a)	823
127.703(a)	173.393(a)	
127.703(b)	173.393(b)	
127.703(c)	173.393(c)	
127.705(a)	173.393(m)	839
127.707(a)	173.393(n)	839
127.711(a)	173.393 Note 1	802
127.711(b)	173.398 Note 2	802
127.713(a)	(new)	815
127.713(b)	(new)	816
127.713(c)	(new)	818
127.713(d)	(new)	801
127.715(a)	173.393(a)(4)	834
127.715(b)	(new)	835
127.715(c)	(new)	836
171.8 (Existing)	171.8	109A
171.8 (Existing)	171.8	109B
171.8 (Existing) and 127.3	(new)	118
171.8 (Existing)		125-128
171.8 (Existing)		129-131
174.700(b)	(new)	534
175.700(d)	(new)	542
175.703(d)	(new)	543, 544, 545
175.703(e)	(new)	546
177.842(g)	173.393(j)(4)	537

III. Substantive proposed changes: While this notice proposes an extensive revision of that portion of the regulations dealing with the transportation of radioactive materials, the majority of the changes are not substantive in nature. A discussion of the more substantive proposed changes follows:

A. INDIVIDUALIZED TYPE A QUANTITIES

The system by which radionuclides have been divided, for the purpose of specifying the number of curies permitted in Type A packages, into seven transport groups, according to their toxicity, plus a "special form" category would be eliminated. Under the present system, the allowable number of curies for each radionuclide in a group is the same as the allowable number of curies for the most restrictive member of that group. This method is unnecessarily restrictive when applied to the less toxic group members, which in some cases have a

maximum permissible body burden more than ten times that of the more toxic members.

The proposed amendments have no groups at all. Instead, for each radionuclide two values, A₁ and A₂, would be assigned as the maximum number of curies permitted in Type A packages in special form and normal form, respectively. The A₁ and A₂ values for various radionuclides would be listed in § 127.305. Methods by which these values were established are described in IAEA Safety Series No. 37. "Advisory Material for the Application of the IAEA Transport Regulations."

The value of A₁ for special form material is based on the possible external radiation dose to individuals if the contents of the package are released, except that an upper limit of 1000 curies is imposed. Under the proposed regulations, special form material must also be nondispersible as determined by certain stringent criteria (which differ somewhat from present criteria for special form) described in § 127.619.

The bases for the A₁ values for normal material (that is, all forms other than special form) are: (1) an accident of moderate severity might release 0.1% of the contents, and 0.1% of the amount released might then be taken into the body of a human being in the vicinity; this intake should not exceed half the maximum permissible annual intake for workers as given in IAEA Safety Series No. 9, 1967 Edition; and (2) A₁ shall not exceed A₂. Intake values are based on International Commission on Radiological Protection (ICRP) 1966 recommended limits for radiation exposure.

The following table compares, for several radionuclides, the present special form and normal form limits with the limits that would be applicable under the proposed rule.

This change would sometimes permit a single Type A package to replace two or more present packages. Also, some of the small number of Type B packages with contents near the lower limit for Type B could be reclassified as Type A. The net effect is expected to be insignificant with respect to the number of Type A packages or the total amount of material in Type A packages.

For special form material, some limits would be increased and some would be decreased. Consequently, the changes in the number of such packages also would be small.

LIMIT IN TYPE A PACKAGES, IN CURIES

Present group	Present		Proposed	
	Special form	Normal form	Special form	Normal form
²⁴¹ Am I.....	20	0.001	8	0.008
²⁴¹ Cm IV.....	20	20	1000	100
²⁴¹ Cf I.....	2	0.001	2	0.009
²⁴¹ Cm I.....	20	0.001	10	0.01
²⁴¹ Co III.....	20	3	7	7
²⁴¹ Ir III.....	20	3	20	20
²⁴¹ Mo IV.....	20	20	100	100
²⁴¹ Na IV.....	20	20	5	5
²⁴¹ P IV.....	20	20	30	30
²⁴¹ Po I.....	20	0.001	200	0.2
²⁴¹ Pu I.....	20	0.001	2	0.002
²⁴¹ Sr II.....	20	0.05	10	0.4

B. LOW-LEVEL SOLID RADIOACTIVE MATERIALS (LLS)

A new category, low level solid (LLS) has been proposed. Its definition, based on specific activity and the leachability characteristics of the material being transported, recognizes immobilization techniques now being used in waste handling operations and the degree to which the radioactive content is fixed in the non-radioactive matrix. The provisions for shipment of LLS materials as proposed herein differ from those in IAEA regulations, in that use of Type A packagings would be required, as opposed to "strong industrial packagings" meeting certain criteria of the United Nations Recommendation on "Transport of Dangerous Goods" as prescribed in §209 of IAEA Safety Series No. 6. MTB has proposed these Type A packaging criteria because it is of the opinion that the packaging reference to the United Nations requirements has not been sufficiently described in the IAEA regulations.

C. LOW SPECIFIC ACTIVITY RADIOACTIVE MATERIALS (LSA)

Some changes are also proposed herein for LSA material, as defined in §127.3. The specific activity limits would be related to A₂ values rather than to transport group. Articles with non-fixed surface contamination have been included within the LSA definition. Methods of concentrating the activity in transport, such as leaching and evaporation, would have to be considered. Finally, the limit for tritium oxide in aqueous solution, after consideration of the hazards due to wetting of the skin and to possible inhalation of vapors, would be increased from 5 curies/liter to 10 curies/liter. In addition, in proposed §127.211, the existing authorization for the use of non-specified "strong tight packaging" for LSA materials in full-load shipments would be deleted, in favor of a specific requirement for Type A packages in all cases for LSA materials,

whether as full-loads, or other than full-loads. This proposal is based on numerous reports received by the DOT of insufficient packagings used with the "strong tight packaging" authorization. Further, the existing provision for the shipment of bulk liquid LSA materials, as authorized in 49 CFR 173.392(d)(2) in specific highway cargo tank or rail tank cars would be deleted. This deletion appears merited in light of the newly revised definition of LSA materials wherein the method of concentrating the activity in transport, such as leaching and evaporation, must be taken into account.

In this proposal the definition for LSA has been qualified for liquid materials so as to clarify that for liquids it must be assumed that the conditions likely to be encountered which could result in increasing the activity concentration would occur during normal or accident conditions. The net effect of this clarification therefore is to remove liquids from consideration as LSA.

D. REQUIREMENTS FOR SPECIAL FORM RADIOACTIVE MATERIALS

The qualification tests for special form radioactive material in proposed §127.619 would modify current requirements primarily by adding a bending test, providing more detailed instructions for the immersion or leaching procedure, and changing the maximum loss by leaching to 0.05 microcurie in each of two determinations rather than the present 0.005% for a single determination. Long, slender objects are more likely to suffer bending under rough handling or accident conditions than are short or large-diameter objects. A minimum length of 10 cm and a minimum length-to-width ratio of 10 have been proposed for application of the bending test. The leaching test specified by the IAEA regulations has been proposed as suitable and should yield uniform results. An absolute amount leached is more appropriately related to the hazard than is a fixed percentage. Although 0.05 microcurie is much smaller than any of the A₂ quantities in this case it is specified as a measure of the indisparability and is equivalent to the maximum permissible non-fixed surface contamination on 50 cm² of a package surface.

Existing regulations require that "special form radioactive material" have either (1) no dimension less than 0.5 mm or (2) at least one dimension greater than 5 mm. It is now proposed that special form radioactive material must have at least one dimension not less than 5 mm. The first option has been deleted because of the possible difficulty of identifying, for safe handling, an object as small as 0.5 mm in every dimension.

The new definition for "special form radioactive materials" as proposed in §127.3 would require that an encapsulated material be so constructed that it can be opened only by destructive means. It should be noted that this criteria would eliminate from consideration any present encapsulations which meet the requirements of a DOT Specification 2R vessel (see §178.34) and the present requirements of §173.398(a).

E. ADDITION OF LEAD-201

In response to a petition for rulemaking by Diagnostic Isotopes, Inc. to the U.S. Nuclear Regulatory Commission, it is proposed to add lead-201 (²⁰¹Pb) to the table of radionuclides found in §127.305. The daughter radionuclide resulting from the decay of ²⁰¹Pb is thallium-201 which is useful in nuclear medicine and clinical diagnosis. The details of the calculations for the A₁ and A₂ values for ²⁰¹Pb are found in Appendix B of the Environmental Impact Appraisal of Changes to Radioactive Material Packaging and Transportation Regulations, which is available for review in the Dockets Branch, Room 6500, at 2100 2nd Street, S.W., Washington, D.C. and will be published by the U.S. Nuclear Regulatory Commission.

F. METRICATION

The metric system, as represented by the International System of Units (SI), has been incorporated to the extent possible in the proposed regulations. Rounded-off values of equivalents for the English system are given in parentheses, except in a few cases where the conversion seems unnecessary or inappropriate.

G. DOT SPECIFICATION 55

As proposed herein, the use of existing DOT Specification 55 (Spec. 55) packages would be discontinued one year after the effective date of the amendments. As a result of prior rulemaking in Docket HM-111 (39 FR 45238), published on December 31, 1974, shipment of Spec. 55 packages constructed after March 31, 1975 has not been authorized. As was stated in the preamble to the notice of proposed rulemaking in Docket HM-111 (38 FR 29483, Oct. 25, 1973), MTB announced its intention to phase out the Spec. 55 as a "limited type B" packaging at some later date. Future use of such packagings one year after the effective date of these amendments would be contingent upon the user obtaining approval and certification of the package design as Type B, pursuant to §127.701.

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H. MARKING OF LIMITED QUANTITY AND RADIOACTIVE DEVICES PACKAGES

As proposed herein, the exemption from the marking requirements of § 172.300 (proper shipping name) for packages bearing limited quantities of radioactive materials or radioactive devices would be deleted. This is consistent with the current regulatory requirements for marking of all other classifications of hazardous materials packages in "limited quantities," as adopted in Docket HM-103/112 (41 FR 15972, April 15, 1976). In those amendments, the exemption from marking limited quantities of radioactive materials and devices was inadvertently retained.

The Department has determined under Council of Environmental Quality guidelines not to prepare an environmental impact statement for the proposed amendments herein. Concurrently with the publication of this notice of proposed rulemaking, the Department is making available in its Dockets Branch, Room 6500, at 2100 2nd Street, S.W., Washington, D.C., an "Environmental Impact Appraisal of Changes to Radioactive Material Packaging and Transportation Regulations" intended to support to a negative declaration. This assessment was prepared by the U.S. Nuclear Regulatory Commission in support of its proposed changes to Title 10 CFR 71, which will be published in a future issue of the FEDERAL REGISTER. Its analysis and conclusions are considered directly applicable to the proposals by MTB herein, in support of this negative declaration.

In consideration of the foregoing, Part 127 would be added and Parts 171, 172, 173, 174, 175, 176, and 177 of Title 49, Code of Federal Regulations would be amended as follows:

1. A new Part 127 Table of Contents would be added to read as follows:

PART 127—TRANSPORTATION OF RADIOACTIVE MATERIALS

Subpart A—Scope and Definitions

- Sec.
127.1 Scope.
127.3 Definitions.

Subpart B—Packaging and Package Design Requirements

- 127.101 General design requirements.
127.103 [Reserved]
127.105 Additional design requirements for Type A packagings.
127.107 Requirements for Type B(U) packagings.
127.109 Requirements for Type B(M) packagings.
127.113 Authorized Type A packagings.
127.115 Authorized Type B(U) and B(M) packagings.
127.117 Authorized packaging—fissile radioactive materials.
127.119 Authorized packaging—pyrophoric radioactive materials.

- Sec.
127.121 Authorized packaging—oxidizing radioactive materials.

Subpart C—Exceptions for Certain Quantities and Items, Low Specific Activity Radioactive Materials and Low Level Solid Radioactive Materials

- 127.201 [Reserved]
127.203 Limited quantities of radioactive materials.
127.205 Exceptions for instruments and devices.
127.207 Table of activity limits—excepted quantities and devices.
127.209 Excepted articles containing natural uranium or thorium.
127.211 Transport requirements for low specific activity (LSA) radioactive materials.
127.213 Transport requirements for low level solid (LLS) radioactive materials.

Subpart D—Activity Limits for Radioactive Material Packages

- 127.301 Activity limits for Type A and Type B packages.
127.303 Requirements for determination of A_1 and A_2 values for radionuclides.
127.304 Activity—mass relationships for uranium and natural thorium.
127.305 Table of A_1 and A_2 values for radionuclides.

Subpart E—Requirements for Transportation

- 127.401 Radiation level limitations.
127.403 Thermal limitations.
127.405 Contamination control.
127.407 Labeling requirements.
127.409 [Reserved]
127.411 Placarding requirements.
127.413 Storage incident to transportation—general requirements.
127.415 General transportation requirements.

Subpart F—Requirements for Fissile Radioactive Materials

- 127.501 General.
127.503 Exceptions.
127.505 Classification of fissile radioactive materials packages.
127.507 Transportation of Fissile Class III radioactive materials—specific requirements.
127.509 Mixing of fissile radioactive materials packages.

Subpart G—Test and Inspection Procedures

- 127.601 Compliance with required tests.
127.605 Preparation of specimens for testing.
127.607 Packaging and shielding—testing for integrity.
127.609 [Reserved]
127.611 Tests for proposed packagings designed for normal conditions of transportation.
127.613 Additional tests for Type A packagings designed for liquids and gases.
127.615 Tests for demonstrating the ability of radioactive materials packagings to withstand accident conditions in transportation.
127.617 Water in-leakage test for fissile radioactive materials packagings.
127.619 Tests for special form radioactive materials.

Subpart H—Additional Requirements for the Transportation of Radioactive Materials

- Sec.
127.701 Requirements for U.S. Nuclear Regulatory Commission approved packages.
127.703 Requirements for foreign-made packages.
127.705 Quality control for radioactive materials packagings.
127.707 Quality control requirements prior to each shipment of radioactive materials.
127.709 [Reserved]
127.711 Approval of special form radioactive material.
127.713 Approval for export shipments.
127.715 Notification to competent authorities for export shipments.

2. A new Part 127 would be added to read as follows:

Subpart A—Scope and Definitions

§ 127.1 Scope.

(a) This part sets forth requirements for the transportation of radioactive materials by carriers and shippers subject to this chapter. The requirements prescribed in this part are in addition to, but not in lieu of, other requirements set forth in this subchapter and in Part 71 of Title 10 of the Code of Federal Regulations for the transportation of radioactive materials.

(b) This part does not apply to—

(1) Radioactive materials produced, used, or stored in an establishment other than during the course of transportation;

(2) Radioactive materials contained in a medical device, such as a heart pacemaker, implanted in a human being or animal.

(3) Radiopharmaceuticals that have been injected into, or ingested by, human beings or animals.

(c) Explosive radioactive materials may be transported only under special arrangements approved by the Department under § 107.103 of this subchapter.

§ 127.3 Definitions.

In this part, " A_1 " means the maximum activity of special form radioactive material permitted in a Type A package.

" A_2 " means the maximum activity of radioactive material, other than special form radioactive material, permitted in a Type A package. These values are either listed in § 127.305 or may be derived in accordance with the procedure prescribed in §§ 127.301 and 127.303.

"Allowable number of packages" means the maximum number of Fissile Class II or Fissile Class III packages that may be grouped together in or place during transportation. When the group is made up of packages of different designs, the allowable number of packages is determined in accordance with the following formula:

$$\frac{n_1 + n_2 + n_3 + \dots}{N_1 N_2 N_3} \text{ may not exceed } 1.$$

In this formula, n_1, n_2, n_3, \dots are the numbers of packages present for which the corresponding allowable numbers are N_1, N_2, N_3 , respectively.

"Closed transport vehicle" means a vehicle equipped with a securely attached exterior enclosure that during normal transportation restricts the access of unauthorized persons to the cargo space containing the radioactive materials. The enclosure may be either temporary or permanent, and in the case of non-dispersible materials may be of the "see-through" type, and must limit access from top, sides, and ends.

"Containment system", with respect to a radioactive materials package, means those components of the packaging, including encapsulation of the contents, where used, that have been specified by the package designer as intended to retain the radioactive contents during transportation, whether or not individual vessels in the packaging retain their integrity of containment.

"Depleted uranium" means uranium in which the uranium-235 content has been reduced to less than 0.72 percent, with the remainder essentially uranium-238.

"Design" means the description of a special form material, a package, or a packaging, that enables those items to be fully identified. The description may include specifications, engineering drawings, reports showing compliance with regulatory requirements, and other relevant documentation.

