October 25, 1973

UNITED STATES OF AMERICA
ATOMIC ENERGY COMMISSION

Before the Atomic Safety and Licensing Board

In the Matter of METROPOLITAN EDISON COMPANY, et al. (Three Mile Island Nuclear Station, Unit 1)	)))))))	Docket No. 50-289

APPLICANTS' PREPARED TESTIMONY RELATED TO TRANSPORTATION OF RADIOACTIVE MATERIALS

I. Protection of the public health and safety through Packaging

While industry bears the primary responsibility for assuming safety in the packaging, transport and safeguarding of radioactive materials, industry's activities are subject to strict regulations. The packaging and transportation of radioactive materials are regulated principally at the Federal level by the Atomic Energy Commission (AEC), the Department of Transportation (DOT), and the U.S. Postal Service, although certain aspects, such as limitations on gross weight of trucks, are subject to State regulations. AEC agreement states have adopted regulations pertaining to intrastate transportation of radioactive materials which require the shipper to conform to the packaging, labeling,

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and marking requirements of DOT to the same extent as if the transportation were subject to the rules and regulations of that agency. (See also 10 CFR §71.5(b)).

Based on considerations such as protecting employees, transport workers and the public from external radiation in the transport of radioactive material under normal conditions, and assuring that the packaging for radioactive materials is designed and constructed so that, under both normal and accident conditions, the radioactive material is unlikely to be released from the packaging, the standards and criteria set forth in the regulations provide assurance that packaging designed to meet such standards can be carried on all modes of transport and will withstand the conditions likely to be encountered in accidents. Thus, government regulations do not require that the shipments be restricted to specific routes since the safety standards of the AEC and DOT do not rely on restriction of routing for assuring safety in transport.

To meet the regulatory standards, packaging must be designed and constructed to provide two and, in some cases, three levels of protection.

The packaging must function in the normal transportation environment with a high degree of reliability. Systems selected to achieve the basic design functions, i.e., containment, shielding, heat dissipation, and nuclear criticality safety, must provide a high degree of inherent safety under normal conditions and have a high tolerance for malfunctions, off-normal conditions, and accidents should they occur. Each shipping container is checked routinely to assure that the "as built" high quality is maintained throughout its lifetime.

Despite the best possible design practices and the highly assured capability for reliable and practicable operation, allowance is made for malfunctions, off-normal conditions, and accidents, thus providing an additional level of protection to resist or accommodate such occurrences. As with the primary level of protection, conservative design practices, adequate safety margins, and inspectability are incorporated into these secondary protection systems to assure both the effectiveness and reliability of the second level of defense.

As an added measure of safety, where the design includes mechanical systems essential to safety, the design is evaluated under normal conditions and against a series of severe hypothetical accident conditions, assuming certain of these protective systems fail. If such failure could produce serious consequences, additional protective measures or redundancy of the safety system must be provided.

II. AEC and DOT Regulatory Requirements

This section of the testimony contains a detailed discussion of the AEC and DOT regulatory requirements related to the transportation of radionuclides. In Section IV below, the application of these regulations to the transportation of new fuel to the TMI site, spent fuel from the TMI site, and radwaste from the TMI site, is described.

The type of packaging is specified in the regulations according to two basic criteria--type of radioactive material; and, quantity of radioactive material (see attached Table entitled "Quantity Limits as Related to Package Requirements"). As to the types of radioactive materials, the regulations recognize two broad classes: (1) "special form" which is a massive, nonfriable, solid material or material confined in a high integrity capsule of inert materials, and (2) "normal form" which applies to all radioactive materials which are not "special form". Normal form radioactive materials are classified into seven groups of radionuclides based primarily on radiotoxicity of the radionuclides. Package limits for the seven transport groups and "special forms" are shown in the above referenced Table.

