#### ATOMIC ENERGY COMMISSION

#### 10 CFR PART 71

#### "SHIPMENT OF SPECIAL NUCLEAR MATERIAL"

#### NOTICE OF PROPOSED RULE MAKING

#### STATEMENT OF CONSIDERATIONS

The Commission's regulations, 10 CFR Part 70, "Special Nuclear Material", require that in approving an application to receive, possess, use and transfer special nuclear material, the Commission must determine that the applicant's proposed procedures, equipment and facilities are adequate to protect health and minimize danger to life or property.

10 CFR Part 71, "Regulations to Protect Against Accidental Conditions of Criticality in the Shipment of Special Nuclear Material", requires that approval by the Commission be obtained for shipping procedures which are to be used in the transfer of special nuclear material, except for small shipments under specified conditions.

The proposed revised 10 GFR Part 71 deals with the prevention of accidental criticality in the transport of special nuclear material. It incorporates criteria developed over several years in the licensing of procedures for such shipments as well as the Commission's own experience in shipping special nuclear material, and includes some recent information based on studies of accident conditions and relating some tests of existing types of shipping containers for special nuclear material to those accident conditions. Shipment of special nuclear material has not yet resulted in a single incident involving accidental criticality. This is a rapidly developing area of knowledge and, as new information becomes available, changes and additions in the criteria may become necessary. On the basis of present knowledge, these criteria are believed to assure an adequate degree of safety.

10 CFR Part 71 presently provides that small quantities of special nuclear material may be delivered to a carrier for transport without prior approval of the Commission. In the proposed revision, a shipment of any number of packages containing no more than the exempt quantities may be made without Commission review of the packaging or the shipping procedures when no more than a specified quantity (5 times the exempt quantity) is transferred during 24 hours. No further restrictions or special precautions are considered necessary for such packages during transport. The quantities permitted in a single package are believed to be sufficiently small to assure nuclear safety during any credible conditions to be encountered in transport.

Shipment of special nuclear material is also subject to the regulations of other Federal Agencies such as the Post Office, Interstate Commerce Commission, Coast Guard or Federal Aviation Agency.

For purposes of the proposed revision of 10 CFR Part 71, shipments of special nuclear material in excess of the exempt quantities are classed according to the shipping procedures which must be imposed on the package or the shipment. Class I packages require no control during transport; Class II packages are subject to the "40 unit rule"; and Class III packages require special control during transport.

Class I includes packages safe from neutron interaction in any arrangement. The definition of Class I has been incorporated into the International Atomic Energy

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Agency's proposed "Regulations for the Safe Transport of Radioactive Material", published May 1961. The packaging specifications in the proposed Part 71 are taken directly from the IAEA publication and were developed by the United Kingdom Atomic Energy Authority. Other types of packaging may satisfy the neutron absorption criteria required for Commission approval as Class I packaging.

Included under Class I are very dilute aqueous solutions, in which the fissionable isotope is present only in very small concentrations. The IAEA regulations include such dilute solutions as an exemption, but require that careful consideration be given to methods of preventing reconcentration during transport. The proposed revised Part 71 requires Commission review of the method of insuring that the concentrations do not exceed those which are permitted at any time during transport. Class I shipments require Commission approval of the shipping procedures and packaging to be used.

Class I packages are so designed that they will remain nuclearly safe in any number and in any arrangement even after being involved in a serious accident. Exempt packages may be mingled with Class I packages.

Class II packages are so limited as to content that the individual unit is safe from accidental criticality, and the number of such packages which can be transported together is limited so that shipment of the allowable number is safe. The packaging must assure an adequate degree of safety for the individual unit even under accident conditions. The spacing provided by the package determines the allowable number of packages which may be collected

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together. The packaging must assure that, under accident conditions, the spacing between units of special nuclear material will not suffer a reduction in excess of 10%.

Class II shipments may be transported by any carrier. The number of packages which may be carried on the same vehicle with other shipments or placed together on a loading dock or a storage area is limited by assigning a certain number of "units" to each package. The carrier determines the extent to which he can safely mix shipments of special nuclear material from one customer with shipments of special nuclear material from another customer, by limiting the total number of units to no more than 40. This method follows the procedures employed by carriers since 1949 for the control of external radiation levels in the shipment of radioactive material. Any accumulation of packages totaling less than 40 units is safe. The number of units assigned to any package of special nuclear material is determined by dividing 40 by the allowable number of similar packages in one shipment. The allowable number of Class II packages which may be safely accumulated in one area in any arrangement includes a safety factor of at least 5.

Class II shipments are designed to be safe within the allowable number of such shipments even though such packages may be mingled with Class I and exempt packages.

Class III shipments are approved on the basis of careful control of the conditions under which they will be transported. The proposed regulations do not permit the mingling of Class I or Class II packages with Class III shipments.

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The primary dependence for nuclear safety in transport is on the packaging. The Commission will approve a shipment of special nuclear material only when there has been supplied information on which the Commission can be reasonably assured that the individual package is safely sub-critical under all conditions of transport, that the number of packages which can be brought together under normal conditions of transport is also safely sub-critical, and that under severe accident conditions the packaging will maintain its integrity and retain its nuclear safety characteristics to the extent that is necessary to assure safety under the conditions of transport as specified. Because of the likelihood of immersion in water, the individual package must remain substantially sub-critical if fully immersed in water and if water should leak into it.