"Enriched uranium" means uranium in which the uranium-235 content has been increased to more than 0.72 percent, with the remainder essentially uranium-238.

"Fissile radioactive material" means any material containing plutonium-238, plutonium-239, plutonium-241, uranium-233 or uranium-235 but does not include unirradiated natural or depleted uranium. See § 127.503 for other exclusions. Fissile radioactive materials are classified according to the controls needed to provide nuclear criticality safety during transportation, as provided in § 127.505.

"Freight Container"—See § 171.8. For purposes of radioactive materials shipments, a "small freight container" is defined as one which has any overall outer dimension less than 1.5 m (4.9 ft) or an internal volume of not more than 3.0 m³ (106 ft³). All other freight containers used for radioactive materials are "large freight containers."

"Full load", "sole use", or "exclusive use" refers to any shipment—

(a) From a single consignor having the exclusive use of a transport vehicle, of a large freight container, of an aircraft, of a hold or compartment of an inland water craft or of a hold, compartment, or defined deck area of a seagoing vessel; and

(b) For which initial, intermediate, and final loading and unloading is carried out by or under the direction of the consignor or consignee, or the designated agent of one of them.

"Low level solid radioactive material" (LLS) means—

(a) Solids such as consolidated wastes or activated materials in which—

(1) The activity under normal transportation conditions is, and remains, distributed throughout a solid or a collection of solid objects, or is, and remains, uniformly distributed in a solid compact binding agent (such as concrete, bitumen, or ceramic);

(2) The activity remains insoluble so that, even under loss of packaging, the loss of radioactive material per package resulting from the effects of wind, rain, other effects of weather, or from total immersion in water is limited to less than 0.1 A₂ in a period of one week; and

(3) The estimated activity averaged throughout the material does not exceed 2×10^{-3} A₂/g; or

(b) Objects of non-radioactive material contaminated with radioactive material, where the radioactive contamination is in a non-readily dispersible form and where the level of contamination averaged over 1 m² (10.8 ft²) (or the area of the surface, if it is less than 1 m² (10.8 ft²)) does not exceed—

(1) 20 μCi/cm² for beta and gamma emitters and the low toxicity alpha emitters (natural or depleted uranium and natural thorium); or

(2) 2 μCi/cm² for other alpha emitters. "Low specific activity radioactive material" (LSA) means:

(a) Uranium or thorium ores, or physical or chemical concentrates of those ores;

(b) Unirradiated natural or depleted uranium or unirradiated natural thorium;

(c) Tritium oxide in an aqueous solution, if the concentration does not exceed 10 Ci/liter;

(d) Materials in which the activity, under normal transport conditions, is, and remains, uniformly distributed, and in which the average estimated specific activity does not exceed 10⁻⁴ A₂/g;

(e) Materials in which the activity is uniformly distributed, and which, if reduced to the minimum volume under conditions likely to be encountered during transportation, including dissolution in water with subsequent

recrystallization, precipitation, evaporation, combustion, and abrasion would have an average estimated specific activity of not more than 10⁻⁴ A₂/g;

(f) Objects of non-radioactive material contaminated with radioactive material, if the non-fixed surface contamination is not more than 10 times the values set forth in § 127.405 and the contaminated object or the contamination on the object, if reduced to the minimum volume under conditions likely to be encountered in transport, including dissolution in water with subsequent recrystallization, precipitation, evaporation, combustion and abrasion would have an average estimated specific activity of no more than 10⁻⁴ A₂/g; and

(g) Objects of non-radioactive material contaminated with radioactive material, if the radioactive contamination is in a non-readily dispersible form and the level of contamination averaged over 1 m² (10.8 ft²) (or the area of the surface, if this is less than 1 m² (10.8 ft²)) is not more than—

(1) 1 μCi/cm² for beta and gamma emitters and the low toxicity alpha emitters (natural or depleted uranium and natural thorium) or

(2) 0.1 μCi/cm² for other alpha emitters.

"Multilateral approval" means approval by both the appropriate competent authority of the country of origin and of each country through or into which the shipment is to be transported. This definition does not include approval from countries over which radioactive materials are carried in aircraft, if there is no scheduled stop in that country.

"Natural uranium" means chemically separated uranium with the naturally occurring distribution of uranium isotopes (approximately 99.28 percent uranium-238 and 0.72 percent uranium-235).

"Non-fixed radioactive contamination" means radioactive contamination that can be readily removed from a surface by wiping with a dry smear. Non-fixed (removable) radioactive contamination is not significant if it does not exceed the limits specified in § 127.405.

"Package". See § 171.8.

"Packaging". See § 171.8.

"Radioactive contents" means the radioactive material, together with any contaminated solids, liquids, or gases, within the package.

"Radiation level" means the radiation dose-equivalent rate expressed in millirem per hour. Radiation levels may be determined by appropriate instruments or by calculation. Measured or calculated neutron flux densities may be converted into radiation levels according to the following table:

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NEUTRON FLUX DENSITIES TO BE REGARDED AS EQUIVALENT TO A RADIATION LEVEL OF 1 MREM/H*

Energy of neutron	Flux density equivalent to 1 mrem/h (n/cm ² /s)
Thermal	268
5 keV	228
20 keV	112
100 keV	32
500 keV	12
1 MeV	7.2
5 MeV	7.2
10 MeV	6.8

*Flux densities equivalent for energies between those listed above are obtained by interpolation.

"Radioactive material" means any material, or combination of materials, having a specific activity greater than 0.002 microcuries per gram ($\mu\text{Ci/g}$).

"Special form radioactive material" means either an indispersible solid radioactive material or a sealed capsule containing radioactive material that is so constructed that it can be opened only by destructive means. Special form radioactive material must—

(a) Have at least one dimension not less than 5 mm (0.20 inch), and

(b) Comply with the applicable test requirements in § 127.619.

"Specific activity", with respect to a radionuclide, means the activity of the radionuclide per unit mass of that nuclide. The specific activity of a material in which the radionuclide is essentially uniformly distributed is the activity per unit mass of the material.

"Transport index" means the number placed on the label of a package or a freight container to designate the degree of control to be exercised by the carrier during transportation. This number expresses the maximum radiation level in millirem per hour at 1 m (3.3 ft) from the external surface of the package or for Fissile Class II and Fissile Class III packages, the larger of either the number which expresses the maximum radiation level or the number obtained by dividing 50 by the allowable number of those packages. The transport index must be rounded up to the first decimal place.

"Transport index for low specific activity material or low level solid radioactive material transported as a full load, or transported by land or sea or stored in transport in a compact stack" means the number expressing the maximum radiation level at any point 1 m (3.3 ft) from the external surface of the load multiplied by the value in the following table appropriate to the cross-sectional area of the load. For uranium and thorium ores and concentrates, in the absence of actual measurements or calculations, the maximum radiation level at any point 1 m (3.3 ft) from the external surface of the load may be taken as:

(a) 40 mrem/h for ores and physical concentrates of uranium and thorium;

(b) 30 mrem/h for chemical concentrates of thorium;

(c) 2 mrem/h for chemical concentrates of uranium other than uranium hexafluorides.

RADIATION LEVEL MULTIPLICATION FACTORS

Size of full load	Multiplication factor
Measurement (Cross-sectional area measurement of the load perpendicular to the direction of interest)	
1 m ² (10.8 ft ²) and less	1
1 m ² (10.8 ft ²) to 5 m ² (53.8 ft ²)	3
5 m ² (53.8 ft ²) to 20 m ² (215 ft ²)	6
20 m ² (215 ft ²) to 100 m ² (1080 ft ²)	19

By multiplying the radiation level in mrem/h at 1 m (3.3 ft) from the surface of the load or stack of packages by the multiplication factor in the table, the transport index may be obtained for full load or a compact stack of packages of—

(1) Uranium of thorium ores, or physical or chemical concentrates of these ores; or

(2) Unirradiated natural or depleted uranium or unirradiated natural thorium.

The "Transport index of a freight container" means the sum of the transport indices of all packages in the freight container except that;

(a) For freight containers holding Fissile Class III packages, the transport index shall be 50 or the sum of the transport indices of the packages, whichever is greater; and

(b) For freight containers holding no Fissile Class II or III packages and in full loads only, the number expressing the maximum radiation level in mrem/h at 1 m (3.3 ft) from the surface of the freight container multiplied by the factor in the "Radiation Level Multiplication Factors" table above appropriate to the maximum cross-sectional area of the freight container.

"Type A package" means a Type A packaging together with its limited radioactive contents. A Type A package does not require competent authority approval, since its contents are limited to A₁ or A₂.

"Type B package" means a Type B packaging together with its radioactive contents.

"Type B(M) package" means a Type B packaging, together with its radioactive contents, that for international shipments requires multilateral approval of the package design, and may require approval of the conditions of shipment.

"Type B(U) package" means a Type B packaging, together with its radioactive contents, that for international shipments, requires only unilateral approval of the package design and of any stowage provisions that may be necessary for heat dissipation.

"Type A packaging" means a packaging designed to retain the integrity

of containment and shielding required by this part under normal conditions of transportation as demonstrated by the tests set forth in §§ 127.611 or 127.613 as appropriate.

"Type B packaging" means a packaging designed to retain the integrity of containment and shielding required by this part when subjected to the accident test conditions set forth in § 127.615.

"Uncompressed gas" means gas at a pressure not exceeding the ambient atmospheric pressure at the time the containment system is closed.

"Unilateral approval" means approval by the competent authority of the country of origin only.

"Unirradiated thorium" means thorium containing not more than 10⁻⁷g uranium-233 per g of thorium-232.

"Unirradiated uranium" means uranium containing not more than 10⁻⁶g plutonium per g uranium-235 and a fission product activity of not more than 0.25 mCi of fission products per g uranium-235.

Subpart B—Packaging and Package Design Requirements

§ 127.101 General design requirements.

In addition to the applicable requirements of § 173.24 of this subchapter, each packaging used for the shipment of radioactive materials, except one that contains a limited quantity or excepted device as prescribed in Subpart C, must be designed so that—

(a) The package can be easily handled and properly secured in or on a vehicle during transport;

(b) For a package with a gross weight exceeding 10 kg (22 lbs) and up to 50 kg (110 lbs), it has a means for manual handling;

(c) For a package with a gross weight of 50 kg (110 lbs) or more, it can be safely handled by mechanical means;

(d) Each lifting attachment on the package, when used in the intended manner, does not impose an unsafe stress on the structure of the package, including appropriate safety factors to cover "abrupt" lifting. Each attachment or other feature on the outer surface of the packaging that could be used to lift the package must be removable or otherwise capable of being made inoperable for transport, or must be designed to support the weight of the package;

(e) The outer layer of packaging will avoid, as far as practicable, the collection and retention of water; and

(f) Each feature that is added to the package at the time of transport, and that is not a part of the package, will not reduce the safety of the package.

§ 127.103 [Reserved]

§ 127.105 Additional design requirements for Type A packagings.

In addition to meeting the general design requirements prescribed in § 127.101, each Type A packaging must be designed to meet the following requirements:

(a) The smallest overall dimension of the package may not be less than 10 cm (4.0 inches);

(b) The outside of the package must incorporate a feature, such as a seal, that is not readily breakable, and that, while intact, is evidence that the package has not been illicitly opened;

(c) So far as practicable, the external surfaces must be free from protrusions;

(d) It must be able to maintain its integrity and shielding during transportation and storage in a temperature range of -40°C (-40°F) to 70°C (158°F). However, special attention must be given to brittle fracture over this temperature range;

(e) It must be able to withstand the effects of any acceleration, vibration, or vibration resonance that may arise during transportation, without any deterioration of the effectiveness of closing devices or in the integrity of the package as a whole. Nuts, bolts or other securing devices must be designed so that they cannot loosen or be released unintentionally after repeated use;

(f) It must include a containment system securely closed by a positive fastening device that cannot be opened unintentionally or by pressure that may arise within the packaging. Encapsulation of the radioactive material may be considered as a component of the containment system. If a containment system forms a separate unit of the packaging, it must be able to be securely closed by a positive fastening device that is independent of any other part of the packaging;

(g) The materials of the packaging and any components or structures must be physically and chemically compatible with each other and with the contents, considering the behavior of each under irradiation;

(h) The design of each component of the containment system must take into account, where applicable, the radiolytic decomposition of liquids and other vulnerable materials and the generation of gas by chemical reaction and radiolysis;

(i) The containment system must retain its radioactive contents under the reduction of ambient pressure to 0.25 kg/cm^2 (3.6 lb/in^2);

(j) Each valve, other than a pressure relief valve, through which the radioactive contents could otherwise escape, must be protected against unauthorized operation and must have an en-

closure to retain any leakage from the valve;

(k) A radiation shield that encloses a component of the packaging specified as a part of the containment system must be able to prevent the unintentional release of that component from the shield;

(l) Each tie-down attachment on the packaging must, under both normal and accident conditions, be able to prevent the forces applied to those attachments from impairing the ability of the package to meet the requirements of this section;

(m) When subject to the tests specified in § 127.611 of this part, the package will prevent—

(1) Loss or dispersal of the radioactive contents; and

(2) An increase in the maximum radiation level recorded or calculated at the external surface for the condition before the test;

(n) Each packaging designed for liquids must—

(1) Meet the conditions prescribed in paragraph (m) of this section when subjected to the tests specified in § 127.613;

(2) For packagings in which the liquid volume does not exceed 50 cm^3 (1.7 fluid ounces), have sufficient absorbent material to absorb twice the volume of the liquid contents. The absorbent material must be suitably positioned to contact the liquid in the event of leakage; and

(3) For packagings in which the liquid volume is greater than 50 cm^3 (1.7 fluid ounces), either:

(i) Have sufficient absorbent material as prescribed in paragraph (n)(2) of this section; or

(ii) Have a containment system composed of primary inner and secondary outer containment components designed to assure retention of the liquid contents within the secondary outer components in the event that the primary inner components leak.

(o) Each package designed for compressed or uncompressed gases must be able to prevent loss of contents when the package is subjected to the tests prescribed in § 127.613. This paragraph does not apply to any package designed for tritium or argon-37.

§ 127.107 Requirements for Type B(U) packagings.

Each Type B(U) package must be designed and constructed to meet the applicable requirements in Part 71 of Title 10 of the Code of Federal Regulations (10 CFR 71).

§ 127.109 Requirements for Type B(M) packagings.

Each Type B(M) package must be designed and constructed to meet the applicable requirements of 10 CFR 71.

§ 127.113 Authorized Type A packagings.

Each of the following packagings is authorized for shipment of quantities not exceeding A₁ or A₂ as prescribed in the Table in § 127.305:

(a) U.S. Department of Transportation (DOT) Specification 7A (§ 178.350 of this subchapter) Type A general packaging. Each shipper of a Specification 7A package must maintain on file for at least one year after the latest shipment, and must be prepared to provide to DOT, a complete documentation of tests, an engineering evaluation or comparative data showing that the construction methods, packaging design, and materials of construction comply with that specification;

(b) DOT Specification 55 metal-encased shielded packaging constructed before April 1, 1975. Construction is not authorized after March 31, 1975. Each packaging designed for liquids must also meet the requirements of § 127.105(m) and (n);

(c) Any Type B(U) or B(M) packaging pursuant to § 127.115; or

(d) Any foreign made packaging that bears the marking "Type A" and complies with the regulations of the country of origin applicable to Type A packages.

§ 127.115 Authorized Type B(U) and B(M) packagings.

Each of the following packages is authorized for shipment of quantities exceeding A₁ or A₂ as prescribed in the table in § 127.305:

(a) Specification 55 metal encased shielded packaging constructed before April 1, 1975, for domestic shipments only of 300 curies or less of special form radioactive materials. Construction is not authorized after March 31, 1975. Use of this package not authorized after (1 year from effective date of the amendment).

(b) Any Type B(U) or Type B(M) packaging that meets the applicable requirements in the regulations of the U.S. Nuclear Regulatory Commission (USNRC) (10 CFR Part 71) and that has been approved by USNRC may be shipped pursuant to § 127.701.

(c) Any Type B(U) or B(M) packaging that meets the applicable requirements of the regulations of the International Atomic Energy Agency (IAEA) in its "Regulations for the Safe Transport of Radioactive Materials—Safety Series No. 6, 1973 Revised Edition" and for which the foreign competent authority certificate has been revalidated by DOT pursuant to § 127.703. Authorized only for export and import shipments.

(d) DOT Specification 6M (§ 178.104 of this subchapter) metal packaging, only for solid or gaseous radioactive materials that will not undergo pres-

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sure generating decomposition at temperatures up to 121°C (250°F).