The regulations also provide different requirements as a function of the quantities of radioactive materials involved. Smaller quantities (Type A) of radioactive materials must be shipped in packaging, identified as Type A packaging, which will prevent loss or dispersal of the radioactive contents and retain shielding efficiency and effectiveness of other safety features under normal conditions of transport. Standards for evaluation and testing of adequacy with respect to normal conditions specified in AEC and DOT regulations include temperatures ranging from -40° to 130°F, all surfaces except the bottom wet for 30 minutes, being subjected while wet to a 4 foot free fall, vibration normally encountered in transport and external pressure reduced to 0.5 atmosphere.

Quantities exceeding Type A quantities must be shipped in Type B packaging. Type B packaging must be designed to withstand normal transport conditions without loss of contents or shielding efficiency and to suffer no more than a specified loss of contents or shielding efficiency if subjected to a specified sequence of accident damage test conditions. That damage test sequence includes: (1) a free fall from a height of 30 feet onto an unyielding surface with the package landing in the orientation which does the most damage, (2) a free fall from a height of 4 feet onto a 6-inch-diameter steel plunger long enough, and with the package in the orientation to do maximum damage, (3) heat input from exposure for 30 minutes to a fire or other radiant environment having a temperature of 1475°F and an emissivity of 0.9, and (4) for fissile material, immersion in water to a depth of 3 feet for 24 hours. Those test conditions make up the design basis accident for Type B packages; i.e., package designs which meet the criteria under these test conditions are considered to provide adequate protection to the public and operating personnel in transportation accidents.

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Large quantities must be shipped in Type B packaging which provides for adequate dissipation of heat. In addition, there must be no loss of contents at an external pressure of 25 psig, which is approximately equivalent to immersion in water to a depth of 50 feet.

With respect to heat dissipation, the regulations require the package to be designed so that the temperature rise due to decay heat will not adversely affect the package or the contents and will not cause excessive pressure. The accessible surface of the package must not exceed a temperature of 180°F.

Fissile material (i.e., uranium-233, uranium-235 and plutonium) in quantities exceeding 15 grams per package or, in homogeneous, hydrogenous solutions and mixtures, quantities exceeding 500 grams of U-233 or Pu or 800 grams of U-235 per package, require some control in transport to assure safety from accidental criticality. Nuclear criticality safety in transport is provided by assuring that the contents of each package of fissile material is subcritical when delivered to a carrier for transport and that the package is so designed that it will remain subcritical under all conditions likely to be encountered in transport, including accidents. In addition, the contents must be limited or the package must be designed so that the number of packages which are likely to be accumulated in one vehicle or area will be subcritical under all conditions likely to be encountered in transport, including accidents and handling errors.

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The AEC regulations specify the conditions for evaluating the adequacy of design of a package for fissile material including form and geometry of the contents and moderation and reflection.

Packages for fissile material are classified as Fissile Class I, II, or III, according to the degree of control which must be exercised to assure nuclear criticality safety. Fissile Class I packages are designed such that they may be transported in unlimited numbers without risk of criticality.

Fissile Class II packages are controlled by the carrier as to an allowable number on a vehicle or in one handling or storage area. This is done by a system of assigning a number to each package, called a transport index (calculated on the basis of either criticality or external radiation level), and requiring the carrier not to allow more than an accumulation of 50 transport indexes on a vehicle or area.

For Fissile Class III, the shipment must be made exclusive use (i.e., the consignor loads the shipment and the consignee unloads the shipment and nothing is allowed on the vehicle other than the consignor's material) or by an escort provided by the shipper who assures the shipment is kept separated from other fissile material, or some other specifically approved procedure.

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In some cases physical properties limit the number of packages in a shipment. For example, in most cases one irradiated fuel cask is shipped on a truck or rail car and the cask is shipped exclusive use because of weight limitations on the vehicle even though some designs might meet the Fissile Class I requirements. For PWR-type unirradiated nuclear fuel, the typically allowable number of packages for Fissile Class III is 20. However, because of the size and weight of each package, only 6 or 7 can be loaded on one truck.