The conditions of shippent of special nuclear material in the exempt category or in either Class I or Class II do not require specific Commission approval. Various combinations of specific procedures, limits or controls, spacing, numbers, or geometric arrangement of the packages may be used to achieve an adequate degree of safety in the transport of special nuclear material. To permit as much latitude as possible in the design of packaging for special nuclear material, specific packaging requirements have not been imposed for all types and forms of special nuclear materia. The type of packaging which has been used for a few types of material is specified, together with performance criteria for judging the adequacy of other packaging.

The general requirements for packaging refer to an inner container and an outer container. The inner container may consist of a pressed steel can

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or a schedule 40 steel pipe fabricated into a suitable container. The structural integrity of the complete package must satisfy the minimum criteria stated in the regulation. For most cases this means that the design of the packaging must be capable of withstanding a 30 foot free fall on an unyielding surface (such as a solid concrete pad), a puncture test and a fire test without loss of contents and without loss of more than 10% of the minimum spacing. The applicant is required to demonstrate that the packaging design will provide a degree of safety which is adequate to insure that, under normal conditions and in case of credible accident conditions, the packaging will prevent accidental criticality. He may do so by including in his application: the results of engineering assessment of the packaging design, if all assumptions made for the purpose of such assessment are stated; tests of models of packaging details or mock-ups representing methods of construction; extrapolation from results of tests of similar designs with similar construction features; reference to shipping experience with packages of similar design; other information, argument, or evidence; or actual tests of prototypes of the design.

Under both Class II and Class III, specified small quantities of special nuclear material under prescribed circumstances may be transported without prior approval by the Commission of the packaging or shipping conditions. The packaging must comply with Interstate Commerce Commission packaging requirements.

Tables III and IV of Sections 71.52 and 71.62 include values for shipment of plutonium-beryllium encapsulated sources. The manufacture of plutoniumberyllium sources is controlled by the Commission, and the quantity of such sources which can be safely shipped under the conditions specified has been carefully assessed. Notice is hereby given that adoption of the following rule is contemplated. All interested persons who desire to submit written comments and suggestions for consideration in connection with the proposed rules should send them in triplicate to the Secretary, United States Atomic Energy Commission, Washington 25, D. C., within 90 days after publication of this notice in the Federal Register. Comments received after that period will be considered if it is practicable to do so, but assurance of consideration cannot be given except as to comments filed within the period specified.

1. 10 CFR Part 71 is revised to read as follows:

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APPENDIX A

APPENDIX B

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"Standard One-Hour Fire" Schedule 40 Steel Pipe

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#### AUTHORITY

Sections 71.1 - 71.121 issued under Sections 53 and 161; 68 Stat. 930 and 948 as amended, 42 U.S.C. 2073 and 2201.

#### GENERAL PROVISIONS

71.1 <u>Furpose</u>. Part 71 establishes procedures and criteria for authorization by the Atomic Energy Commission of the use of containers and procedures for transporting special nuclear material. The criteria include safeguards against accidental conditions of criticality, release of special nuclear material and overheating of the package. Special nuclear material shipments are also subject to the regulations of other agencies having jurisdiction over means of transportation. Accordingly, the requirements of this part are in addition to, and not in substitution for, other requirements.

71.2 <u>Scope</u>. This part applies to all persons licensed pursuant to Part 70 of this chapter to receive, possess, use or transfer special nuclear material. The shipment of irradiated solid nuclear reactor fuel elements containing radioactivity in a single cask in excess of 2000 curies is not authorized by this part but is governed by Part 72 of this chapter.

71.3 <u>Requirements for Shipment of Special Nuclear Material</u>. No licensee may transport or deliver to a carrier special nuclear material for transport outside the confines of an authorized location, unless the packaging and procedures used have been authorized by the Commission when either:

(a) any single package contains more than 16 grams computed by adding the weight of any U-233 and of any U-235 to 1.77 times the weight of any plutonium; or

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(b) the aggregate quantity of special nuclear material transported or delivered to any single carrier for transportation during any consecutive period of 24 hours contains more than five times the quantity defined in paragraph (a) of this section.

Approval will be granted by the issuance of a license or an amendment of a license under Part 70 of this chapter.

71.4 Definitions. As used in this part:

(a) "Birdcage" means the portion of packaging which surrounds and holds an inner container;

(b) "Package" means packaging and its contents;

(c) "Packaging" means a container in which special nuclear material is transported, including any birdcage and any inner container;

(d) Terms defined in Part 30 and Part 70 have the same meaning when used in this part.

71.5 <u>Communications</u>. All communications concerning the regulations in this part may be addressed to the Atomic Energy Commission, Washington 25, D. C., Attention: Director, Division of Licensing and Regulation, or may be delivered in person at the Commission's offices at 1717 H Street, N. W., Washington, D. C., or its offices at Germantown, Maryland.

71.6 <u>Interpretations</u>. Except as specifically authorized by the Commission in writing, no interpretation of the meaning of the regulations in this part by any officer or employee of the Commission other than a written interpretation by the General Counsel will be recognized to be binding upon the Commission.