(e) For contents in other than special form, DOT Specification 20WC (§ 178.194 of this subchapter), wooden protective jacket, when used with a single, snug-fitting inner DOT Specification 2R (§ 178.34 of this subchapter) or DOT Specification 55 container. (Construction of DOT Specification 55 packagings is not authorized after March 31, 1975.) For liquid contents, the inner packaging requirements in § 127.105(m) and (n) must also be met.

(f) For contents in special form only, DOT Specification 20WC (§ 178.194 of this subchapter), wooden protective jacket, with a single snug-fitting inner Type A packaging that has a metal outer wall and conforms to § 178.350 of this subchapter or DOT Specification 55. (Construction of DOT Specification 55 packagings is not authorized after March 31, 1975.) Radioactive thermal decay energy may not exceed 100 watts.

(g) For contents in special form only, DOT Specification 21WC (§ 178.195 of this subchapter), wooden protective overpack, with a single inner DOT Specification 2R (§ 178.34 of this subchapter) or DOT Specification 55 container. (Construction of DOT Specification 55 packagings is not authorized after March 3, 1975.) Contents must be loaded within the inner packaging to preclude loose movement during transportation. The inner packaging must be securely positioned and centered within the overpack by solid cushioning materials so that there can be no significant displacement of the inner packagings when subjected to the 9m (30 ft) drop test described in 10 CFR Part 71.

§ 127.117 Authorized packaging—fissile radioactive materials.

(a) Fissile radioactive materials containing not more than A₁ or A₂ total radioactivity, unless exempted by § 127.503, must be packaged in one of the following packagings:

(1) DOT Specification 6L (§ 178.103 of this subchapter), metal packaging. Authorized fissile contents are set forth in paragraph (b)(1) of this section.

(2) DOT Specification 6M (§ 178.104 of this subchapter), metal packaging. Authorized fissile contents are set forth in paragraph (b)(2) of this section.

(3) Any packaging listed in § 127.113, limited to the following radioactive materials:

(i) 500 grams of uranium-235 in a single shipment as Fissile Class III or not more than 40 grams of uranium-

235 per package as Fissile Class II. For Fissile Class II shipments, the transport index to be assigned to each package must be 0.4 for each gram of uranium-235 above 15 grams up to the maximum of 40 grams (transport index of 10).

(ii) 32 grams of plutonium-239 as plutonium-beryllium neutron sources in special form. Total radioactivity content may not exceed 2 curies. The transport index to be assigned to each package must be 0.5 for each 20 grams, or fraction thereof, of fissile plutonium.

(4) Any other Type A packaging for fissile radioactive materials that also meets the applicable standards for fissile materials in the regulations of the U.S. Nuclear Regulatory Commission (10 CFR Part 71), and is approved in accordance with § 127.701.

(5) Any other Type A packaging for fissile radioactive materials that also meets the applicable requirements for fissile material in Section VI of the 1973 regulations of the International Atomic Energy Agency, and for which the foreign competent authority certificate has been revalidated by DOT, in accordance with § 127.703.

(6) A DOT Specification 6J (§ 178.100 of this subchapter) or 17H (§ 178.118 of this subchapter) 55-gallon steel drum, subject to the following conditions:

(i) The quantity may not exceed 350 grams of uranium-235 (which must not be pyrophoric) enriched to any degree in the U-235 isotope.

(ii) Each drum must have a minimum 18-gauge body and bottom head and 16-gauge removable top head with one or more corrugations in the cover near the periphery.

(iii) Closure must conform to § 178.103-5(a) of this subchapter.

(iv) At least four equally spaced 12 mm (0.5 inch) diameter vent holes on the sides of the drum near the top, each covered with weatherproof tape, or equivalent device must be provided.

(v) Appropriate primary inner containment of the contents and sufficient packaging material, such as plastic wrapping, must be provided.

(vi) Each inner container must be able to vent when subjected to the thermal test described in 10 CFR 71.

(vii) Liquid contents must be packaged in accordance with § 127.105(m) and (n).

(viii) The maximum weight of contents including internal packagings may not exceed 91 kg (200 lbs) with fissile material content limited as follows:

Maximum U-235 per package (grams)	Minimum transport index per package as Fissile Class II	Maximum packages per transport vehicle as Fissile Class III
350	1.8	72
300	1.0	129
250	0.5	256
200	0.3	500
150	0.1	500
100	0.1	500
50	(^c)	(^c)

^c Fissile Class I.

(7) Any metal cylinder that meets the performance requirements for Specification 7A Type A packaging in §§ 127.113 and 178.350 of this subchapter may be used as a Fissile Class I package for the transport of residual "heels" of enriched solid uranium hexafluoride without a protective overpack in accordance with the following table:

Maximum cylinder diameter		Cylinder volume		Maximum U-235 enrichment (weight percent)	Maximum weight per cylinder	
Inches	Centimeters	Cubic feet	Liters		Pounds UF ₆	Kilograms U-235
5	12.7	0.311	8.8	100.0	0.1	0.031
8	20.3	1.359	39	12.5	.5	.019
12	30.5	2.410	68	5.0	1.0	.015
30	76	25.64	725	5.0	25.0	.383
48	122	108.9	3084	4.5	50.0	.890
		142.7	4041			

¹⁰-ton.

¹⁴-ton.

(8) DOT Specification 20PF-1, 20PF-2, or 20PF-3 (§ 178.120 of this subchapter) or Specification 21PF-1 or 21PF-2 (§ 178.121 of this subchapter) phenolic-foam insulated overpack with snug fitting inner metal cylinders. (See paragraph (b)(5) of this section

for authorized use.)

(b) Fissile radioactive materials with radioactive content exceeding A₁ or A₂ must be packaged in one of the following packages:

(1) DOT Specification 6L (§ 178.103 of this subchapter), metal packaging

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Authorized only for uranium-235, plutonium-239 or plutonium-241, as metal, oxide, or compounds that do not decompose at temperatures up to 149°C (300°F). Radioactive thermal decay energy output may not exceed 5 watts. Radioactive materials in normal form must be packaged in one or more

sealed and leak tight metal cans or polyethylene bottles within a DOT Specification 2R (§ 178.34 of this subchapter) containment vessel. For Fissile Class II and III packages, fissile radioactive materials must be limited in accordance with the following:

Uranium-235 ^{2/}	Plutonium ^{2/4/}	Fissile Class II transport index	Fissile Class III maximum number of packages per transport vehicle
^{5/} H/X 3	3 H/X 20	H/X 10	10 H/X 20
14----- ^{3/} 3.6-----	----- 2.5	2.4	1.3
-----	-----	1.8	80
-----	-----	-----	55

- ^{1/} Quantity in kilograms.
- ^{2/} All sources of hydrogen within the inner containment vessel must be considered in determining the H/X ratio of inner containment vessel.
- ^{3/} Volume not to exceed 3.6 liters.
- ^{4/} Plutonium solutions are not authorized.
- ^{5/} H/X is the ratio of hydrogen atoms to fissile atoms.

(2) DOT Specification 6M (§ 178.104 of this sub-

(2) DOT Specification 6M (§ 178.104 of this subchapter), metal packaging. Authorized only for solid radioactive materials that will not decompose at temperatures up to 121°C (250°F). Radioactive thermal decay energy output may not exceed 10 watts. Radioactive materials in other than special form must be packaged in one or more sealed and leak-tight metal cans or polyethylene bottles within a DOT Specification 2R containment vessel. For fissile materials:

(i) Fissile Class I packages are limited to the following amounts of fissile radioactive materials: 1.6 kilograms of uranium-235; 0.9 kilograms of plutonium (because of the 10-watt thermal decay heat limitation, the limit for plutonium-238 is 0.02 kilograms); 0.5 kilograms of uranium-233. The maximum ratio of hydrogen to fissile material must not exceed three, including all of the sources of hydrogen within the DOT Specification 2R (§ 178.34 of this subchapter) containment vessel.

(ii) For Fissile Class II and Fissile Class III packages, quantities of fissile radioactive material are limited as shown in the following table. For a Fissile Class II package, the minimum transport index to be assigned is shown in the following table. For a Fissile Class III package, the allowable number of similar packages per transport vehicle is shown. Each Fissile Class III shipment is also subject to the requirements in § 127.507 of this part. Where a maximum ratio of hydrogen to fissile material is specified in the table, only the hydrogen interspersed with the fissile material need be considered. For a uranium-233 shipment, the maximum inside diameter of the inner containment vessel must not exceed 12 cm (4.8 inches). Where necessary, a tight fitting steel insert must be used to reduce a larger diameter inner containment vessel specified in § 178.104-3(b) of this subchapter to the 12 cm (4.8 inches) limit.

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[4910-60-C]

Uranium-233 ^{5/}		Uranium-235 ^{4/7/}		Plutonium ^{2/3/4/}		Fissile class III maximum number of packages per transport vehicle					
Metal or alloy H/X=0	Compounds	Metal or alloy H/X=0	Compounds	Metal or alloy H/X=0	Compounds		Fissile class II transport index				
H/X=0	H/X ^{3/}	H/X=0	H/X ^{3/}	H/X=0	H/X ^{3/}						
3.6	4.4	2.9	2.9	7.2	7.6	5.3	3.1	4.1	3.4	0.1	1,250
6/4.2	5.2	3.5	3.5	8.7	9.6	6.4	3.4	4.5	4.1	.2	625
6/5.2	6.8	4.5	4.5	11.2	13.9	8.3	4.2	-----	4.5	.5	250
-----	-----	-----	-----	13.5	16.0	10.1	4.5	-----	-----	1.0	125
-----	-----	-----	-----	26.0	26.0	16.1	-----	-----	-----	5.0	25
-----	-----	-----	-----	32.0	32.0	19.5	-----	-----	-----	10.0	12

- ^{1/} Quantity in kilograms.
- ^{2/} Minimum percentage of plutonium-240 is 5 weight percent.
- ^{3/} 4.5 kg limitation of plutonium due to 10 watt decay heat limitation.
- ^{4/} For a mixture of uranium-235 and plutonium an equal amount of uranium-235 may be substituted for any portion of plutonium authorized.
- ^{5/} Maximum inside diameter not to exceed 12 cm (4.75 in) (see par. (c)(2)(ii) of this section).
- ^{6/} Granulated or powdered metal with any particle less than 8 mm (0.25 inch) in the smallest dimension is not authorized.
- ^{7/} Maximum uranium-235 enrichment is 93 percent.

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(3) Type B(U) or B(M) packaging that meets the standards for packaging of fissile radioactive materials in 10 CFR Part 71, and is approved by the U.S. Nuclear Regulatory Commission in accordance with § 127.701.

(4) Type B(U) or B(M) packaging that meets the applicable requirements for fissile radioactive materials in Section VI of the 1973 regulations of the International Atomic Energy Agency, and for which the foreign

competent authority certificate has been revalidated by the Department in accordance with § 127.703. Authorized only for import and export shipments.

(5) DOT Specifications 20PF-1, 20PF-2, or 20PF-3 (§ 178.120 of this subchapter) or Specifications 21PF-1 or 21PF-2 (§ 178.121 of this subchapter) phenolic-foam insulated protective overpacks, with snug-fitting inner metal cylinders meeting all of

the applicable requirements of §§ 127.701, 127.105, 173.24. Handling procedures and packaging criteria must be in accordance with the most current issue of U.S. Department of Energy Report No. ORO-651 or ANSI Standard N-14.1-1971. Quantities of uranium hexafluoride are authorized as follows, with each package to be shipped as Fissile Class II, and assigned a minimum transport index as indicated in the following table:

Authorized Quantities of Uranium Hexafluoride as Fissile Class II

Protective overpack specification No.	Maximum inner cylinder diameter		Maximum weight of UF ₆ contents		Maximum U-235 enrichment (weight percent)	Fissile class II transport index
	Inches	Centimeters	Pounds	Kilograms		
20PF-1	5	12.7	55	25	100	0.1
20PF-2	8	20.3	255	116	12.5	.4
20PF-3	12	30.5	460	209	5.0	1.1
21PF-1 ^{1/}	^{2/} 30	76	4,950	2,247	5.0	5.0
	^{3/} 30	76	5,020	2,279		
21PF-2 ^{1/}	^{2/} 30	76	4,950	2,247	5.0	5.0
	^{3/} 30	76	5,020	2,279		

^{1/} For 30-in cylinders, the maximum H/U atomic ration is 0.088.

^{2/} Model 30A inner cylinder (Reference: ORO-651).

^{3/} Model 30B inner cylinder (Reference: ORO-651).

§ 127.119 Authorized packaging—pyrophoric radioactive materials.

(a) Pyrophoric (materials which are capable of spontaneous ignition) radioactive materials, as referenced in § 172.101 of this subchapter, and which are not fissile radioactive materials and not in quantities exceeding A₂ per package, must be in packages of such a design and constructed of materials that will not react with nor be decomposed by the contents. Contents must be in solid form, and:

(1) Contained in one or more sealed and corrosion resistant innermost receptacles with positive closures (friction or slip-fit covers or stoppers are not authorized);

(2) Dry of water and free of any contaminants which would increase the reactivity of the material; and

(3) Made inert to prevent self-ignition during transport by either:

(i) Mixing with large volumes of inerting materials such as graphite or sand, or other suitable inerting material, or blended into a matrix of hardened concrete; or

(ii) Filling the innermost receptacle with an appropriate inert gas.

(b) In addition to the applicable requirements of § 173.24 of this subchapter—

(1) Each innermost sealed receptacle must contain not more than 4.5 kg (10 lbs.) of materials;

(2) Each innermost receptacle must be further enclosed within an outer wooden or metal packaging with non-combustible cushioning material positioned on all sides between the inner receptacle and outer enclosure;

(3) The maximum net weight of the contents may not exceed 34 kg (75 lbs.); and

(4) The package must be capable of passing the test conditions of § 127.611 without leakage of contents.

§ 127.121 Authorized packaging—oxidizing radioactive materials.

Certain oxidizing radioactive materi-

als, as referenced in § 172.101 of this subchapter, and which are also not fissile radioactive materials and not in quantities exceeding A₂, must be packed in suitable inside packagings of earthenware, glass, metal or compatible plastic and suitably cushioned with a material which will not react with the contents. Inner packagings and cushioning must be enclosed within an outside packaging of wood, metal, or plastic. The package must also meet the applicable test requirements of § 127.611 without leakage of contents. For shipment by air, the maximum quantity in any package may not exceed 11.3 kg (25 lbs).

Subpart C—Exceptions for Certain Quantities and Items, Low Specific Activity Radioactive Materials and Low Level Solid Radioactive Materials

§ 127.201 [Reserved]

§ 127.203 Limited quantities of radioactive materials.

Radioactive materials whose activity per package does not exceed the limits specified in § 127.207, are excepted from the labeling requirements of Part 172 of this subchapter, from specification packaging, and the requirements of this part if—

(a) The materials are packaged in strong, tight packages that will not leak any of the radioactive materials during conditions normally incident to transportation;

(b) The radiation level at any point on the external surface of the package does not exceed 0.5 mrem/h;

(c) The non-fixed (removable) radioactive surface contamination on the external surface of the package does not exceed the limits specified in § 127.405(a);

(d) The packaging bears the marking "Radioactive" in such a manner that it is visible upon opening the package;

(e) Except as provided in § 127.209, the package does not contain more than 15 grams of uranium-235; and

(f) The smallest external dimension of the package is not less than 10 (4.0 inches).

§ 127.205 Exceptions for instruments and devices.

Instruments and manufactured articles (including clocks, electronic tubes or apparatus) or similar devices having radioactive materials (other than fluids) in a non-dispersible form a component part are excepted from labeling requirements of Part 172 of this subchapter, from specification packaging, and the requirements of this part, if—

(a) The activity of the instrument article does not exceed the relevant limit listed in the table in § 127.207;

(b) The total activity per package does not exceed the relevant limit listed in the table in § 127.207;

(c) The radiation level at 10 cm (inches) from any point on the external surface of any instrument or device does not exceed 10 mrem/h;

(d) The radiation level at any point on the external surface of a package bearing the devices or instrument does not exceed 0.5 mrem/h; except for full-load shipments, for which the limit is 2 mrem/h;

(e) The non-fixed (removable) radioactive surface contamination on the external surface of the package does not exceed the limits specified in § 127.405(a);

(f) Except as provided in § 127.209, no package contains more than 15 grams of U-235;

(g) The smallest external dimension of the package is not less than 10 (4.0 inches); and

(h) The instrument or device (except radioluminescent time pieces or dials) is marked "Radioactive."

§ 127.207 Table of activity limits—excepted quantities and devices.