Because the primary consideration for achievement of safety in the transportation of radioactive materials is the use of proper packaging for the specific radioactive materials to be transported, applicants for approval of a packaging design must provide a detailed analysis of that design to demonstrate, for example, by quantitative assessment, tests of models or mock-ups, or actual tests, that the design meets the standards and the criteria of the regulations. In addition, quality assurance and control regulations, which require that licensees who wish to fabricate casks must describe their quality assurance program when they apply for approval of the design and require that packages for fissile material and large quantities be tested prior to first use with respect to shielding and heat dissipation and prior to each use as to proper assembly, proper closing, temperature, pressure, and presence of neutron absorbers, give further assurance that adequate protection is provided. The regulations strictly limit external radiation exposure by limiting, for example, the radiation emitted from individual packages of radioactive material in order to limit the direct exposure to the person handling the package, and to limit the radiation level to which persons and property in the vicinity of the package would be exposed. There are further regulatory requirements related to the levels of surface contamination, temperature at any accessible surface of a cask, types and position-placement of warning labels and placards, establishment of procedures for coping with accidental releases, and certifications by the shipper in writing on the shipping papers that the radioactive materials are properly classified, described, packaged, marked, and labeled and are in proper conditions for transport.

As a result of the detailed regulations and industry's strict adherence to them, there has been an excellent record of safety in the transportation of millions of packages of radioactive packages during the three decades since the beginning of the atomic energy industry. DOT has estimated that shipments in 1972 involved approximately 800,000 packages of radioactive materials in the U.S.A. Yet, a DOT review published in December 1972 states that there have been no known serious injuries to the public or to the transportation industry personnel as a result of the radioactive nature of any radioactive material shipment.

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AEC Physical Protection Requirements

In 10 CFR Part 73 the AEC imposes requirements for the physical protection of specified quantities of special nuclear material in transit. Since Part 73 was first adopted in 1969, it has been periodically amended to strengthen, in the interest of the common defense and security, these requirements for physical protection. Part 73 requires, for example, that each licensee who transports or delivers to a carrier for transport special nuclear material shall make arrangements to assure that the material is protected in transit by providing that the special nuclear material will be transported in the continuous personal custody of an individual who has been designated by the licensee to have surveillance responsibility and that a system of hand-to-hand receipts will be followed. The licensee further is required to comply with detailed procedures concerning notification of the consignee as to time of departure, method of transportation, and estimated time of arrival, and in the event a shipment fails to arrive at its destination at the estimated time, to initiate notification of the proper authorities and conduct a tracer.

Currently the AEC has proposed amendments to Part 73 which are intended further to reduce the risk of theft of special nuclear material. The factors that lead to theft of vehicle commodities generally have been identified by DOT studies as (a) longer dwell-time in transportation; (b) packages of a size and weight that can be moved by one man; and (c) large numbers of intervehicular transfers during the course of a shipment. The dwell-time is proposed to be reduced by requiring direct shipper to receiver shipments for truck transportation, and minimization of any transfers between flights where air cargo transportation is used. Rather than continuous personal custody, reliance would be placed on the monitoring of shipments at transfer points to assure against misroutings. Additionally, shipments would be by specially designed and dual occupied trucks or by dual occupied ordinary trucks and an armed escort vehicle; rail shipments would have to be escorted by two armed guards. Other measures required to be taken would include use of closed vans, locked containers, fingerprinted seals on containers, and a communications capability which would not allow a lapse of more than 2 hours.

III. Evaluation of environmental impact.

In implementation of the National Environmental Policy Act of 1969, the AEC requires applicants for a license

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to operate nuclear power plants to evaluate the environmental impact of transportation of nuclear fuel and solid radioactive wastes to and from the plant. Consideration is given to such parameters as shipping distance, weather, radiation levels, package contents, population density, accident frequency, numbers of anticipated shipments, and estimated degrees of package damage assigned to different accidents.