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71.7 <u>Specific Exemptions</u>. The Commission may, on application of any interested person or on its own initiative, grant such exemptions from the requirements of the regulations in this part as it determines are authorized by law and will not endanger life or property or the common defense and security and are otherwise in the public interest.

71.8 <u>Additional Requirements</u>. The Commission may by rule, regulation, or order impose upon any licensee such requirements, in addition to those established in the regulations in this part. as it deems appropriate or necessary to protect health or to minimize danger to life or property.

71.9 New Application by Holder of Existing License. On finding that,

of the nature of the operations of the holder of an existing license, or because of other special circumstances, it is necessary or appropriate for the protection of the public health and safety, the Commission may issue an order requiring the licensee to file an application for a new license in accordance with the requirements of this part. On the failure of the licensee to request a hearing within 30 days or to file such an application within 90 days after receipt of the order, the license shall terminate.

#### LICENSE APPLICATIONS

71.21 Filing.

(a) An application for a license shall be filed with the Commission in six copies as provided in \$71.5. The Commission may require the filing of six additional copies.

(b) An application may incorporate by clear and specific reference any relevant information in previous applications, statements or reports filed with the Division of Licensing and Regulation of the Commission. The Commission may require that an application be re-submitted with incorporation by reference eliminated or limited. 71.22 <u>Contents of Application</u>. An application for a license to receive, possess, use or transfer special nuclear material under the authority of Part 70 of this chapter may request approval of one or more methods of shipment of the special nuclear material. That portion of the application pertaining to shipment shall be organized and presented in accordance with the requirements of this section and shall include:

(a) The total quantity of each type of special nuclear material to be shipped in each shipment;

(b) Chemical and physical form of special nuclear material in each shipment, including isotopic content; the nature of any materials blended, alloyed or mixed with the special nuclear material; and the resulting concentrations, densities and degrees of moderation;

(c) The class of each shipment as defined in \$71.33;

(d) A description of the inner container of each package, including i a materials of construction, dimensions and method of fabrication;

(e) The maximum quantity of special nuclear material in each package, in accordance with the criteria and packaging requirements for the class of shipment specified in \$\$71.41 to 71.67 inclusive, taking into account the posibilities of accidental moderation and change in configuration;

(f) A description of each birdcage and method of support of the inner container, including materials of construction, dimensions and method of fabrication with an engineering assessment confirming the integrity of the packaging based on calculations, accident experience or results of testing programs, in accordance with the requirements of this part for the class of shipment;

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(g) The maximum decay heat anticipated at any time during loading, transport and unloading, with full information as to the methods of heat transfer and dissipation;

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(h) A description of any built- in neutron poisons or moderators, including means of attachment, and procedures for confirming periodically the presence and effectiveness of the neutron poison and moderator;

(i) The maximum number of packages in each shipment and any special loading procedures, taking into consideration the spacing afforded by the packaging and the requirements of this part for the class of shipment;

(j) Information to be entered on the label of each package, including the number of radiation units determined as required by this part for the class of shipment;

(k) Administrative procedures, including delineation of supervisory and advisory responsibilities, delegation of responsibility for assuring that operating procedures are consistent with nuclear safety practices prescribed by the license and by this chapter and methods of communicating operating procedures and transmitting orders throughout the organization;

Procedures for periodic and routine inspection of operations including:
 (1) examination of all packaging whether newly constructed
 or reused and method of determining its suitability for use;

(2) filling of packages, including confirmation that each package is loaded with the authorized amount of special nuclear material of specified isotopic assay and physical and chemical form;

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(3) preparation of the shipment and provisions to insure isolation of packages in the packaging area, loading dock and transport vehicle from other special nuclear material.

71.23 <u>Additional Information</u>. The Commission may at any time require further information in order to enable it to determine whether a license should be granted, denied, modified suspended or revoked.

# STANDARDS FOR SHIPMENT

#### GENERAL STANDARDS

## 71.31 Criteria of Nuclear Safety.

(a) A licensee shall obtain specific approval for each type of packaging used in the shipment of special nuclear material unless the shipment complies with §71.51 or 71.63.

(b) In evaluating a shipment for nuclear safety, the Commission will consider:

(1) limit on quantity of special nuclear material in each package on the basis of the type and form of the special nuclear material;

(2) design and construction specifications of the packaging;

(3) spacing between containers of special nuclear material, any limitation in arrangement during transport, and the allowable number of such packages in a single shipment;

(4) any special conditions to be imposed on the shipment;

(5) number of radiation units assigned to each package; and

(6) the classification of the shipment as prescribed by \$71.33.

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## 71.32 General Considerations of Nuclear Safety.

(a) In the transportation of special nuclear material, a variety of limits may be required to insure nuclear safety of the individual packages and prevention of the collection of more than an allowable number of packages in one place. The Commission may require in appropriate cases a variety or combination of limits in the nuclear safety of one or more individual packages.

(b) <u>Moderation</u>. In establishing limits, the most effective degree of moderation shall be assumed unless control of moderation can be assured.

(c) <u>Reflection</u>. Thick reflector conditions shall be assumed for establishing limits for a package.