The limits applicable to instrument devices, and excepted quantities subject to exceptions under §§ 127.203 and 127.205 are as follows:

Nature of contents	Instruments and articles		Materials
	Item limits ^{1/}	Package limits	Package limits
Solids			
Special forms	10 ⁻² A ₁	A ₁	10 ⁻³ A ₁
Other forms	10 ⁻² A ₂	A ₂	10 ⁻³ A ₂
Liquids			
Tritiated water			
<0.1 Ci/l	-	-	1000 Ci
between			
0.1Ci/l and 1.0Ci/l	-	-	100 Ci
>1.0 Ci/l	-	-	1 Ci
Other liquids	10 ⁻³ A ₂	10 ⁻¹ A ₂	10 ⁻⁴ A ₂
Gases			
Tritium ^{2/}			
Special form	20 Ci	200 Ci	20 Ci
Other forms	10 ⁻³ A ₁	10 ⁻² A ₁	10 ⁻³ A ₁
	10 ⁻³ A ₂	10 ⁻² A ₂	10 ⁻³ A ₂

^{1/} For mixture of radionuclides in items, see § 127.303(b).
^{2/} These values also apply to tritium in activated luminous paint and tritium absorbed on solid carriers.

§ 127.209 Excepted articles containing natural uranium or thorium.

Manufactured articles in which the sole radioactive material content is natural or depleted uranium or natural thorium are excepted from the labeling requirements of Part 172 of this subchapter, from specification packaging, and from the requirements of this part if—

(a) The outer surface of the uranium or thorium is enclosed in an inactive sheath made of metal or other protective material; and

(b) The conditions specified in § 127.203(b), (c) and (d) are met.

§ 127.211 Transport requirements for low specific activity (LSA) radioactive materials.

(a) Low specific activity (LSA) radioactive materials must be packaged in accordance with §§ 127.101, 127.105(a), (e), (g) and (m), 127.611, and 173.24 of this subchapter.

(b) LSA materials when transported in other than full loads must be labeled in accordance with Part 172 of this subchapter.

(c) For shipments of LSA materials transported as full load:

(1) Packages are excepted from the labeling requirements of Part 172 of this subchapter;

(2) Packages must be stenciled or otherwise marked with the notation "RADIOACTIVE-LSA";

(3) The surface contamination limits on packages may not exceed the levels prescribed in § 127.405(c);

(4) External radiation levels may not exceed those prescribed in § 127.401(b);

(5) The transport vehicle must be placarded by the shipper with the placards prescribed in Part 172 of this subchapter, however, shipments of unconcentrated uranium or thorium ores are excepted from placarding;

(6) The activity of the "full-load" shipment may not exceed the following limits:

Nature of Material	Vehicle, Aircraft, hold, compartment or deck area of a seagoing vessel	Hold or compartment of an inland waterway craft
Solids.....	No Limit.....	100 x A.
Tritiated water.....	50,000 Ci.....	5,000
Other liquids and gases.....	100 x A.....	100 x A.

Note.—See also part 176 of this subchapter.

(7) Shipments must be loaded by the consignor and unloaded by the consignee from the transport vehicles in which originally loaded;

(8) Specific written instructions for maintenance of sole use shipment controls must be provided by the shipper to the carrier. Such instructions must

be included with the shipping paper information; and

(9) Shipments must be loaded in accordance with § 127.415(a).

(d) Unpackaged (bulk) shipments of low specific activity materials transported in closed transport vehicles (except aircraft) designated for the sole use of the consignor must comply with the following:

(1) Authorized materials are limited to the following:

(i) Uranium or thorium ores and physical or chemical concentrates of those ores;

(ii) Uranium metal or natural thorium metal, or alloys of these materials;

(iii) Materials which, if reduced to the minimum volume under conditions likely to be encountered during transportation, including dissolution in water with subsequent recrystallization, precipitation, evaporation, combustion, and abrasion would have an average estimated specific activity of not more than 10⁻⁴A₂/g;

(iv) Objects of non-radioactive material contaminated with radioactive material, if the non-fixed surface contamination is not more than 10 times the values set forth in § 127.405 and the contaminated object or the contamination on the object, if reduced to the minimum volume under conditions likely to be encountered during transportation, including dissolution in water with subsequent recrystallization, precipitation, evaporation, combustion, and abrasion would have an average estimated specific activity of no more than 10⁻⁴A₂/g.

(2) External radiation levels must comply with § 127.401(b);

(3) The transport vehicles must be placarded with the placards prescribed in § 172.504 of this subchapter, however, shipments of unconcentrated uranium or thorium are excepted from placarding;

(4) Shipments must be loaded by the consignor, and unloaded by the consignee from the transport vehicle in which originally loaded; and

(5) Specific written instructions for maintenance of sole use shipment controls must be provided by the shipper to the carrier. Such instructions must be included with the shipping paper information.

§ 127.213 Transport requirements for low level solid (LLS) radioactive materials.

(a) Low level solid radioactive materials (LLS) must be packaged in accordance with §§ 127.101, 127.105 (a), (e), (g) and (m), 127.611, and 173.24 of this subchapter.

(b) LLS materials may be transported only as full loads, and are subject to the following requirements:

(1) Packages are excepted from the labeling requirements of Part 172 of this subchapter.

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(2) Packages must be stenciled or otherwise marked with the notation "RADIOACTIVE-LLS".

(3) Surface contamination limits on packages may not exceed the levels prescribed in §127.405(c).

(4) External radiation levels must comply with §127.401(b).

(5) Shipments must be loaded by the consignor and unloaded by the consignee from the transport vehicle in which originally loaded.

(6) Shipments must be loaded in accordance with §127.415(a).

(7) Specific written instructions for maintenance of sole use shipment controls must be provided by the shipper to the carrier. Such instructions must be included with the shipping paper information.

Support D—Activity Limits for Radioactive Materials Packages

§127.301. Activity limits for Type A and Type B packages.

(a) A Type A package may not contain activities greater than the following, determined in accordance with the procedures described in §127.303, or as listed in §127.305:

(1) For special form radioactive materials, A_1 .

(2) For all other radioactive materials, A_2 .

(b) The limits on activity contained in Type B(U) and Type B(M) packages are those as prescribed in their approval certificates under §§127.115, 127.701, and 127.703.

§127.303 Requirements for determination of A_1 and A_2 values for radionuclides.

(a) *Single radionuclides.* (1) For single radionuclides of known identity, the values of A_1 and A_2 are those given in the table in §127.305. The values of A_1 and A_2 are also applicable for radionuclides contained in (α, n or (β, n) neutron sources.

(2) For any single radionuclide of known identity, which is not listed in §127.305, the values of A_1 and A_2 shall be determined in accordance with the following:

(i) If the radionuclide emits only one type of radiation, A_1 is determined in accordance with paragraphs (A), (B), (C), and (D) of this paragraph. For radionuclides emitting different kinds of radiation, A_1 is the most restrictive value of those determined for each individual radioisotope. However, in both cases, A_1 is restricted to a maximum of 1000 Ci. If a parent nuclide decays into a shorter lived daughter, of a half-life not greater than 10 days, A_1 is calculated for both the parent and the daughter, and the more limit-

ing of the two values is assigned to the parent nuclide.

$$A_1 = \frac{9}{I} \text{ curie}$$

where:

I is the gamma-ray constant, corresponding to the dose in R/h at 1 m per Ci; the number 9 results from the choice of 1 rem/h at a distance of 3 m as the reference dose-equivalent rate.

(B) For x-ray emitters, A_1 is determined by the atomic number (Z) of the nuclide: for $Z < 55$, $A_1 = 1000$ Ci for $Z > 55$, $A_1 = 200$ Ci.

(C) For beta emitters, A_1 is determined by the maximum beta energy (E_{max}) according to the following table:

E_{max} (MeV)	A_1 (Ci)
<0.5	1000
0.5-1.0	300
1.0-1.5	100
1.5-2.0	30
>2.0	10

(D) For alpha emitters, A_1 is determined by the expression:

$$A_1 = 1000 A_2$$

where A_2 is the value listed in the following table:

Atomic number	A_2		
	Half-life less than 1000 days	Half-life 1000 days to 10 years	Half-life greater than 10 years
1 to 81	3 Ci	50 mCi	3 Ci
82 and above	2 mCi	2 mCi	3 Ci

(ii) For assignment of A_2 values, A_2 is the more restrictive of the following values:

(A) The corresponding A_1 .

(B) The value A_2 obtained from the table in subparagraph (2)(i) of this paragraph.

(3) For any single radionuclide whose identity is unknown, the value of A_1 is 2 Ci and the value of A_2 is 0.002 Ci. However, if the atomic number of the radionuclide is less than 82, the value of A_1 is 10 Ci and the value of A_2 is 0.4 Ci.

(b) *Mixture of radionuclides, including radioactive decay chains.* (1) For mixed fission products, where a detailed analysis of the mixture is not

(A) For gamma emitters, A_1 is determined by the expression:

carried out, the following activity limits apply:

$$A_1 = 10 \text{ Ci}$$

$$A_2 = 0.4 \text{ Ci}$$

(2) A single radioactive decay chain is considered to be a single radionuclide when the radionuclides are present in their natural occurring proportions and no daughter nuclide has a half-life either longer than 10 days or longer than that of the parent nuclide. The activity to be taken into account and the A_1 or A_2 value to be applied are those corresponding to the parent nuclide of that chain. However, in the case of radioactive decay chains in which any daughter nuclide has a half-life either longer than 10 days or greater than that of the parent nuclide, the parent and daughter nuclides are considered to be mixtures of different nuclides.

(3) In the case of a mixture of different radionuclides, where the identity and activity of each radionuclide is known, the permissible activity of each radionuclide R_1, R_2, \dots, R_n must be such that $F_1 + F_2 + \dots + F_n$ is not greater than unity, when—

$$F_1 = \frac{\text{Total activity of } R_1}{A_1 (R_1)}$$

$$A_1 (R_1)$$

$$F_2 = \frac{\text{Total activity of } R_2}{A_1 (R_2)}$$

$$A_1 (R_2)$$

$$F_n = \frac{\text{Total activity of } R_n}{A_1 (R_n)}$$

$$A_1 (R_n)$$

where $A_1 (R_1, R_2, \dots, R_n)$ is the value of A_1 or A_2 as appropriate for the nuclide R_1, R_2, \dots, R_n .

(4) When the identity of each radionuclide is known but the individual activities of some of the radionuclides are not known, the formula given in

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subparagraph (3) of this paragraph must be applied to establish the values of A₁ or A₂ as appropriate. All the radionuclides whose individual activities are not known (but whose total activity is known) must be classed in a single group and the most restrictive value of A₁ and A₂ applicable to any one of them shall be used as the value of A₁ or A₂ in the denominator of the fraction.

(5) Where the identity of each radionuclide is known but the individual activity of the radionuclides is not known, the most restrictive value of A₁ or A₂ applicable to any one of the radionuclides present is the applicable value.

(6) When the identity of the radionuclides is not known, the value of A₁ is 2 Ci and the value of A₂ is 0.002 Ci. However, if alpha emitters are known to be absent, the value of A₂ is 0.4 Ci.

§ 127.304 Activity-mass relationships for uranium and natural thorium.¹

Radioactive material	Ci/g	g/Ci
Uranium (Wt% ²³⁵ U present)		
0.45.....	5.0 x 10 ⁻⁷	2.0 x 10 ⁶
0.72 (natural).....	7.06 x 10 ⁻⁷	1.42 x 10 ⁶
1.0.....	7.6 x 10 ⁻⁷	1.3 x 10 ⁶
1.5.....	1.0 x 10 ⁻⁶	1.0 x 10 ⁶
10.0.....	2.7 x 10 ⁻⁶	3.7 x 10 ⁵
10.00.....	4.8 x 10 ⁻⁶	2.1 x 10 ⁵
20.00.....	1.0 x 10 ⁻⁵	1.0 x 10 ⁵
35.00.....	2.0 x 10 ⁻⁵	5.0 x 10 ⁴
50.0.....	2.5 x 10 ⁻⁵	4.0 x 10 ⁴
80.0.....	5.8 x 10 ⁻⁵	1.7 x 10 ⁴
93.0.....	7.0 x 10 ⁻⁵	1.4 x 10 ⁴
95.00.....	9.1 x 10 ⁻⁵	1.1 x 10 ⁴
Natural thorium	2.2 x 10 ⁻⁷	4.5 x 10 ⁶

¹The figures for uranium include the activity of uranium-234 which is concentrated during the enrichment process. The activity for thorium includes the equilibrium concentration of thorium-233.

§ 127.305 Table of A₁ and A₂ values for radionuclides

Symbol of radionuclide	Element and atomic number	A ₁ (Ci)	A ₂ (Ci)	Specific activity (Ci/g)
²²⁷ Ac.....	Actinium(89).....	1000	0.008	7.2x10
²²⁸ Ac.....	Actinium(89).....	10	4	2.2x10 ⁶
¹⁰⁹ Ag.....	Silver(47).....	40	40	3.1x10 ⁴
^{110m} Ag.....	Silver(47).....	7	7	4.7x10 ³
^{114a} Am.....	Americium(95).....	100	1000	1.6x10 ⁵
²⁴¹ Am.....	Americium(95).....	8	0.008	3.2
²⁴³ Am.....	Americium(95).....	8	0.008	1.9x10 ⁻¹
³⁹ Ar(compressed or uncompressed).....	Argon(18).....	1000	1000	1.6x10 ⁶
⁴¹ Ar(uncompressed).....	Argon(18).....	20	20	4.3x10 ⁷
⁴¹ Ar(compressed).....	Argon(18).....	1	1	
⁷⁵ As.....	Arsenic(33).....	1000	400	2.4x10 ⁴
⁷⁴ As.....	Arsenic(33).....	20	20	1.0x10 ⁵
⁷⁶ As.....	Arsenic(33).....	10	10	1.8x10 ⁶
⁷⁷ As.....	Arsenic(33).....	300	300	1.1x10 ⁶
²¹¹ At.....	Astatine(85).....	200	7	2.1x10 ⁶
¹⁹⁷ Au.....	Gold(79).....	200	200	9.3x10 ⁶
¹⁹⁸ Au.....	Gold(79).....	30	30	1.2x10 ⁶
¹⁹⁹ Au.....	Gold(79).....	40	40	2.5x10 ⁶
¹⁹⁹ Au.....	Gold(79).....	200	200	3.1x10 ⁶
¹³⁷ Ba.....	Barium(56).....	40	40	8.7x10 ⁴
¹³⁵ Ba.....	Barium(56).....	40	10	4.0x10 ²
¹⁴⁰ Ba.....	Barium(56).....	20	20	7.3x10 ⁴
⁷⁸ Bc.....	Beryllium(4).....	300	300	3.5x10 ³
²⁰⁹ Bi.....	Bismuth(83).....	5	5	9.9x10 ⁴
²¹⁰ Bi.....	Bismuth(83).....	10	10	2.16x10 ²
²¹⁰ Bi(RaE).....	Bismuth(83).....	100	4	1.2x10 ³
²¹¹ Bi.....	Bismuth(83).....	6	6	1.5x10 ¹
⁹⁷ Bk.....	Berkelium(97).....	1000	1	1.8x10 ³
⁸¹ Br.....	Bromine(35).....	6	6	1.1x10 ⁶
¹⁴ C.....	Carbon(6).....	1000	100	4.6
⁴⁴ Ca.....	Calcium(20).....	1000	40	1.9x10 ⁴
⁴⁷ Ca.....	Calcium(20).....	20	20	5.9x10 ³
¹⁰⁶ Cd.....	Cadmium(48).....	1000	70	2.6x10 ³
^{112m} Cd.....	Cadmium(48).....	30	30	2.6x10 ⁴
¹¹³ Cd.....	Cadmium(48).....	80	80	5.1x10 ³
¹³⁷ Ce.....	Cerium(58).....	100	100	8.5x10 ³
¹⁴¹ Ce.....	Cerium(58).....	300	200	2.8x10 ⁴
¹⁴² Ce.....	Cerium(58).....	60	60	6.6x10 ³
¹⁴⁴ Ce.....	Cerium(58).....	10	7	3.2x10 ³
²⁴⁵ Cf.....	Californium(98).....	2	0.002	9.1
²⁵⁰ Cf.....	Californium(98).....	7	0.007	1.3x10 ³
²⁵² Cf.....	Californium(98).....	2	0.008	6.5x10 ²
³⁵ Cl.....	Chlorine(17).....	300	30	3.2x10 ⁻²
³⁷ Cl.....	Chlorine(17).....	10	10	1.3x10 ⁴
²⁴⁷ Cm.....	Curium(96).....	200	0.2	3.3x10 ³
²⁴⁸ Cm.....	Curium(96).....	9	0.009	4.2x10
²⁴⁹ Cm.....	Curium(96).....	10	0.01	8.2x10
²⁴⁵ Cm.....	Curium(96).....	6	0.006	1.0x10 ⁻¹
²⁴⁶ Cm.....	Curium(96).....	6	0.006	3.0x10 ⁻¹
²⁷ Co.....	Cobalt(27).....	5	5	3.0x10 ³
⁵⁷ Co.....	Cobalt(27).....	90	90	8.5x10 ³
¹⁰⁸ Co.....	Cobalt(27).....	1000	1000	5.9x10 ³
⁵⁸ Co.....	Cobalt(27).....	20	20	3.1x10 ³
⁶⁰ Co.....	Cobalt(27).....	7	7	1.1x10 ³
⁵² Cr.....	Chromium(24).....	600	600	9.2x10 ³
¹³⁷ Cs.....	Cesium(55).....	1000	1000	1.0x10 ⁶
^{134m} Cs.....	Cesium(55).....	1000	1000	7.4x10 ⁶
¹³⁵ Cs.....	Cesium(55).....	10	10	1.2x10 ³