A comprehensive generic survey of the environmental impact associated with the transportation of radioactive materials to and from nuclear power plants has been conducted by the AEC. It was concluded in that survey (reported in WASH-1238) that:

1. The amount of heat released from a shipment of unirradiated nuclear fuel or of solid radioactive waste is negligible. A rail cask containing irradiated fuel may release as much as 70 kilowatts or about 250,000 Btu/hr. This might be compared to about 50 kilowatts of waste heat released from a 100 horsepower truck engine during full power operation. Even in those cases where more than one cask is located in an area, such as two or more loaded casks on a barge or train, the amount of heat released during shipment is too small to have any appreciable effect on the environment along the shipping route.

2. The temperature on the accessible surface of packages in transport is limited by DOT regulations to 122°F if the package is shipped other than under "full load" conditions. Under "full load" conditions, the shipper has exclusive use of the vehicle and the cargo is loaded by the consignor and unloaded by the consignee so that contact with the package is controlled. Under "full load" conditions, the temperature on the accessible surface of the package is limited to 180°F. Under normal conditions of transport, there is unlikely to be damage to property or injury of persons due to external temperature.

3. Shipments by truck must meet State restrictions on gross weight of vehicle which ensures against damage to bridges or roadways. The total number of shipments per reactor year, about 200, is too small to have any measurable effect on the environment due to the resultant increase in traffic density.

4. The weights of rail and barge shipments must meet the regulatory limitations of the Federal Railroad Administration and the U.S. Coast Guard and are within the range of weights of other commodities routinely handled on those modes of transport. The weights and numbers of shipments are too small to result in any measurable effects on the environment.

5. The total impact on the environment from radiation in the transportation of fuel and wastes from a

power reactor under normal conditions, based on the present packaging standards, is estimated to be a population dose of 5 man-rem per reactor year. An individual transport worker is unlikely to receive more than 500 mrem/yr. The average radiation dose to the highest exposed group of transport workers (truck drivers) is estimated to be about 100 mrem/yr. The cumulative dose to all transport workers is estimated to be about 3 man-rem per reactor year. The cumulative radiation dose to persons other than transport workers would be about 2 man-rem per reactor year, distributed among approximately 600,000 people. This is about one-millionth of the applicable Federal radiation protection guide for the average exposure to the general population from all sources of radiation other than natural background and excluding radiation exposure for medical purposes. The dose to those same persons due to the average normal background radiation, about 130 mrem/person/year, would be about 78,000 man-rem per year.

6. The risk of radioactive contamination or radiation exposure from accidents in transportation is extremely small.

7. The probability of a truck, rail or barge accident occurring in transportation is very small, about 10^{-6} per vehicle mile. Based on those accident statistics, the average number of shipments per year and average shipping distances, a shipment of nuclear fuel, solid radwaste, or

empty fuel shipping containers for a typical nuclear power reactor would be involved in a transportation accident offsite about once for each 5 years of reactor operation.

8. More than 70% of the accidents which occur are of a minor nature and would produce little or no damage to a shipment. Less than 1% of the accidents involve a severe impact or fire.

9. The probability of a release of radioactive material or an increase in external radiation levels in an accident is small. One-third of the shipments are empty containers. In a severe accident, the vehicle may absorb most of the impact and the fire may not involve the shipment of radioactive material. Packages containing radioactive materials which might present serious potential radiation hazards if released must be designed to withstand accident conditions. The regulations limit the contents of packages not designed to withstand accident conditions, so only a small amount of radiation exposure would result should the package be severely damaged.

10. The extent to which the material is dispersed and the amount of radiation exposure that results from the releases are affected by the weather conditions and the number of people in the vicinity of the accident. The probability is small of a severe accident occurring in a location where the population density is high.

11. The impact on the environment from accidents in

transportation of unirradiated fuel, irradiated fuel, solid radwastes, and empty containers due to common (non-radiological) causes is estimated to be 1 fatal injury per 100 reactor years, 1 non-fatal injury per 10 reactor years, and property dama s of about $475 per reactor year.

IV. Transportation to and from Three Mile Island

In order to describe more clearly the application of these comprehensive regulatory requirements related to radioactive materials in transit to and from the Three Mile Island Station, Unit 1, as well as the assessment of the related environmental impact, the transportation of new fuel, spent fuel and radioactive waste to and from TMI 1 will be discussed separately.