(d) <u>Neutron Poisons</u>. Built-in neutron poisons may be considered in the proposed limits if there is assurance of their continued presence and effectiveness under all conditions of transport.

#### 71.33 Classes of Shipments.

(a) <u>Class I Shipment</u>. A shipment which may be considered to be safe from neutron interaction in any spatial arrangement because it complies with the criteria of  $\frac{6}{5}$ 71.41, requires no administrative control by the licensee during transport and shall be designated as a Class I shipment.

(b) <u>Class II Shipment</u>. A shipment which meets the criteria of \$71.51 or \$71.52 as to contents, size of package and number of packages in a shipment, requires no administrative control by the licensee during transport and shall be designated as a Class II shipment.

(c) <u>Class III Shipment</u>. A shipment not within the other categories specified in this section shall be designated as a Class III shipment.

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§71.41 <u>Requirements for Shipment of Class I Package</u>. A Class I package shall be deemed to be one which:

(a) is so composed and packed that the special nuclear material contained is effectively shielded from neutrons having energy not greater than 0.3 electron volts, and, if the package were exposed to an adjacent source of neutrons whose angular distribution and energy spectrum are as effective as emanate from a like package, the number of neutrons having energy greater than 0.3 electron wolts leaving the package would be less than the number of such neutrons entering it; or

(b) contains an aqueous or other homogeneous solution being transported in such a manner that homogeneity is assured at all times, taking into account the possibility of freezing, agglomeration and evaporation, and in which the only special-nuclear material present is:

(1) U-235 in any enrichment with a degree of moderation (H/X) greater than 5200;

(2) plutonium with a degree of moderation (H/X) greater than 7600; or

(3) U-233 with a degree of moderation (H/X) greater than 7600.

#### \$71.42 Requirements for Class I Package.

Packaging consisting of a container of solid wood, the hydrogen content of which is not less than 6.5% by weight, having a central cavity surrounded on all sides by at least a 10.2 centimeter thickness of wood, and lined with not less than 0.325 grams of cadmium per square centimeter of the surface of the central cavity, together with contained special nuclear material complying with the requirements of \$71.43, will be considered to be a Class I package as defined in \$71.41(a). (a) The package shall be so designed and constructed that, when loaded and closed as for use, it is capable of withstanding the following individual tests:

(1) A free fall on any side, including the top and bottom, from a height of 30 feet on an unyielding horizontal surface;

(2) Exposure to the conditions of a standard one-hour fire as described in Appendix A; and

(3) Immersion in water to a depth of 3 feet for a period of 24

hours; without leakage from the inner container, reduction of more than 10% in thickness of any built-in moderator, or significant reduction in effectiveness of any builtin neutron poison.

(b) The package shall be at least 12 inches in diameter if cylindrical, and any square or rectangular cross-section shall have no dimension which is less than 12 inches.

\$71.43 Specific Limits for Class I Package. Special nuclear material may be shipped as a Class I package in a container which meets the requirements of \$71.42, within the following limits:

(a) The diameter of the central cavity shall not exceed the following

dimensions:

(1) In the case of plutonium nitrate solution; uranyl fluoride solution or uranyl nitrate solution containing no U-233; a nonhydrogenous uranium compound or mixture containing no U-233 and in which the concentration of U-235 does not exceed 4.8 grams per cubic centimeter; or uranium metal containing no U-233 and in which the

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enrichment of 235 does not exceed 24% by weight, as specified in Curve A of Figure 1.

(2) A solution of U-233 fluoride or U-233 nitrate, as specified in Curve B of Figure 1.

(3) In the case of non-hydrogeneous uranium compound or mixture containing no U-233 and in which the concentration of U-235 does not exceed 9.6 grams per cubic centimeter; or uranium metal containing no U-233 and in which the enrichment of U-235 does not exceed 50% by weight; as specified in Curve C of Figure 1.

(4) A material in which U-235 is the only special nuclear material and in which the U-235 concentration does not exceed 17.3 grams per cubic centimeter; or uranium metal containing no U-233 and in which the enrichment of U-235 does not exceed 92.5% by weight, as specified in Curve D of Figure 1.

(5) A non-hydrogeneous plutonium compound or mixture in which the concentration of Pu-239 does not exceed 10 grams per cubic centimeter, as specified in Curve E of Figure 1.

(6) Any special nuclear material not otherwise specified in this paragraph, as specified in Curve F of Figure 1.

(b) The mass of metal shall not exceed the following limits:

(1) Uranium metal containing no U-233 and in which the enrichment of U-235 does not exceed 92.5% by weight, as specified in Curve G of Figure 2, when the volume of the inner container does not exceed 1 liter;

(2) Plutonium metal as specified in Curve H of Figure 2, when the volume of the inner container does not exceed 0.2 liter.



Figure & MAXIMUM DIAMETER OF CENTRAL CAVITY FOR CLASS I PACKAGE



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\$71.51 Class II Shipment: Small Quantities not Requiring Prior Approval.