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Symbol of radionuclide	Element and atomic number	A ₁ (Cl)	A ₂ (Cl)	Specific activity (Ci/g)
¹⁴ Cs		1000	100	3.9×10 ⁻⁴
¹³⁷ Cs		7	7	7.4×10 ⁴
⁶⁴ Cu		30	20	9.8×10 ⁴
⁶⁴ Dy	Copper (29)	80	89	3.9×10 ⁵
¹⁶⁴ Dy	Dysprosium (66)	100	100	3.2×10 ⁵
¹⁹² Dy		1000	200	3.3×10 ⁵
¹⁷⁵ Er	Erbium (68)	1000	300	3.2×10 ⁵
¹⁵⁴ Eu		50	50	2.4×10 ⁵
¹⁵² Eu	Europium (63)	30	30	2.3×10 ⁵
¹⁵⁰ Eu		20	20	1.9×10 ⁵
¹⁵¹ Eu		10	5	1.5×10 ⁵
¹⁸ F	Fluorine (9)	400	90	1.4×10 ⁵
⁵⁹ Fe	Iron (26)	20	20	9.3×10 ⁴
⁵⁵ Fe		6	6	7.3×10 ⁴
⁶⁰ Fe		1000	1000	2.2×10 ⁴
⁷⁰ Ga		10	10	4.9×10 ⁴
⁶⁷ Gd	Gallium (31)	7	7	3.1×10 ⁵
¹⁵³ Gd	Gadolinium (64)	200	100	3.8×10 ⁵
⁷⁶ Ge	Germanium (32)	300	300	1.1×10 ⁵
³ H	Hydrogen (1) see T-Tritium	1000	1000	1.6×10 ⁵
¹⁰⁸ Hf	Hafnium (72)	30	30	1.8×10 ⁴
¹⁹⁹ Hg	Mercury (80)	200	200	6.6×10 ⁴
²⁰³ Hg		200	200	2.5×10 ⁴
¹⁹⁷ Hg		80	80	1.4×10 ⁴
¹⁶⁶ Ho	Holmium (67)	30	30	6.9×10 ⁴
¹²⁷ I	Iodine (53)	1000	70	1.7×10 ⁴
¹³¹ I		40	10	7.8×10 ⁴
¹³¹ I		1000	2	1.62×10 ⁻⁴
¹³² I		40	10	1.2×10 ⁵
¹³³ I		7	7	1.1×10 ⁵
¹³⁴ I		30	30	1.1×10 ⁵
¹³⁵ I		8	8	2.7×10 ⁷
^{115m} In		10	10	3.5×10 ⁵
¹¹⁵ In	Indium (49)	60	60	1.6×10 ⁷
^{113m} In		30	20	2.3×10 ⁴
¹⁹² Ir	Iridium (77)	100	100	6.1×10 ⁵
¹⁹⁴ Ir		10	10	6.2×10 ⁴
¹⁹⁶ Ir		20	20	9.1×10 ⁵
⁴¹ K	Potassium (19)	10	10	8.5×10 ⁴
⁸⁶ Kr (uncompressed)	Krypton (36)	10	10	6.0×10 ⁵
⁸⁴ Kr (compressed)		100	100	8.4×10 ⁴
⁸¹ Kr (uncompressed)		3	3	8.0×10 ⁴
⁸³ Kr (compressed)		1000	1000	4.0×10 ⁵
⁸⁵ Kr (uncompressed)		5	5	4.0×10 ⁵
⁸³ Kr (compressed)		20	20	2.8×10 ⁷
¹³⁹ La	Lanthanum (57)	0.6	0.6	
L.L.S.	See § 127.3(b) and § 127.212.	30	30	5.8×10 ⁴
L.S.A.	See § 127.3(c) and § 127.211.			
¹⁷⁶ Lu	Lutetium (71)	300	300	1.1×10 ⁵
M.F.P.	Mixed fission products	10	0.4	
²⁴ Mg	Magnesium (12)	6	6	5.2×10 ⁵
⁵⁴ Mn	Manganese (25)	5	5	4.4×10 ⁵
⁵⁵ Mn		20	20	8.3×10 ⁵
⁵⁶ Mn		5	5	2.3×10 ⁵
²³ Na	Sodium (11)	100	100	4.7×10 ⁵
²⁴ Na		8	8	6.3×10 ⁵
⁹³ Nb	Niobium (41)	5	5	8.7×10 ⁵
⁹⁵ Nb		1000	1000	1.1×10 ⁵
⁹⁷ Nb		20	20	3.9×10 ⁴
¹⁴⁷ Nd	Neodymium (60)	20	20	2.8×10 ⁵
¹⁵⁰ Nd		100	100	8.0×10 ⁴
¹⁵¹ Nd		30	30	1.1×10 ⁵
⁶³ Ni	Nickel (28)	1000	900	8.1×10 ⁻³
⁶⁵ Ni		1000	100	0.46×10 ⁻³
²³⁷ Np	Neptunium (93)	10	10	1.9×10 ⁵
²³⁹ Np		5	0.005	6.9×10 ⁻⁴
¹⁹⁰ Os	Osmium (76)	200	200	2.3×10 ⁵
¹⁹² Os		20	20	7.3×10 ⁵
¹⁹⁴ Os		600	400	4.6×10 ⁴
¹⁹⁶ Os		200	200	1.2×10 ⁵
³¹ P	Phosphorus (15)	100	100	5.3×10 ⁵
²¹⁰ Pb	Protoactinium (91)	30	30	2.9×10 ⁵
²¹⁰ Pb		20	0.8	3.2×10 ⁴
²¹² Pb		2	0.002	4.5×10 ⁻³
²¹⁴ Pb		100	100	2.1×10 ⁴
²¹⁰ Pb	Lead	30	30	1.7×10 ⁵
²¹¹ Pb		100	0.2	8.8×10 ⁴
¹⁰⁷ Pd		6	5	1.4×10 ⁶
¹⁰⁶ Pd	Palladium (46)	1000	700	7.5×10 ⁴
¹⁰⁵ Pd		100	100	2.1×10 ⁵
¹⁴⁷ Pm	Promethium (61)	1000	80	8.4×10 ⁵
¹⁴⁹ Pm		100	100	4.2×10 ⁵

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Symbol of radionuclide	Element and atomic number	A ₁ (Ci)	A ₂ (Ci)	Specific activity (Ci/g)
²¹⁰ Po	Polonium (84)	200	0.2	4.5 × 10 ³
¹⁴⁷ Pm	Praseodymium (59)	10	10	1.2 × 10 ⁶
¹⁹¹ Pt	Platinum (78)	300	200	6.6 × 10 ³
¹⁹⁵ Pt		100	100	2.3 × 10 ³
¹⁹⁷ Pt		200	200	
²³⁹ Pu	Plutonium (94)	300	300	1.2 × 10 ³
²⁴⁰ Pu		300	300	8.8 × 10 ³
²⁴¹ Pu		3	0.003	1.7 × 10 ³
²⁴² Pu		2	0.002	6.2 × 10 ³
²⁴⁴ Pu	2	0.002	2.3 × 10 ³	
²³⁸ Pu	1000	0.1	1.1 × 10 ³	
²²⁶ Ra	Radium (88)	3	0.003	8.9 × 10 ³
²²⁸ Ra		50	0.2	5.0 × 10 ³
²²⁹ Ra		6	0.5	1.6 × 10 ³
²³⁰ Ra		10	0.05	1.0
²²⁸ Rb	Rubidium (37)	10	0.05	2.3 × 10 ³
²²⁹ Rb		30	30	8.1 × 10 ³
Rb (natural)	Unlimited	Unlimited	6.6 × 10 ⁻³	
¹⁸⁷ Re	Rhenium (75)	Unlimited	Unlimited	1.8 × 10 ⁻³
¹⁸⁶ Re		100	100	1.9 × 10 ³
¹⁸⁷ Re	Unlimited	Unlimited	3.8 × 10 ⁻³	
Re (natural)	10	10	1.0 × 10 ³	
¹⁰⁶ Rh	Rhodium (45)	Unlimited	Unlimited	2.4 × 10 ⁻³
¹⁰⁵ Rh		1000	1000	3.2 × 10 ³
²²² Rn	200	200	8.2 × 10 ³	
²²² Rn	10	2	1.5 × 10 ³	
¹⁰¹ Ru	Ruthenium (44)	80	80	5.5 × 10 ³
¹⁰⁰ Ru		30	30	3.2 × 10 ³
⁹⁹ Ru		20	20	6.6 × 10 ³
¹⁰¹ Ru		10	7	3.4 × 10 ³
³² S	Sulphur (16)	1000	300	4.3 × 10 ³
¹²⁵ Sb		30	30	3.9 × 10 ³
¹²⁵ Sb	5	5	1.8 × 10 ³	
⁴⁶ Sc	Scandium (21)	40	30	1.4 × 10 ³
⁴⁷ Sc		8	8	3.4 × 10 ³
⁴⁵ Sc	200	200	8.2 × 10 ³	
⁷⁶ Se	5	5	1.5 × 10 ³	
⁷⁶ Se	40	40	1.4 × 10 ³	
³¹ Si	Silicon (14)	100	100	3.9 × 10 ³
¹⁴⁷ Sm		Unlimited	Unlimited	2.0 × 10 ⁻³
¹⁵² Sm	1000	90	2.8 × 10 ³	
¹⁵³ Sm	300	300	4.4 × 10 ³	
¹⁵⁴ Sm	80	60	1.0 × 10 ³	
¹⁵⁵ Sm	10	10	1.1 × 10 ³	
⁹⁰ Sr	Strontium (38)	80	80	3.2 × 10 ³
⁸⁹ Sr		30	30	2.4 × 10 ³
⁸⁷ Sr		50	50	1.2 × 10 ³
⁹¹ Sr		100	48	2.9 × 10 ³
⁹⁰ Sr		10	0.4	1.5 × 10 ³
⁹¹ Sr	10	10	3.6 × 10 ³	
⁹² Sr	10	10	1.3 × 10 ³	
T (uncompressed)	Tritium (1)	1000	1000	9.7 × 10 ³
T (compressed)		1000	1000	
T (activated luminous paint)		1000	1000	
T (adsorbed on solid carrier)		1000	1000	
T (tritiated water)		1000	1000	
T (other forms)		1000	1000	
¹⁸² Ta	Tantalum (73)	20	20	6.2 × 10 ³
¹⁸⁰ Tb		20	20	1.1 × 10 ³
¹⁶⁰ Tb	Terbium (65)	20	20	3.8 × 10 ³
¹⁸⁶ Tc		1000	1000	3.2 × 10 ³
⁹⁹ Tc	6	6	1.5 × 10 ³	
^{99m} Tc	1000	200	1.4 × 10 ³	
⁹⁹ Tc	1000	400	5.2 × 10 ³	
⁹⁹ Tc	100	100	1.7 × 10 ³	
¹²⁷ Te	Tellurium (52)	1000	82	1.8 × 10 ³
¹²⁹ Te		1000	100	4.0 × 10 ³
¹³⁰ Te		300	40	2.6 × 10 ³
¹³¹ Te		300	300	2.5 × 10 ³
¹³² Te		50	30	2.0 × 10 ³
¹³³ Te	100	100	8.0 × 10 ³	
¹³⁴ Te	10	10	3.1 × 10 ³	
²³² Th	Thorium (90)	7	7	3.2 × 10 ³
²³⁰ Th		200	0.2	8.3 × 10 ³
²³¹ Th		6	0.008	1.9 × 10 ³
²³² Th		3	0.003	5.3 × 10 ³
²³⁴ Th		1000	1000	1.1 × 10 ³
Th (natural)	Unlimited	Unlimited	2.3 × 10 ³	
Th (irradiated)	10	10	Unlimited (see § 127.304)	
²⁰³ Tl	Thallium (81)	Unlimited	Unlimited	5.6 × 10 ³
²⁰⁴ Tl		20	20	2.2 × 10 ³
²⁰⁵ Tl	200	200	5.4 × 10 ³	
²⁰⁶ Tl	40	40	4.3 × 10 ³	
¹⁹⁷ Tm	Thulium (69)	300	30	6.0 × 10 ³
¹⁹⁸ Tm		300	40	1.1 × 10 ³
²³⁵ U	Uranium (92)	1000	100	2.7 × 10 ³
²³⁸ U		100	0.1	2.1 × 10 ³
²³⁴ U		30	0.03	9.5 × 10 ³

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Symbol of radionuclide	Element and atomic number	A ₁ (Ci)	A ₂ (Ci)	Specific activity (Ci/g)
²³⁵ U	Uranium (92)	100	0.1	8.2 × 10 ⁻³
²³⁸ U	Uranium (92)	100	0.2	2.1 × 10 ⁻³
²³⁹ U	Uranium (92)	200	0.2	8.3 × 10 ⁻³
²³⁵ U (natural)	Uranium (92)	Unlimited	Unlimited	3.3 × 10 ⁻³
U (enriched) 20% or greater	Uranium (92)	Unlimited	Unlimited (see § 127.304)	Unlimited (see § 127.304)
U (depleted)	Uranium (92)	100	0.1	0.1
U (irradiated)	Uranium (92)	Unlimited	Unlimited (see § 127.304)	Unlimited (see § 127.304)
⁵¹ V	Vanadium (23)	6	6	1.7 × 10 ³
¹⁸³ W	Tungsten (74)	200	100	5.0 × 10 ³
¹⁸⁷ W	Tungsten (74)	1000	100	9.7 × 10 ³
¹³⁶ Xe (compressed)	Xenon (54)	40	40	7.0 × 10 ³
¹³⁶ Xe (uncompressed)	Xenon (54)	10	10	1.0 × 10 ³
¹³⁵ Xe (uncompressed)	Xenon (54)	100	100	1.0 × 10 ³
¹³⁵ Xe (compressed)	Xenon (54)	1000	1000	1.9 × 10 ³
¹³⁴ Xe (uncompressed)	Xenon (54)	5	5	1.9 × 10 ³
¹³⁴ Xe (compressed)	Xenon (54)	70	70	2.5 × 10 ³
⁹⁰ Y	Yttrium (39)	2	2	2.5 × 10 ³
⁹¹ Y	Yttrium (39)	10	10	5.3 × 10 ³
⁹⁰ Y	Yttrium (39)	30	30	4.1 × 10 ³
⁹¹ Y	Yttrium (39)	30	30	2.5 × 10 ³
⁹² Y	Yttrium (39)	10	10	9.5 × 10 ³
⁹³ Y	Yttrium (39)	10	10	3.2 × 10 ³
¹⁷⁴ Yb	Ytterbium (70)	400	400	1.8 × 10 ³
⁶⁸ Zn	Zinc (30)	30	30	8.0 × 10 ³
⁶⁹ Zn	Zinc (30)	40	40	3.3 × 10 ³
⁷⁰ Zn	Zinc (30)	300	300	5.3 × 10 ³
⁹⁰ Zr	Zirconium (40)	1000	200	3.5 × 10 ³
⁹¹ Zr	Zirconium (40)	20	20	2.1 × 10 ³
⁹² Zr	Zirconium (40)	20	20	2.0 × 10 ³

¹The values for A₁ and A₂ must be calculated in accordance with the procedure specified in § 127.303 taking into account the activity of the fission products and the Uranium-233, in addition to the activity of the Thorium.

²The values for A₁ and A₂ must be calculated in accordance with the procedure specified in § 127.303(b)(3), taking into account the activity of the fission products and plutonium isotopes in addition to that of Uranium.

Support E—Requirements for Transportation

§ 127.401 Radiation level limitations.

(a) Except for packages shipped as a full load, each package of radioactive materials offered for transportation must be designed and prepared for shipment so that during normal transportation conditions the radiation level does not exceed 200 millirem per hour at any point on the external surface of the package, and the transport index does not exceed 10.

(b) Except for shipments by air, a shipment which exceeds the radiation level limits specified in paragraph (a) of this section, may be transported as full load if the radiation level does not exceed any of the following at any time during transportation:

(1) 1000 millirem per hour at any point on the external surface of the package;

(2) 200 millirem per hour at any point on the external surface of the vehicle, including the upper and lower surfaces, or, in the case of an open vehicle, at any point on the vertical planes projected from the outer edges of the vehicle, on the upper surface of the load, and on the lower external surface of this vehicle;

(3) 10 millirem per hour at 2 m (6.6

feet) from the planes projected from the outer surfaces of the vehicle, or if the load is transported in an open transport vehicle, at any point 2 m (6.6 feet) from the planes projected from the outer edges of the vehicle and top of the load; and

(4) 2 mm/h in any normally occupied position in the car or vehicle, except that this provision does not apply to private motor carriers.

(c) For shipments made under the provision of § 127.401(b), the shipper must provide specific written instructions for maintenance of the full load shipment controls to the carrier. The instructions must be included with the shipping paper information.

§ 127.403 Thermal limitations.

Each package of radioactive materials must be designed, constructed, and loaded so that—

(a) The heat generated within the package because of the radioactive contents will not, at any time during transportation, affect the integrity of the package under conditions normally incident to transportation; and

(b) The temperature of the accessible external surfaces of the loaded package will not, assuming still air in the shade at an ambient temperature of 38°C (100°F) exceed either—

- (1) 50°C (122°F) in other than a full load; or
- (2) 82°C (180°F) in a full load.

§ 127.405 Contamination control.

(a) The non-fixed (removable) external radioactive contamination of the surface of each package offered for shipment must be kept as low as practicable, and under normal conditions of transport may not exceed the following levels when averaged over any 300 cm² area of any part of the package surface:

Removable External Radioactive Contamination Levels

Contaminant	Maximum Permissible Levels	
	uCi/cm ²	dls/min/cm ²
Natural or depleted uranium, natural thorium, uranium-235, uranium-238, thorium-228, thorium-230, thorium-232, radionuclides with a half-life of less than 10 days and beta and gamma emitters	10 ⁻⁴	220
All other alpha emitting radionuclides	-	22

(b) In assessing the surface contamination of a package, sufficient wipe samples must be taken in the most appropriate locations to yield a representative assessment of the contamination levels. The average amount of non-fixed (removable) radioactive contamination may be determined by wiping the external surface of the package with an absorbent material, using moderate pressure, and then measuring the activity on the wiping material. If the measured activity on the wiping material (dis/min) divided by the surface area wiped (cm²) is less than 10 percent of the levels prescribed in the table in paragraph (a) of this section, it may be assumed that those levels have not been exceeded. Other methods of equal or greater efficiency may also be utilized.

(c) In the case of packages transported as full load by rail or highway only, the removable (non-fixed) radioactive contamination at any time during transport may not exceed ten times the levels prescribed in paragraph (a) of this section. The levels at the beginning of transport may not exceed the levels prescribed in paragraph (a) of this section.

(d) Except as provided in paragraph (e) of this section, each transport vehicle used for transporting radioactive materials shipped as a full load must

be surveyed with appropriate radiation detection instruments after each use. A vehicle may not be returned to service until the radiation dose rate at each accessible surface is 0.5 millirem per hour or less, and there is no significant removable (non-fixed) radioactive surface contamination as computed under paragraph (a) of this section.

(e) Except in the case of aircraft, paragraph (d) of this section, does not apply to any closed transport vehicle used solely for the transportation of radioactive materials if:

(1) A survey of its interior surface shows that the radiation dose rate does not exceed 10 millirem per hour at any interior surface or 2 millirem per hour at 1 m (3.3 ft) from any interior surface;

(2) Each vehicle is stenciled with the words "For Radioactive Materials Use Only" in letters at least 76mm (3.0 inches) high in a conspicuous place on both sides of the exterior of the vehicle; and

(3) Each vehicle is kept closed except for loading or unloading.

§ 127.407 Labeling requirements.

Each package or freight container of radioactive materials, unless excepted by §§ 127.203, 127.211(c), or 127.213 must be labeled as required in Part 172 of this subchapter.

§ 127.409 [Reserved]

§ 127.411 Placarding requirements.

Each transport vehicle or freight container of radioactive materials, unless excepted by § 127.203 or § 127.211(c) must be placarded as required in this Part.

§ 127.413 Storage incident to transportation—general requirements.

(a) The number of packages and freight containers bearing Radioactive Yellow II or Radioactive Yellow III labels stored in any one storage area, such as a transit area, terminal building, store-room, or assembly yard, must be limited so that the sum of the transport indices in any individual group of packages or freight containers does not exceed 50. Groups of these packages and freight containers must be stored so as to maintain a spacing of at least 6 m (20 ft) from other groups of packages or freight containers containing radioactive materials.

(b) Except in the case of a Fissile Class II or Fissile Class III package, the limitations in paragraph (a) of this section do not apply to any packages marked "RADIOACTIVE LSA" which contain low specific activity material, or any packages marked "RADIOACTIVE LLS" which contain low level solid radioactive material when they

are maintained in a compact stack or in freight containers.

(c) Mixing of different kinds of packages, including Fissile Class I packages with Fissile Class II packages, is authorized.

§ 127.415 General transportation requirements.

(a) Each shipment of radioactive materials must be securely stowed, in order to prevent shifting during normal transportation conditions.

(b) Except as may be specifically required by the competent authority in the applicable certificate, a package of radioactive materials may be carried among packaged general cargo without special stowage provisions, if:

(1) The average surface heat flux of the package does not exceed 15 watts/m², and

(2) The surrounding cargo is not contained in sacks or bags.

(c) Packages bearing radioactive labels may not be carried in compartments occupied by passengers, except in those compartments exclusively reserved for couriers accompanying those packages.

(d) Mixing of different kinds of packages, including Fissile Class I packages with Fissile Class II packages, is authorized.

(e) The accumulation of packages and freight containers is subject to the following conditions:

(1) Each person responsible for the loading of packages into a freight container must determine the transport index of the freight container;

(2) In the case of a full load, the sum of the transport indices of the packages in any one freight container may exceed 50 only if:

(i) No Fissile Class II or Fissile Class III radioactive materials are loaded into the freight container; and

(ii) The person loading the packages into the freight container determines by use of the appropriate monitoring equipment that the radiation levels of the loaded freight container will at no time during normal transportation conditions exceed:

(A) 200 mrem/h at any point on the exterior surface of the freight container; and

(B) 10 mrem/h at any point 2 m (6.6 ft) from the exterior surface of the freight container.

(iii) The appropriate placard required by Part 172 of this subchapter is displayed on the exterior of the four vertical walls of the freight container.

Subpart F—Requirements for Fissile Radioactive Materials

§ 127.501 General.

Except as provided in § 127.503, each package containing radioactive materi-

als that are also fissile materials must comply with this subpart.

§ 127.503 Exceptions.

This subpart does not apply to—

(a) Any package containing a maximum of 15 g or uranium-233, uranium-235, plutonium-238, plutonium-239, plutonium-241, or any combination of these radionuclides, if the smallest external dimension of the package is 10 cm (4.0 inches) or more. When radioactive materials are transported in bulk, the quantity limitations apply to the vehicle, inland waterway vessel, or stowage area of a seagoing vessel;

(b) Any package containing only natural or depleted uranium that has been irradiated in thermal reactors.

(c) Any package containing homogeneous hydrogenous solutions or mixtures satisfying conditions listed in the following table. When the material is transported in bulk, the quantity limitations of the table apply to the vehicle, inland waterway craft, or stowage area of a seagoing vessel;

Limitations on Homogeneous Hydrogenous Solutions or Mixtures

Parameters	²³⁵ U only	Any other fissile material (including mixtures)
Minimum H/X ¹	5,200	5,200
Maximum concentration of fissile nuclide in g/l.....	5	5
Maximum mass of fissile nuclide in g/package.....	1800	500

¹Where H/X is the ratio of the number of hydrogen atoms to the number of atoms of fissile nuclide.
²With a tolerance of Pu and uranium-233 of not more than 1 percent of mass of uranium-235.

(d) Any package containing uranium enriched in uranium-235 to a maximum of one percent by weight, and with a total plutonium and uranium-233 content of up to one percent of the mass of uranium-235, if the fissile materials are distributed homogeneously throughout the material. In addition, if uranium-235 is present in metallic or oxide forms, it must not be able to form a lattice arrangement within the package.

(e) Any package containing a fissile radioactive material, if it does not contain more than 5 g of fissile material in any 10 liter volume. However, the fissile radioactive material must be packed in packages that will maintain the required limitations for fissile material distribution during normal transportation conditions.

(f) Any package containing a maximum of 1 kg of total plutonium, of which not more than 20 percent of its mass consists of plutonium-239, plutonium-241, or any combination of those radionuclides.

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(g) Any package containing a liquid solution of uranyl nitrate enriched in uranium-235 to a maximum of 2 percent by weight, with a maximum tolerance for plutonium and uranium-233 of 0.1 percent of the mass of uranium-235.

§ 127.505 Classification of fissile radioactive materials packages.

(a) Except as provided in § 127.503, each package of fissile radioactive materials must be classified as follows:

(1) Fissile Class I. Packages that may be transported in unlimited number, and in any arrangement, and that require no nuclear criticality safety controls during transportation. A transport index is not assigned to Fissile Class I packages for the purposes of nuclear criticality safety control. However, the external radiation levels may require a transport index number.

(2) Fissile Class II. Packages that may be transported together in any arrangement but in numbers that do not exceed an aggregate transport index of 50. For the purposes of nuclear criticality safety control, individual packages may have a transport index number of 0.1 but not more than 10. However, the external radiation levels may require a higher transport index number, but not to exceed 10. These shipments require no nuclear criticality safety control by the shipper during transportation.

(3) Fissile Class III. Packages of fissile radioactive materials that do not meet the requirements of Fissile Class I or Fissile Class II and that are controlled in transportation as prescribed in § 127.507 by appropriate arrangements between the shipper and the carrier.

(b) The numerical values for package assignments as Fissile Class I, the transport indices for Fissile Class II packages, and the vehicle limitations for Fissile Class III packages must be determined in accordance with §§ 71.36 through 71.40 of Title 10 of the Code of Federal Regulations.

§ 127.507 Transportation of Fissile Class III radioactive materials—specific requirements.

(a) Fissile Class III radioactive materials packages must be shipped in accordance with this section. The transportation controls must provide nuclear criticality safety and must protect against loading, storing, or transporting that shipment together with any other fissile material. Fissile Class III radioactive materials must be transported:

(1) In a transport vehicle assigned for the sole use of the shipper with a specific restriction for the sole use to be provided in the appropriate arrangements between shipper and carrier

and with instructions to that effect issued with the shipping papers;

(2) Except for shipments by aircraft, with an escort in a vehicle having the capability, equipment, authority, and instructions to provide administrative controls necessary to assure compliance with this section;

(3) In a transport vehicle containing no other packages of radioactive material that are required to bear one of the "Radioactive" labels described in Part 172. Specific arrangements must be made between the shipper and the carrier, with instructions to that effect issued with the shipping papers; or

(4) Under any other procedure specifically approved by MTB in accordance with Part 107 of this subchapter.

§ 127.509 Mixing of fissile radioactive materials packages.

(a) Mixing of packages of other types of radioactive materials, including Fissile Class I with Fissile Class II packages, is authorized if the total transport index in any transport vehicle or storage location does not exceed 50.

(b) For Fissile Class II packages shipped under the exclusive use provisions of § 127.401(b) to provide the packages with high radiation dose rates, the transport index number which is calculated for nuclear criticality control purposes must not exceed 10 for any single package or total of 50 for the full load, unless specifically authorized by MTB for Fissile Class III shipments. Additionally:

(1) Fissile Class II packages may be shipped with a transport index greater than 10, and combined with other packages of the same or different designs in a Fissile Class III shipment, under the conditions prescribed in paragraph (c) of this section, provided:

(i) The transport index which has been assigned in the package approval for nuclear criticality control purposes does not exceed 10 for any single package;

(ii) The total transport index for nuclear criticality control purposes does not exceed 100 for all of the packages in the shipment;

(iii) The shipment satisfies the provisions of § 127.401(b) if any package has radiation dose rates exceeding 10 millirem per hour at 1 m (3.3 feet) from any accessible external surface of the package; and

(iv) The shipment will not be transported by water.

(2) Fissile Class III packages, which have been assigned a transport index for nuclear criticality purposes in accordance with Fissile Class II criteria, may be combined with other Fissile Class III packages of the same or different design for which a transport index has been so assigned for nuclear criticality control purposes, and may

be combined with Fissile Class II packages, in a Fissile Class III shipment under the conditions prescribed in paragraph (c) of this section, provided:

(i) The transport index which has been assigned in the package approval for nuclear criticality control purposes does not exceed 50 for any single package;

(ii) The total transport index for nuclear criticality control purposes for all packages in the shipment does not exceed 100;

(iii) The shipment satisfies the provisions of § 127.401(b) if any package has radiation dose rates exceeding 10 millirem per hour at 1 m (3.3 feet) from any accessible external surface of the package; and

(iv) The shipment will not be transported by water.

(c) A fissile class III shipment may be made only in accordance with subparagraph (1), (2), or (3) of this paragraph or in accordance with other procedures authorized by the MTB. The transport controls must provide nuclear criticality safety and must be carried out by the shipper or carrier, as appropriate, to protect against loading, storing, or transporting of that shipment together with any other fissile material:

(1) Transportation in a transport vehicle assigned for the sole use of the consignor, with a specific restriction for such sole use to be provided in the special arrangements, and with instructions to that effect issued with the shipping papers;

(2) Except for shipments by aircraft, transportation under escort by person in a separate vehicle, with the escort having the capability, equipment, authority, and instructions to provide administrative controls adequate to assure compliance with this paragraph; or

(3) Transportation in a transport vehicle containing no other packages of radioactive material which are required to bear one of the "Radioactive" labels described in § 172.436, 172.438 or 172.440 of this subchapter. Specific arrangements must be effected between shipper and carrier, with instructions to that effect issued with the shipping papers.

Subpart G—Test and Inspection Procedures

§ 127.601 Compliance with required tests.

(a) Compliance with the test requirements in this subpart must be shown by any of the methods prescribed in this paragraph, or by any combination of these methods:

(1) By performance of tests with prototypes of samples of the packaging as normally presented for transportation, in which case the contents of the packaging for the test must simulate as closely as practicable the expected normal radioactive contents;

(2) By reference to a previous satisfactory showing of compliance of a sufficiently similar nature;

(3) By performance of tests with models of appropriate scale incorporating those features that are significant with respect to the item under investigation, when engineering experience has shown results of those tests to be suitable for design purposes. When a scale model is used, the need for adjusting certain test parameters, such as the penetrator diameter or the compressive load, must be taken into account; or

(4) By engineering evaluation or comparative data.

(b) With respect to the initial conditions for the tests under this subpart, except for the water immersion tests, compliance must be based upon the assumption that the package is in equilibrium at an ambient temperature of 38°C (100°F). With respect to the thermal test, the effects of solar radiation can be neglected prior to and during the test, but must be taken into account in the subsequent evaluation of the test results.

§ 127.605 Preparation of specimens for testing.

(a) Each specimen must be examined before testing to identify and record faults or damage, including:

- (1) Divergence from the specifications or drawings;
- (2) Defects in construction;
- (3) Corrosion or other deterioration; and
- (4) Distortion of features.

(b) The containment system of the packaging must be clearly specified.

(c) The external features of the specimen must be clearly identified so that references may be made to any part of it.

§ 127.607 Packaging and shielding—testing for integrity.

After conducting each of the applicable tests required in § 127.611 and § 127.613, the integrity of the packaging, or of the packaging and its shielding, must be retained to the extent required by § 127.105(m) for the packaging being tested.

§ 127.609 [Reserved]

§ 127.611 Tests for proposed packagings designed for normal conditions of transportation.

Prototypes of the proposed packaging must be subjected to the tests prescribed in this paragraph. The water spray test described in subparagraph (a) of this paragraph must precede each of the other tests prescribed in this paragraph. One prototype may be used for all tests, if the requirements of § 127.601 are met.