(a) Notwithstanding any other provision of this part, a licensee may transport or deliver to a carrier for transport, in one or more packages, special nuclear material not exceeding an aggregate of either 115 grams of U-233, 160 grams of U-235, 100 grams of plutonium, or 400 grams of plutonium encapsulated as plutonium-beryllium neutron sources, when:

the licensee makes only one such shipment in any period of
 hours;

(2) the total volume of each package is not less than 8 liters; and

(3) each package bears a label stating a number of radiation units not less than 40 multiplied by the actual number of grams of special nuclear material divided by the number of grams permitted under the conditions of this paragraph.

(b) A licensee may transport or deliver to a carrier for transport in one or more packages special nuclear material constituting a mixture of the specific types of such material specified in paragraph (a) of this section when the sum of the ratios of the quantity of each type of special nuclear material shipped to the quantity of such material specified in paragraph (a) of this section does not exceed unity.

# \$71.52 Class II Packages Which Require Spacing During Shipment.

(a) A Class II shipment other than one specified in \$71.51 shall be made only in an inner container having the following specifications:

 Resistance to crushing and fracture shall be at least equivalent to that provided by steel pipe meeting the specifications in Appendix
 B, Schedule 40 Steel Pipe.

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(2) The bottom shall be equivalent in strength to a plate, equal in thickness to the wall of the container, welded or threaded to the bottom of the container.

(3) The top closure which may be a flanged and gasketed cover or a standard pipe cap shall be equivalent in strength and leaktightness to the container itself.

(b) An inner container specified in this section shall be supported within an enclosed birdcage in such manner that, when closed as for use and loaded with material at least equal in weight to that of the proposed contents;

> (1) The package is capable of withstanding a drop on any side, including the top and bottom, on an unyielding flat horizontal surface from a height of 30 feet with no loss of contents from the inner container and no more than a 10% reduction in any spacing measured from the outside of the inner container to the outside of the outer container;

(2) The surface of the birdcage is so designed and constructed that spacing will be maintained under normal conditions of transport, that over-riding or interlacing of packages will be prevented, and that it will be capable of withstanding a free fall of 3.5 feet on an unyielding horizontal flat surface no larger than 6 inches in diameter without exceeding the ultimate strength of the structural material of the outer surface of the birdcage;

(3) The package is capable of withstanding exposure to the first ten minutes of the standard one-hour fire as described in Appendix A with no loss of contents from the inner counter and no more than a 10% reduction in any spacing measured from the outside of the inner container to the outside of the outer container; and

(4) The distance between any surface of the contained special nuclear material and any outer surface of the outer container is not less than 4 inches.

(c) The quantity of special nuclear material within the package shall not exceed the quantity determined from the following table on the assumption

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of a degree of moderation which would result from the filling of all voids within the inner container by water but without allowance for variations in enrichment, density, dilution or ratio of height to diameter.

Degree of	Moderation (H/X)	<u>U-235</u>	Pu	U-233	
More than	Not more than	Mass Lim	its (in ki	lograms)	
-	2	5.0	1.7	2.0	
2	3	4.0	1.5	1.8	
3	5	3.0	1.3	1.4	
5	10	1.8	1.0	1.0	
10	20	1.0	0.7	0.7	
		Volume Li	Volume Limits (in liters)		
20	. 800	2,0	1.3	1.3	
800	440 (t)) 410	4.0	3.0	3.0	

The limit established by this subparagraph, is applicable to plutonium, U-233, or U-235, the density of which does not exceed that specified in Figure 13 of \$70.43 for the degree of moderation. In any case in which the density exceeds that specified in Figure 13, the limit shall be reduced by the adjustment factor specified in \$70.43(b).

(d) <u>Allowable Numbers</u>. The maximum number of packages, each complying with this section, in a single shipment shall not exceed that determined from Figure 3 of this section, depending on the volume of the entire package but without allowance for any hoops or other projections. If the quantity of special nuclear material within the package is less than the quantity determined from paragraph (c), the allowable number of such packages determined from Figure 3 may be increased in the ratio of the allowable quantity to the actual quantity.

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#### CLASS III STANDARDS

#### \$71.61 Class III Shipment.

(a) The pertinent criteria specified in \$71.62, \$71.63 or \$71.64 may be used to establish the proposed limit on the contents of a package and the allowable number of packages in a single Class III shipment if each package complies with the requirements of \$71.65 and the shipment is made in accordance with the requirements of \$71.66.

(b) Any Class III shipment which does not meet the criteria of \$71.62, \$71.63 or \$71.64 shall be designated as a special Class
III shipment. Authority for such a shipment will be granted only in accordance with \$71.67.

#### \$71,62 Class III; Individual Package Limits for Cubical Array.

(a) A Class III package may contain the quantity of special nuclear material specified in the following table, without allowance for variations in enrichment, density, dilution, or ratio of height to diameter of the inner container:

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Degree of M	Moderation (H/X)	<u>U-235</u>	Pu	U-233
More than	Not more than	Mass li	mits (in ki	llograms)
	2	10.0	2.5	2.8
2	3	9.0	2.5	2.5
3	5	7.3	2.5	2.2
5	10	5.2	2.5	1.8
10	20	3.6	2.4	1,3
		Volume	limits (in	liters)
20		3.6	2.4	1.3

(b) The maximum number of packages, each complying with paragraph (a) of this section, in a single shipment shall not exceed that determined from Figure 4 of this section, depending on the volume of the entire package but without allowance for any hoops or other projections.