(a) *Water spray test.* A water spray test is considered to be satisfactory if—

(1) The amount of water per unit of ground area is equivalent to a rainfall rate of 5 cm (2.0 inches) per hour;

(2) The water impinges upon the specimen at an angle of approximately 45 degrees from the horizontal;

(3) The water is uniformly distributed over the entire surface of the specimen in the direction of the spray;

(4) The spray lasts at least one hour;

(5) The package must be positioned such that the effects of the water spray tests are most severe for the features of the packaging being tested, and the packaging specimen is supported so that it does not sit in a pool of water; and

(6) The time interval between the end of the water spray test and the beginning of the next test is such that the water has soaked into the maximum extent without appreciable drying of the exterior of the specimen. In the absence of evidence to the contrary, this interval may be assumed to be two hours if the water spray is applied from four different directions simultaneously. However, no time interval may elapse if the water spray is applied from each of the four directions consecutively.

(b) *Free drop test.* The packaging specimen must fall onto the target in a manner that causes maximum damage to the safety features being tested, and:

(1) For packagings weighing 5,000 kg (11,000 lbs) or less, the distance of the fall measured from the lowest point of the packaging to the upper surface of the target must not be less than 1.2 m (4.0 ft);

(2) For packaging weighing more than 5,000 kg (11,000 lb), the distance of the fall must not be less than the distance specified in the following table, for the applicable packaging weight:

Free-Fall Distance for Packaging Weighing More than 5,000 kg

Packaging weight (kg)	Free-fall distance (ft)	Free-fall distance (m)
5,000 to 10,000	3	0.9
10,000 to 15,000	2	0.6
More than 15,000	1	0.3

(3) For Fissile Class II Packagings, the free drop specified in paragraph (b)(1) of this Section must be preceded by a free drop from a height of 0.3 m (1.0 ft) on each corner. For cylindrical packagings, the 0.3 m (1.0 ft) drop must be onto each of the quarters of each rim;

(4) For fiberboard or wood rectangular packagings not exceeding 50 kg (110 lb) in weight, a separate specimen of the proposed packaging must be

subjected to a free drop onto each corner from a height of 0.3 m (1.0 ft);

(5) For fiberboard cylindrical packagings weighing not more than 100 kg (220 lb) a separate specimen of the proposed packaging must be subjected to a free drop onto each of the quarters of each rim from a height of 0.3 m (1.0 ft);

(6) The target must have a flat, horizontal surface which will not increase in its resistance to displacement or deformation upon impact to an extent that will significantly increase the damage to the packaging specimen.

(c) *Compression test.* The packaging specimen must be subjected, for a period of at least 24 hours, to a compressive load equal to the greater of the following.

(1) Five times the weight of the actual package; or

(2) 1300 kg/m² (225 lb/ft²) multiplied by the vertically projected area of the package. The compressive load must be applied uniformly to two opposite sides of the packaging specimen, one of which must be the base on which the package would normally stand.

(d) *Penetration test.* (1) The packaging specimen must be placed on a rigid, flat, horizontal surface that will not move while the test is being performed.

(2) A bar of 3.2 cm (1.25 inches) diameter with a hemispherical end, weighing 6.0 kg (13.2 lb) must be dropped with its longitudinal axis vertical, onto the center of the weakest part of the packaging specimen, so that, if it penetrates far enough, it will hit the containment system. The bar must not be deformed by the test.

(3) The distance of the fall of the bar measured from its lower end to the upper surface of the packaging specimen must be 1 m (3.3 ft).

§ 127.613 Additional tests for Type A packaging designed for liquids and gases.

(a) Specimens of Type A packaging designed for liquids and gases must also be subjected to the following tests:

(1) *Free drop test.* The packaging specimen must fall onto the target in a manner which will cause it to suffer the maximum damage to its containment. The distance of the fall measured from the lowest part of the packaging specimen to the upper surface of the target must be 9.0 m (30 ft).

(2) *Penetration test.* The specimen must be subjected to the test specified in § 127.611(d) except that the distance of the fall must be 1.7 m (5.5 ft).

PROPOSED RULES

§ 127.615 Tests for demonstrating the ability of radioactive materials packagings to withstand accident conditions in transportation.

Each Type B packaging must meet the test requirements prescribed in 10 CFR 71 for ability to withstand accident conditions in transportation.

§ 127.617 Water in-leakage test for fissile radioactive materials packagings.

Each packaging for fissile radioactive materials must meet the test requirements prescribed in 10 CFR 71 for water in-leakage.

§ 127.619 Tests for special form radioactive materials.

(a) Special form radioactive materials must meet the test requirements of paragraph (b) of this section. Each solid radioactive material or capsule specimen to be tested must be prepared as normally offered for transportation. The radioactive material must be duplicated as closely as practicable. In addition:

(1) A different specimen may be used for each of the tests;

(2) The specimen must not break or shatter when subjected to the impact, percussion, or bending tests;

(3) The specimen must not melt or disperse when subjected to the heat test; and

(4) After each test, a leaching assessment must be performed on the specimen by a method as sensitive as the procedure set forth in paragraph (c) of this section.

(b) *Test methods:* (1) *Impact test.* The specimen must fall onto the target from a height of 9 m (30 ft). The target must be as specified in § 127.611(b)(6);

(2) *Percussion test.* (i) The specimen must be placed on a sheet of lead that is supported by a smooth solid surface, and be struck by the flat face of a steel billet so as to produce an impact equivalent to that resulting from a free fall of 1.4 kg (3.1 lb) through 1 m (3.3 ft);

(ii) The flat face of the billet must be 25 mm (1 inch) in diameter with the edges rounded off to a radius of: 3 mm ± 0.3 mm (.12 inch ± .012 inch);

(iii) The lead must be of a hardness within 3.5 to 4.5 on the Vickers scale, and not more than 25 mm (1 inch) thick, and must cover an area greater than that covered by the specimen;

(iv) A fresh surface of lead must be used for each impact; and

(v) The billet must strike the specimen in a manner that causes maximum damage.

(3) *Bending test.* (i) This test applies only to long, slender sources with a minimum length of 10 cm (4.0 inches) and a length to minimum width ratio of not less than 10;

(ii) The specimen must be securely clamped in a horizontal position so that one half of its length protrudes from the face of the clamp;

(iii) The position of the specimen must be such that it will suffer maximum damage when its free end is struck by the flat face of a steel billet;

(iv) The billet must strike the specimen in a manner that produces an impact equivalent to that resulting from a free vertical fall of 1.4 kg (3.1 lb) through 1 m (3.3 ft);

(v) The flat face of the billet must be 25 mm (1 inch) in diameter with the edges rounded off to a radius of 3 mm ± 0.3 mm (.12 ± 0.12 inch).

(4) *Heat test.* The specimen must be heated in air to a temperature of 800°C (1472°F), held at that temperature for a period of 10 minutes, and then allowed to cool.

(c) *Leaching assessment methods.* (1) For indispersible solid material—

(i) The specimen must be immersed for seven days in water at ambient temperature. The water must have a pH of 6-8 and a maximum conductivity of 10 micromho/cm at 20°C (68°F);

(ii) The water and specimen must then be heated to a temperature of 50°C ± 5° (122°F ± 9°) and maintained at this temperature for four days;

(iii) The activity of the water must then be determined and may not exceed 0.05 µCi;

(iv) The specimen must then be stored for at least seven days in still air with humidity not less than 90 percent at 30°C (86°F);

(v) The specimen must then be immersed in water with the same pH and maximum conductivity specifications as in paragraph (c)(1)(i) of this Section. The water and specimen must be heated to 50°C ± 5° (122°F ± 9°) and maintained at that temperature for four hours;

(vi) The activity of the water must then be determined and may not exceed 0.05 µCi. (2) For encapsulated material—

(i) The specimen must be immersed in water at ambient temperature. The water must have a pH of 6-8 and a maximum conductivity of 10 micromho/cm. The water and specimen must be heated to a temperature of 50°C ± 5° (122°F ± 9°) and maintained at this temperature for four hours;

(ii) The activity of the water must then be determined and may not exceed 0.05 µCi

(iii) The specimen must then be stored for at least seven days in still air a temperature not less than 30°C (86°F);

(iv) Step (i) must be repeated; and

(v) The activity of the water must be determined and may not exceed 0.05 µCi.

Support H—Additional Requirements for the Transportation of Radioactive Materials.

§ 127.701 Requirements for U.S. Nuclear Regulatory Commission approved packages.

In addition to the applicable requirements of the U.S. Nuclear Regulatory Commission (USNRC) approval and of this subchapter, any shipper of a package containing radioactive materials that has been approved by the USNRC in accordance with 10 CFR 71 must also comply with the following requirements:

(a) The shipper must be registered as a party to the approval, and the shipment must be made in compliance with the terms of the approval;

(b) The outside of each package must be durably and legibly marked with the package identification marking indicated in the USNRC approval;

(c) Each shipping paper related to the shipment of the package must bear the package identification marking indicated in the USNRC approval;

(d) Before the first export shipment of the package, the shipper must submit a copy of the U.S. Competent Authority Certificate applying to that package design to the national competent authority of each country into or through which the package will be transported, unless a copy has already been furnished;

(e) The designated competent authority in the United States responsible for administering the requirements of Section VIII of the IAEA "Regulations for the Safe Transport of Radioactive Materials, Safety Series No. 6, 1973 edition," is—Office of Hazardous Materials Regulation, U.S. Department of Transportation, Washington, D.C. 20590.

(f) Each request for a U.S. Competent Authority certificate as required by the IAEA regulations must be submitted in writing to the address set forth in paragraph (e) of this section. The request must be in duplicate and contain all the information required by Section VIII of the IAEA regulations. Each request will be considered in the order in which it is received. To allow sufficient consideration by the U.S. Competent Authority, requests should be submitted at least 45 days before the requested effective date;

(g) Each Fissile Class II package must be marked with the assigned transport index unless radiation levels require a higher transport index. Each vehicle limitation indicated in the USNRC approval applies if the shipment is Fissile Class III; and

(h) For a Fissile Class III shipment, the statement prescribed in § 172.203(d) of this subchapter must be included on the shipping papers.

§ 127.703 Requirements for foreign-made packages.

(a) In addition to the applicable requirements of Parts 100-189 of this subchapter, each shipper of a foreign made package containing radioactive materials, for which a foreign competent authority certificate is required must also comply with the following requirements:

(1) Prior to the first shipment of a package of radioactive materials into the U.S., the shipper must—

(i) Have the foreign competent authority certificate revalidated by the U.S. Competent Authority, unless this has been done previously. The U.S. Competent Authority is the Office of Hazardous Materials Regulation, U.S. Department of Transportation, Washington, D.C. 20590.

A copy of the foreign competent authority certificate (in English) must be submitted with the request for revalidation. To allow sufficient consideration by OEHMR, requests should be submitted at least 45 days before the requested effective date;

(ii) Register his identity in writing to the U.S. Competent Authority as a shipper of the package covered by the foreign competent authority certificate and its revalidation; and

(iii) Supply to the carrier, upon request, the applicable competent authority certificates. However, the competent authority certificates are not required to accompany the packages to which they apply;

(2) The outside of each package must be durably and legibly marked with the same competent authority identification marking indicated on the competent authority certificate or revalidation;

§ 127.705 Quality control for radioactive materials packagings.

(a) Prior to the first shipment of any radioactive materials packaging, the shipper must determine, that—

(1) The packaging meets the quality of design and construction requirements as specified in this subchapter; and

(2) The effectiveness of the shielding, containment, and, when required, the heat transfer characteristics of the package, are within the limits specified for the package design.

§ 127.707 Quality control requirements prior to each shipment of radioactive materials.

Before each shipment of any radioactive materials packaging the shipper must ensure, that—

(a) The packaging is proper for the contents to be shipped;

(b) The packaging is in unimpaired physical condition, except for superficial marks;

(c) Each closure device of the package, including any required gasket, is properly installed, secured, and free of defects;

(d) For a fissile material, each moderator and neutron absorber, if required, is present and in proper condition;

(e) Each special instruction for filling, closing, and preparing the packaging for shipment has been followed;

(f) Each closure, valve, or other opening of the containment system through which the radioactive content might escape is properly closed and sealed;

(g) Each packaging containing liquid in excess of an A_2 quantity and destined for air shipment is tested to show that it will not leak under an ambient atmospheric pressure of not more than 0.25 atmosphere, absolute (0.25 kg/cm² or 3.6 psia). The test must be conducted on the entire containment system, or any receptacle or vessel within the containment system, to determine compliance with this requirement;

(h) Internal pressure of the containment system will not exceed the design pressure during transportation; and

(i) External radiation and containment levels are within the allowable limits specified in this subchapter.

§ 127.709 [Reserved]

§ 127.711 Approval of special form radioactive material.

(a) Except as provided in paragraph (c) of this section, each shipper of special form radioactive material must maintain on file for at least one year after the latest shipment, and provide to MTB on request, a complete documentation of tests, or a safety analysis demonstrating that the special form material meets the requirements of § 127.619 of this part.

(b) Except as provided in paragraph (c) of this section, prior to the first export shipment of a special form radioactive material from the United States, each shipper must obtain a U.S. Competent Authority certificate for the specific material. Each petition must be submitted in accordance with § 127.701(e) and (f), and must include the following additional information:

(1) A detailed description of the material or if a capsule, a detailed description of the contents. Particular reference must be made to both physical and chemical states;

(2) If a capsule is to be used, a detailed statement of its design and dimensions, including complete engineering drawings and schedules of material, and methods of construction; and

(3) A statement of the tests that have been made and their results; evi-

dence based on calculative methods used to show that the material is able to pass the tests; or other evidence that the special form radioactive material complies with § 127.619 of this part.

(c) Paragraphs (a) and (b) of this section do not apply in those cases where A_1 equals A_2 .

§ 127.713 Approval for export shipments.

(a) Each export shipment of a packaging for which an IAEA certificate of competent authority has been issued or revalidated in accordance with §§ 127.701 or § 127.703 of this subchapter, must have multilateral approval, if the shipment includes—

(1) A vented Type B (M) packaging;

(2) A Type B (M) packaging containing radioactive materials with an activity greater than $3 \times 10^4 A_1$, or $3 \times 10^4 A_2$, as appropriate, or $3 \times 10^4 Ci$, whichever is less;

(3) A Fissile Class III package; or

(4) Transportation by special arrangements.

(b) Each application for shipment approval must contain—

(1) The period of time for which the approval is sought;

(2) A description of the contents, the expected modes of transportation, the type of vehicle to be used, and the proposed route; and

(3) How the special precautions and special administrative and operational controls referred to in the package design certificates are to be put into effect.

(c) The packaging and shipment approvals may be combined into a single approval issued in accordance with § 127.701 or § 127.703.

(d) Approval by competent authorities is not required for packagings designed for materials covered by Subpart C nor for Type A packagings designed for non-fissile radioactive materials.

§ 127.715 Notification to competent authorities for export shipments.

(a) Before the first export shipment of any packaging with contents exceeding A_1 and A_2 , the shipper must ensure that copies of each applicable competent authority certificate issued in accordance with § 127.701 or 127.703 have been submitted to the competent authority of each country through or into which it is to be transported. The shipper is not required to await an acknowledgment from the competent authority prior to shipping the radioactive materials, nor is the competent authority required to acknowledge receipt of the certificate.

(b) For each of the shipments described in this paragraph, the shipper must notify the competent authority of each country through or into which the shipment is to be transported.

PROPOSED RULES

This notification must be received by each competent authority at least 15 days before the shipment starts:

(1) Type B (U) packagings containing radioactive materials with an activity greater than $3 \times 10^3 A_1$, or $3 \times 10^3 A_2$, as appropriate, or $3 \times 10^3 Ci$, whichever is less;

(2) Type B(M) packagings;

(3) Fissile Class III packagings under Section VIII; or

(4) Transportation by special arrangements.

(c) The shipper notification must include—

(1) Sufficient information to enable the packaging to be identified, including all applicable certificate numbers and identification marks; and

(2) Information as to the date of shipment, the expected date of arrival, and the proposed routing.

(d) The shipper is not required to send a separate notification if the required information has been included

in the application for shipment approval.

**PART 171—GENERAL INFORMATION,
REGULATIONS, AND DEFINITIONS**

§ 171.8 [Amended]

3. In § 171.8 under "Full Load" § 173.389 would be changed to read "§ 127.3 of this subchapter" and under "Radioactive Materials" reference § 173.389 would be changed to "§ 127.3 of this subchapter."