(c) The distance between any surface of the contained special nuclear material and any outer surface of the outer container shall be not less than 4 inches.

### **571.63** <u>Class III:</u> <u>Small Quantities in Controlled Shipment Not Requiring Prior</u> <u>Approval</u>.

(a) A licensee may transport or deliver to a carrier for transport, in one or more packages, not more than 500 grams of U-235, 300 grams of U-233, 300 grams of plutonium, or 2500 grams of plutonium encapsulated as plutonium-beryllium neutron sources, when shipment is made in accordance with the requirements of \$71.66.

(b) A licensee may transport or deliver to a carrier for transport, in one or more packages, special nuclear material constituting a mixture of the specific types of such material specified in paragraph (a) of this section when the sum of the ratios of the quantity of each type of special nuclear material shipped to the quantity of such material specified in paragraph (a) of this section does not exceed unity.

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(c) The quantity of plutonium transported in any one package in the form of a plutonium-beryllium neutron source shall not exceed 400 grams.

## \$71.64 Class III Shipment: Insoluble Compounds and Metals.

(a) <u>General</u>. A package of special nuclear material in the form of metal or compounds insoluble in water, or both, may contain a quantity specified in either paragraph (b), (c) or (d) of this section, and the maximum number of units per shipment may be determined in accordance with the requirements of paragraph (e) of this section, if the packaging complies with the requirements of \$71.65 and shipment is made in accordance with the requirements of \$71.66.

(b) <u>Geometry Control</u>. The size of an inner container shall not exceed that determined in accordance with Figures 2, 3, or 4 of \$70.42, Figures 19, 20, or 21 of \$70.44 for U-235; Figures 6, 7, or 8 of \$70.42 for plutonium; or Figures 10, 11, or 12 of. \$70.42 for U-233; assuming the most effective degree of moderation and thick reflector with incorporation of adjustment and allowance factors required or permitted by \$70.43.

(c) <u>Mass Control with Limited Moderation</u>. The allowable mass shall be that determined from Figure 1 of \$70.42 or Figure 19 of \$70.44 for U-235; Figure 5 of \$70.42 for plutonium; or Figure 9 of \$70.42 for U-233. The determination of allowable mass, with incorporation of adjustment and allowance factors required or permitted by \$70.43, shall be based on thick reflector conditions and a degree of moderation determined by assuming that water has filled all void spaces within the inner container including interstices between particles.

(d) <u>Mass Control with Optimum Moderation</u>. The limit of the amount of U-235 in an individual package may be based on limitation of mass, with incorporation of adjustment and allowance factors required or permitted by \$70.43, determined

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for thick reflector conditions at the most effective degree of moderation, from Figure 1 of \$70.42 or Figure 19 of \$70.44.

(e) <u>Maximum Number of Packages per Shipment</u>. The number of packages in a shipment shall be limited in accordance with the solid angle criteria of \$70.52, taking into account the spacing provided by the package and any special arrangement on the vehicle.

\$71.65 Class III Packaging Requirements.

(a) Special nuclear material, the limits of which have been determined in accordance \$71.62 and paragraphs (b) and (c) of \$71.64 shall be shipped in inner containers having the following specifications:

 Resistance to crushing and fracture shall be at least equivalent to that provided by steel pipe meeting the specifications in Appendix
 B, Schedule 40 Steel Pipe.

(2) The bottom shall be equivalent in strength to a plate, equal in thickness to the wall of the container, welded or threaded to the bottom of the container.

(3) The top closure which may be flanged and gasketed cover or a standard pipe cap shall be equivalent in strength and leak-tightness to the container itself.

(b) Quantities of special nuclear material prescribed in \$71.64(d) shall be shipped in inner containers at least equivalent in structural integrity and leak-tightness to Specification 6A drums of \$78.97 of the Interstate Commerce Commission regulations (Title 49, Chapter 1, Code of Federal Regulations, Part 78 - Shipping Container Specifications).

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(e) An inner container ecified in this section shall supported within an enclosed birdcage in such manner that, when closed as for use and loaded with material at least equal in weight to that of the proposed contents:

(1) The package is capable of withstanding a drop on any side, including the top and bottom, on an unyielding horizontal flat surface from a height of 30 feet with no loss of contents from the inner container and no more than a 10% reduction in any spacing measured from the outside of the inner container to the outside of the outer container;
(2) The surface of the birdcage is so designed and constructed that spacing will be maintained under normal conditions of transport, that over-riding or interlacing of packages will be prevented, and that it will be capable of withstanding a free fall of 3.5 feet on an unyielding horisontal flat surface no larger than 6 inches in diameter without exceeding the ultimate strength of the structural material of the outer surface of the birdcage;

(3) The package is capable of withstanding exposure to the first ten minutes of the standard one-hour fire as described in Appendix A with no loss of contents from the inner container and no more than a 10% reduction in any spacing measured from the outside of the inner container to the outside of the outer container; and

(4) The distance between any surface of the contained special nuclear material and any outer surface of the outer container is not less than 6 inches, except

in the case of a package which meets the limits specified in \$71.62. (d) When compliance with the criteria in this part requires that packages in a shipment be arranged in planar array and not stacked, there shall be affixed to the top of each birdcage, an angle-iron tripod or frame. The following legend shall be legibly and indelfably printed in red letters at least one inch high on a white background, painted on or securely affixed to the top surface of the containers

CLASS III SHIPMENT SPECIAL ARRANGEMENT THIS END UP DO NOT STACK - 31 -

#### §71,66 Class III: Transportation Procedures

(a) A Class III shipment shall be shipped in accordance with one of the following procedures:

(1) As a shipment having exclusive use of the vehicle.

(2) Under escort by a courier, employed by the licensee, having adequate knowledge and authority to assure compliance with the requirements of this part.

(3) Under any other procedure specifically approved by the Commission. The Commission will accept as adequate evidence of compliance with the provisions of this subparagraph, a written certificate of a carrier that the special nuclear material will be loaded under the licensee's supervision and will be transported in the same vehicle with no intermediate unloading or trans-shipment until final delivery to the consignee; that no cargo containing source or special nuclear material, explosive or flammable materials be transported in the same vehicle; and that the name of the carrier, the consignee and the location of the consignee's facility at the destination, the mode of transfer and the general route to be followed will be as described in the certificate.

(b) A shipment under subparagraph (1) or (2) of paragraph (a) shall not be placed in any vehicle containing source or other special nuclear material, heavy water, beryllium, graphite or flammable or explosive material, or in the same hold of a ship with such materials, or at any time during loading, transshipment or delivery closer than 20 feet from such material, but may be transported in the same vehicle with materials other than those specified in this paragraph when such other materials are shipped by the licensee.

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#### \$71.67 Special Class III Shipments.

A shipment of a solution, water soluble compound, fuel element, or other special nuclear material which does not comply with the criteria of \$\$71.62 to 71.64 inclusive, may be authorized by the Commission if the nuclear safety of the proposed shipment is demonstrated by experimental data, calculations or plans for special controls as specified in \$\$70.47 and 70.56.

#### HEAT REMOVAL

#### \$71.71 Heat Removal.

(a) A package of special nuclear material shall be so designed and constructed and loaded on a vehicle that under normal conditions of transport:

(1) The temperature of any readily accessible surface of the package or of any external structure will not at any time exceed  $180^{\circ}$ F.

(2) The maximum surface temperature of the special nuclear material will not cause damage to the packaging and will be no higher than the higher of the following:

(1) 300<sup>°</sup>F; or

(ii) 200°F below the melting point of the special nuclear material or the melting point of the cladding, whichever is lower.

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(b) Temperatures will be estimated on the basis of assumptions that the ambient air is at a temperature of  $100^{\circ}$ F without wind, with maximum solar heat load anticipated for the proposed route and conditions of shipment, and exposure to the sun.

## \$71.72 Pyrophoric Materials.

Special nuclear material which is subject to spontaneous ignition at 80°F or at a lower temperature shall be packed in a manner which precludes spontaneous combustion.

#### SHIPPING PROCEDURES

\$71.81 Labeling.

(a) Prior to shipment, the licensee shall label each package in accordance with \$73.402 of the regulations of the Interstate Commerce Commission (Title 49, Code of Federal Regulations, Part 73) employing a label as specified in paragraph (a) or (c) of \$73.414 of Title 49, Code of Federal Regulations, Part 73, showing the number of radiation units assignable to the package in accordance with paragraph (b) of this section or, in the case of Class III shipments, the words "Exclusive Use", "Courier" or "Special Handling".

(b) The number of radiation units assignable to a package shall be considered to be the larger of the following:

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(1) The aggregate of the number of milliroentgens per hour of xradiation and gamma radiation; the number of millirads per hour of beta radiation; and the number of milliroentgens per hour which is equivalent to the neutron flux, in accordance with the following table, measured at a distance one meter from the surface of the package approved by the Commission.

Energy of Neutrons in electron volts (ev) or in million electron volts (Mev)	Neutron Flux Equivalent to 1 milliroentgen per hour of gamma radiation (neutrons per square centimeter per second)	
0.025 ev 10 ev 0.01 Mev 0.1 Mev 0.5 Mev 1 2 Mev	267 267 133 27 11 8 5	
3 to 10 Mev	4	

(2) The number obtained by dividing 40 by the number of similar packages which may be transported in one shipment in accordance with 871.51 or 871.52.

871.82 <u>Defective Packaging</u>. The licensee shall not transport or cause to be transported special nuclear material in packaging which he knows or has reason to believe may be defective in any respect having a potentially significant adverse effect on the efficiency of the packaging.

\$71.91 <u>Requirements for Tests</u>.

(a) No special nuclear material shall be transported until the licensee has completed any tests of packaging required by \$\$71.92 and 71.93, and has ascertained that each package complies with the provisions of this part and the conditions of the license.

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(b) Packaging the has been involved in any action or in which significant corrosion or other deterioration is suspected shall not be employed for the transportation of special nuclear material until the licensee has ascertained that it complies with the provisions of this part.

871.92 Preliminary Tests.

(a) Prior to the first use of any packaging for special nuclear material which produce significant amounts of decay heat, the licensee shall ) experimentally verify the calculated heat transfer characteristics of the packaging and any mechanical cooling device under ordinary conditions of transport.