**PART 172—HAZARDOUS MATERIALS TABLE
AND HAZARDOUS MATERIALS COMMUNICATIONS REGULATIONS**

4. In § 172.101 the entry for "plutonium nitrate solution" would be deleted; the following entries in the table would be revised as follows:

§ 172.101 Hazardous Materials Table.

* * * * *

PROPOSED RULES

1877

[4910-60-C]

(1)	(2)	(3)	(4)	(5)		Maximum net quantity in one package		(7)		
				(a)	(b)	(a)	(b)	(a)	(b)	(c)
* W/ A		Hazard class	Labels(s) required (if not excepted)	Exception	Specific requirements	Passenger carrying aircraft or tailcar	Cargo only aircraft	Cargo vessel	Passenger vessel	Other requirements
	(Change) Radioactive device, n.o.s.	Radioactive material	None	127.205 127.207 127.209				1, 2	1, 2	
*	Radioactive materials, fissile, n.o.s.	Radioactive material	Radioactive	127.203 127.503				1, 2	1, 2	
*	Radioactive material, low specific activity or LSA, n.o.s.	Radioactive material	Radioactive	127.203	127.211			1, 2	1, 2	
*	Radioactive material, low level solid or LLS, n.o.s.	Radioactive material	Radioactive	127.203	127.213					X
**	Radioactive material, n.o.s.	Radioactive material	Radioactive	127.203	127.113 127.115			1, 2	1, 2	
**	Radioactive material, limited quantity, n.o.s.	Radioactive material	None	127.203	127.203			1, 2	1, 2	
*	Radioactive material, special form, n.o.s.	Radioactive material	Radioactive	127.203	127.113 127.115			1, 2	1, 2	
	Thorium metal, pyrophoric	Radioactive material	Radioactive and Flammable solid	None	127.119	Forbidden	Forbidden	1, 2	1, 2	
	Thorium nitrate, solid	Radioactive material	Radioactive and Oxidizer	None	127.121	Forbidden	25 lbs	1, 2	1, 2	Separate longitudinally by a complete hold or compartment from explosives
				122						

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(1) */ W/ A	(2) Hazardous materials descriptions and proper shipping names	(3) Hazard class	(4) Labels(s) required (if not excepted)	(5) Packaging		Maximum net quantity in one package		(7) Water shipments		
				(a) Exception	(b) Specific requirements	(a) Passenger carry- ing aircraft or railcar	(b) Cargo only aircraft	(a) Cargo vessel	(b) Pass- enger vessel	(c) Other requirement
	Uranium hexafluoride, fissile (containing more than 0.7% U-235)	Radioactive material	Radioactive and corrosive	127.273 127.503	127.117			1, 2	1, 2	
	Uranium hexafluoride, low specific activity (containing 0.7% or less U-235)	Radioactive material	Radioactive and corrosive	127.301	127.211			1, 2	1, 2	
	Uranium metal, pyrophoric	Radioactive material	Radioactive and flammable solid	None	127.119	Forbidden		1, 2	1, 2	
	Uranyl nitrate hexahydrate solution	Radioactive material	Radioactive and corrosive	127.203	127.111			1, 2	1, 2	
	Uranyl nitrate, solid	Radioactive material	Radioactive and oxidizer	None	127.121	Forbidden		1, 2	1, 2	Separate long- itudinally by an interven- ing hold or compartment from explosives
				123						

PROPOSED RULES

§ 172.203 [Amended]

5. In § 172.203(d)(1)(i) reference § 173.390 would be changed to read "§ 127.305 of this subchapter"; reference to § 173.396 in paragraph (d)(1)(vi)(A) would be changed to read "§ 127.503(a)(1) of this subchapter"; reference to § 173.393a in paragraph (d)(1)(vii) would be changed to read "§ 127.701 of this subchapter"; reference to § 173.393(a)(3) in paragraph (d)(1)(viii) would be changed to read "§ 127.703 of this subchapter."

§ 172.204 [Amended]

6. In § 172.204 paragraph (c)(4) would be amended by changing the last sentence to read as follows: * * * "Prior to May 3, 1979, this provision does not apply to materials meeting the requirements of §§ 127.203, 127.205 or 127.209 of this subchapter."

§ 172.310 [Amended]

7. In § 172.310(a)(2) reference to §§ 173.389 (j) and (k) and 173.398 (b)

and (c) would be changed to read "§ 127.3 and Subpart B of Part 127"; reference to § 173.393a and 173.393b in § 172.310(a)(3) would be changed to read "127.703 of this subchapter."

8. In § 172.400 paragraph (b)(10) would be revised to read as follows:

§ 172.400 General labeling requirements.

(b) * * * (10) Package of low specific activity or low level solid radioactive material, when being transported in a transport vehicle assigned for the sole use of the consignor under §§ 127.111 or 127.113 of this subchapter.

9. In § 172.403(a) reference to § 173.391 or § 173.392 would be changed to read "Subpart C, Part 127"; in paragraph (g)(1) the reference to § 173.390 would be changed to read

"§ 127.305 of this subchapter" and in paragraph (g)(3) the reference to § 173.389(i) would be changed to read "§ 127.3 of this subchapter", paragraphs (b)(2) and (d)(3) would be deleted as follows:

§ 172.403 Radioactive material.

(b) * * * (2) Deleted

(d) * * * (3) Deleted.

10. In § 172.436 paragraph (a) the comma following "label" would be deleted and the label would be changed to read as follows:

§ 172.436 RADIOACTIVE WHITE-I label. (a) * * *



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11. In §172.438 paragraph (a) the comma following "label" would be deleted and the label would be revised to read as follows:

§172.438 RADIOACTIVE YELLOW-II label.

(a) * * *



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12. In § 172.440 paragraph (a) the label would be changed to read as follows:

§ 172.440 RADIOACTIVE YELLOW-III
label.

(a) * * *



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13. In § 172.504 paragraph (c)(2) Table 1, footnote 5 following the table would be revised to read as follows:

§ 172.504 General placarding requirements.

(c) * * *
(2) * * *

* Applies to full load shipments of low specific activity or low level solid radioactive material when transported pursuant to § 127.111 or 127.113 of this subchapter.

PART 173—SHIPPERS—GENERAL REQUIREMENTS FOR SHIPMENTS AND PACKAGINGS

§ 173.29 [Amended]

14. In § 173.29 paragraph (d) the reference to § 173.397(a) would be changed to read "§ 127.405 of this subchapter."

§ 173.226 [Deleted]

15. § 173.226 would be deleted.

§§ 173.389-173.398 [Deleted]

16. §§ 173.389 through 173.398 would be deleted.

PART 174—CARRIAGE BY RAIL

§ 174.700 [Amended]

17. In § 174.700 paragraph (a) reference to § 173.389(c) would be changed to read "§ 127.3 of this subchapter"; reference to § 173.392 would be changed to read "§§ 127.211 and 127.213 of this subchapter." In paragraph (b) the reference to § 173.389(j) and § 173.389(o) would be changed to read "§ 127.3 of this subchapter"; reference to § 173.392 would be changed to read "§§ 127.211 and 127.213 of this subchapter"; reference to § 173.393(j) would be changed to read "§ 127.401 of this subchapter"; and § 173.396(f) would be changed to read "§ 127.415 of this subchapter." In paragraph (d) the reference to § 173.389(a)(3) and § 173.396(g) would be changed to read "§ 127.505(a)(3) of this subchapter" and "§ 127.507 of this subchapter" respectively. Paragraph (g) would be added to read as follows:

§ 174.700 Special handling requirements for radioactive materials.

(g) In the case of a full load of packages shipped under the provisions of § 127.401(b) of this subchapter:

(1) The vehicle must have an enclosure that during normal transportation conditions prevents the access of unauthorized person to the interior of the cargo area; and

(2) Provisions must be made to secure the packages so that their position within the vehicle remains fixed during normal transportation conditions.

§ 174.715 [Amended]

18. In § 174.715 reference to § 173.389(e) in paragraph (a) would be changed to read "§ 127.3 of this subchapter."

§ 174.750 [Amended]

19. In § 174.750 reference to § 173.397 in paragraph (a) would be changed to read "127.405 of this subchapter."

PART 175—CARRIAGE BY AIRCRAFT

20. In § 175.10 paragraph (a)(6) would be revised to read as follows:

§ 175.10 Exceptions.

(a) * * *

(6) Prior to May 3, 1979, radioactive materials which meet the requirements of § 127.203, 127.205 or 127.209 of this subchapter.

§ 175.700 [Amended]

21. In § 175.700 reference to § 173.397 in paragraph (c) would be changed to read "§ 127.405"; paragraph (d) would be added to read as follows:

§ 175.700 Special requirements for radioactive materials.

(d) Type B(M) packages may not be offered, accepted, nor transported on passenger-carrying aircraft.

§ 175.703 [Amended]

22. In § 175.703(b)(2)(iv) reference to § 173.398(b)(3)(v) would be changed to read "§ 127.611(a)(3) of this subchapter"; in paragraph (c) reference to § 173.389(a)(3) would be changed to read "§ 127.505(a)(3) of this subchapter." Paragraph (b)(2)(iii)(B) would be revised and new paragraphs (d) and (e) would be added to read as follows:

§ 175.703 Other special requirements for the acceptance and carriage of packages containing radioactive materials.

(b) * * *

(2) * * *

(iii) * * *

(B) Except for fissile radioactive materials, direct measurement of the

maximum radiation level in millirep per hour at 1 meter (3.3. ft) from the external surface of the overpack.

(d) No person may offer or accept for transportation, nor transport by air:

(1) Any Type B(U) or Type B(M) package with an accessible surface temperature in excess of 50° C.

(2) Continuously vented Type B(M) packages, packages which require external cooling by an ancillary cooling system or packages subject to operational controls during transport, or

(3) Liquid pyrophoric radioactive materials.

(e) Full load shipments of packages having a surface radiation level in excess of 200 mrem/hr, otherwise authorized under § 127.401(b), may not be transported by air except by special arrangement approved by the Department.

PART 176—CARRIAGE BY VESSEL

23. § 176.700 would be revised to read as follows:

§ 176.700 General stowage requirements.

(a) Radioactive materials must not be stowed in the same hold with mail bags.

(b) A package of radioactive materials which is a significant heat source may not be overstowed with any other cargo. If the package is stowed under deck, the hold or compartment in which it is stowed must be ventilated.

(c) Each Fissile Class III shipment must be stowed in a separate hold, compartment, or defined deck area and be separated by a distance of at least 6 meters (20 feet) from all other Radioactive Category II or III-Yellow labeled packages. For a shipment of radioactive material requiring supplemental operational procedures, the shipper must furnish the master or person in charge of the vessel a copy of the necessary operational instructions.

(d) A person may not remain unnecessarily in a hold or compartment or in the immediate vicinity of any package on deck containing radioactive materials.

24. § 176.704 would be added to read as follows:

§ 176.704 Requirements relating to transport indices.

(a) The sum of the transport indices of all packages or freight containers of radioactive materials on board a vessel may not exceed 200.

(b) The sum of transport indices for packages not in a freight container may not exceed 50 in any hold, compartment, or defined deck area. Each

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group of packages must be separated by a distance of at least 6 meters (20 feet) at all times.

(c) The number of freight container with packages of radioactive materials contained therein must be limited so that the total sum of the transport indices for the containers in any hold or defined deck area does not exceed 200, provided:

(1) The sum of transport indices for any individual freight container, or group of freight containers, does not exceed 50.

(2) Each freight container or group of freight containers is handled and stowed in such a manner that groups are separated from each other by a distance of at least 6 meters (20 feet).

(d) The limitations specified in paragraphs (a), (b), and (c) of this section do not apply to consignments of either low specific activity materials or low-level solid radioactive materials marked on the labels as "RADIOACTIVE LSA" or "RADIOACTIVE LLS" respectively, provided that Fissile Class II or Fissile Class III radioactive materials are not included in the shipment.

(e) For full loads, the limitations specified in paragraphs (b), and (c) of this section do not apply if:

(1) For packages not in freight containers, the sum of the transport indices of Fissile Class II packages does not exceed 50 in each hold;

(2) For packages in freight containers, the radiation level does not exceed 200 mrem/h at any point on the surface and 10 mrem/h at 2 meters (6 feet) from the outside surface of the freight container and the sum of the transport indices of Fissile Class II packages does not exceed 50 in each freight container and 200 in each hold or defined deck area; and

(3) Each group of Fissile Class II packages is separated by a distance of at least 6 meters (20 feet) at all times.

(f) The limitations specified in paragraphs (a) through (e) of this section do not apply when the entire vessel is reserved or chartered for the exclusive use of a single shipper under full load conditions if the number of Fissile Class II and Fissile Class III packages of radioactive materials aboard the vessel does not exceed the amount authorized in Part 129 of this subchapter. The entire shipment operation must be approved by the Office of Hazardous Materials Regulation (OEMR) in advance.

25. § 176.708 would be added to read as follows:

§ 176.708 Segregation distance table.

(a) Table VI applies to the stowage of packages of radioactive materials on board a vessel with regard to transport index numbers which are shown on the labels of individual packages. Ra-

dioactive Category II or III-Yellow labeled packages may not be stowed any closer to living accommodations, regularly occupied working spaces and spaces that may be continually occupied by any person (except those spaces exclusively reserved for couriers specifically authorized to accompany such packages), or to undeveloped film than the distance specified in Table VI. Where only one consignment of a radioactive substance is to be loaded on board a vessel as full load, the appropriate segregation distance may be established by demonstrating that the direct measurement of the radiation level at regularly occupied working spaces and living quarters is less than 0.75 millirem per hour. More than one consignment may be loaded onboard a vessel with the appropriate segregation distance established by demonstrating that direct measurement of the radiation level at regularly occupied working spaces and living quarters is less than 0.75 millirem per hour, provided that the vessel has been chartered for the exclusive use of a competent person specialized in the carriage of radioactive substances. Stowage arrangements shall be predetermined for the entire voyage, including any radioactive substances to be loaded at ports of call enroute. The radiation level shall be measured by a responsible person skilled in the use of monitoring instruments.

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26. § 176.710 would be revised to read as follows:

§ 176.710 Care following leakage or sifting of radioactive materials.

(a) In case of fire, collision, or breakage involving any shipment of radioactive materials other than materials of low specific activity, the radioactive materials must be segregated from unnecessary contact with personnel. In case of obvious leakage, or if the inside container appears to be damaged, the stowage area (hold, compartment, or deck area) containing this cargo must be isolated as much as possible to prevent radioactive material from entering any person's body through contact, inhalation, or ingestion. No person may handle the material or remain in the vicinity unless supervised by a qualified person.

(b) A hold or compartment in which leakage of radioactive materials has occurred may not be used for other cargo until it is decontaminated in accordance with the requirements of § 176.715.

(c) For reporting requirements, see § 171.15 of this subchapter.

PART 177—CARRIAGE BY PUBLIC HIGHWAY

§ 177.842 [Amended]

27. In § 177.842 paragraph (a) reference to § 173.389(i) would be changed to read “§ 127.3” and references § 173.393(j), 173.396(f), or 173.392 would be changed to read “§§ 127.401(b), 127.415, 127.211 or 127.213” respectively; in paragraph (c) reference to § 173.391 would be changed to read “§§ 127.203, 127.205, or 127.209”; in paragraph (f) reference to § 173.389(a)(3)” and § 173.396(g) would be changed to read “§ 127.505(a)(3)” and “§ 127.507” respectively. A new paragraph (g) would be added to read as follows:

(g) For shipments transported as full load under the provisions of § 127.401(b) of this subchapter, the vehicle must have an enclosure that during normal transportation conditions prevents access of unauthorized persons to the interior of the cargo area.

§ 177.843 [Amended]

28. In § 177.843 paragraph (a) would be revised to read as follows:

§ 177.843 Contamination of vehicles.

(a) Each motor vehicle used for transporting radioactive materials as a full load must be surveyed with radi-

ation detection instruments after each use. A vehicle may not be returned to service until the radiation dose rate at each accessible surface is 0.5 mrem/h or less and the removable (non-fixed) radioactive surface contamination is not greater than the levels prescribed in § 127.404(a) of this subchapter.

§ 177.861 [Amended]

29. In § 177.861 paragraph (a) reference to § 173.397 would be changed to read “§ 127.405.”

(49 U.S.C. 1803, 1804, 1808, 49 CFR 1.53(e) and paragraph (a)(4) of App. A to Part 102).

NOTE.—The Materials Transportation Bureau has determined that this notice will not result in a major economic impact under the terms of Executive Order 12044 and DOT implementing procedures (43 FR 9583). A regulatory evaluation is available in the public docket.

Issued in Washington, D.C., on December 21, 1978.

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