(b) Prior to the first use of any packaging involving radiation shielding or neutron moderators or poisons, the licensee shall determine the effectiveness of the shielding, moderator and poison, and shall establish the absence of cracks, pinholes, uncontrolled voids or other defects which "would significantly reduce their effectiveness.

#### \$71.93 Routine and Periodic Tests.

(a) <u>External radiation levels</u>. Prior to each shipment of any package, the licensee shall determine that the external radiation level does not exceed either 200 milliroentgens per hour at any accessible surface of the package or of the external structure, if used, or 10 milliroentgens per hour at a distance of 1 meter from any accessible surface of the package or the external structure.

(b) <u>External contamination</u>. Prior to each shipment of any package, the licensee shall survey representative parts of the surface of the package for external contamination by wiping an area of approximately 100 square centimeters with clean absorbent paper, applying moderate finger pressure,

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and measuring contamination on the paper through standard counting techniques for beta-gamma and alpha activity. Surface contamination so measured shall not exceed either  $10^{-2}$  microcuries per 100 square centimeters of beta-gamma activity or  $10^{-3}$  microcuries per 100 square centimeters of alpha activity.

(c) <u>Closure</u>. Prior to each closing of any package, the licensee shall visually inspect the closure and sealing gaskets for defects and, prior to shipment of each package, shall visually inspect and test, wherever possible, the integrity and adequacy of the closure.

(d) <u>Neutron Moderators and Poisons</u>. The licensee shall perform periodic tests to establish that any built-in neutron moderators and neutron poisons which are considered in the nuclear safety of the shipment are present and effective in accordance with the approved packaging design.

#### RECORDS, REPORTS AND INSPECTIONS

\$71.101 <u>Conditions of Licenses</u>. In addition to the requirements of \$71.91, the following shall be deemed to be conditions of the license:

(a) <u>Records of Shipments</u>. The licensee shall maintain records of each shipment of special nuclear material showing the type and quantity of special nuclear material in each package and the total quantity in each shipment together with the date the shipment was made, the class of shipment, the means of transport used, the carrier's certificate if required, the license number of the recipient, and the address to which the shipment was made.

(b) <u>Records of Tests</u>. The licensee shall maintain records of details and results of tests and observations made on each shipping container, including calculated and observed rates of heat generation and dissipation, coolant and container temperatures and pressures, and radiation and contamination surveys.

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(c) <u>Certification</u>. Each shipment shall be made in accordance with the conditions of the license and with the regulations in this chapter, and the licensee shall provide the carrier with a duly executed certificate to that effect.

(d) <u>Reports</u>. The licensee shall report to the Division of Licensing and Regulation within 30 days, each case of failure of packaging, regardless of the cause, if such packaging is used or was to be used in shipment of special nuclear material.

# 71.111 Inspection and Tests.

(a) The licensee shall afford to the Commission at all reasonable times opportunity to inspect the special nuclear material, packaging and the premises and facilities wherein the special nuclear material or packages are used, produced, tested, stored or transported.

(b) The licensee shall make available to the Commission for inspection all records required by this part.

(c) The licensee shall perform, or permit the Commission to perform, such tests as the Commission deems appropriate or necessary for the administration of the regulations in this part.

### ENFORCEMENT

\$71.121 <u>Violations</u>. An injunction or other court order may be obtained prohibiting any violation of any provision of the Act or any regulation or order issued thereunder. Any person who wilfully violates any provision of the Act.

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or any regulation or order issued thereunder may be guilty of a crime and, upon conviction, may be punished by fine or imprisonment, or both, as provided by law.

FOR THE ATOMIC ENERGY COMMISSION

Woodford B. McCool Secretary

Dated at Germantown, Maryland this

15th day of February , 1963

#### APPENDIX A

The "standard one-hour fire" mentioned in §§71.42, 71.52 and 71.65 assumes exposure for one hour to a fire in which the following temperatures are reached at various times after the beginning of the fire:

1000 <sup>0</sup> F	After 5 minutes;
1300 <sup>0</sup> F	after 10 minutes;
1550 <sup>o</sup> F	after 30 minutes;
1 700 <sup>0</sup> F	after 1 hour.

NOTE: The standard fire is described in specifications of the National Fire Protection Association (NFPA No. 251) and the American Society for Testing Materials (ASTM, Design E 119-61). Details of methods for testing by means of the standard fire may be found in the cited references.

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## SCHEDULE 40 STEEL PIPE

Dimensions and Weights of Welded and Seamless Steel Pipe

Nominal Size (in inches)	Outside Diameter (In inches)	Nomin <b>al</b> Wall Thickness (in inches)	Weight-Plain End (in pounds per foot)
2	2.375	0.154	3.65
2.5	2.875	0.203	5.79
3	3.500	0.216	7.58
4	4.500	0.237	10.79
5	5.563	0.258	14.62
6	6.625	0.280	18.97
8	8,625	0.322	28.55
10	10.750	0.365	40.48
12	12.750	0.406	53.56
14	14.000	•0.438	63,37
16	16.000	0.500	82.77
20	20.000	0.593	122.91
24	24.000	0.687	171.17

NOTE: Reference: American Standards Association B 36.10-1959, Specifications for Schedule 40 Steel Pipe

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