New fuel (also referred to as fresh fuel or cold fuel) consists of unirradiated fuel assemblies, each of which includes two hundred and eight fuel rods containing sintered low-enrichment uranium dioxide fuel clad in Zircalloy-4 tubing and sealed by Zircalloy-4 end caps. Shipment of new fuel is classified under AEC regulations as a large quantity, Fissile Class III radioactive material shipment. The initial shipment of new fuel to the TMI site will be made by exclusive use truck from Babcock & Wilcox's (B&W's) Commercial Nuclear Fuel Plant in Lynchburg, Virginia. It is estimated that for the initial reactor core load, fifteen truck shipments will occur over a two month period, and that after shipment of the initial core, the frequency of fuel shipments is expected to be five shipments per year where a normal shipment consists of six containers.

Licensing requirements associated with the shipment of new fuel to TMI include approval by the AEC of the design of B&W's fresh fuel shipping container and authority for Met Ed to receive the fresh fuel. Approval of B&W Model No. B Fresh Fuel Shipping Container, designed, constructed and tested to meet the previously discussed Federal regulations covering normal and hypothetical accident situations occurring during transport was granted by DOT Special Permit No. 6206, dated March 30, 1970, and amended and renewed January 21, 1972, and Amendment 71-1 of March 11, 1970 to B&W's AEC special nuclear materials license, SNM-1168 of December 16, 1969, which authorizes B&W to receive, possess, and ship unirradiated nuclear fuel of 4% and less U-235 content. B&W is required as the shipper to assure that shipments of new fuel are accomplished in accordance with 10 CFR Parts 70 and 71. Although the AEC in 10 CFR Part 73 has established requirements for the physical protection of specified quantities of special nuclear material in transit, Part 73 is not applicable to B&W's shipments of fuel to TMI, since no single shipment of "more than 5000 grams of uranium-235 (contained in uranium enriched to 20% or more in the U-235 isotope), uranium-233, or plutonium, or a combination thereof" will be made. (10 CFR §73.1(a)).

Metropolitan Edison's licensing requirements with respect to receiving new fuel at the site could be met through AEC's issuance of a "fuel storage" license or an operating license. While a facility operating license grants authority to the licensee to receive, possess and use specified amounts of special nuclear material, scheduling dictates that the licensee seek authority to receive new fuel prior to the date anticipated for obtaining an operating license. Thus, Met Ed has applied on June 8, 1972, for such storage license which would authorize it to receive, possess, inspect, and store (but not to use) new fuel at the TMI site. In its application for the fuel storage license (which would be superseded by the granting of an operating license), Met Ed has detailed the special nuclear material for which it desires to be licensed, and has provided information on the mode of transportation, storage conditions, inspection and handling procedures, safety evaluation consideration, and radiation monitoring equipment and procedures.

Both Met Ed and the AEC have considered the anticipated environmental impact due to transportation of fresh fuel. Based on the low levels of radioactivity in unirradiated fuel assemblies, the high integrity of the fuel cladding, and the severe tests which the shipping container is required to have passed, Met Ed believes that the environmental effects of the transportation of new fuel assemblies from the fabrication plant to the reactor site are negligible. While the AEC in

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its Final Environmental Statement has estimated some exposure to transportation personnel and the general public (e.g., less than 1 millirem per shipment for individual transport workers), the AEC's conclusion is that under normal conditions there will be essentially no effect on the environment due to transport of new fuel.

Spent fuel has the same physical appearance as fresh fuel, however, as a result of the irradiation and fissioning of the uranium, fuel elements when recovered from a reactor contain large amounts of fission products and some plutonium. As the radioactive isotopes decay, radiation and heat are produced, the rates varying dependent upon the length of time after discharge from the reactor. In order to provide time for radioactive decay and resultant decreases in the level of radiation and heat emission rates, after discharge from the TMI 1 reactor, the fuel elements will be placed underwater in a storage pool for at least a four-month cooling period. During this period of time, the heat and radiation release rates would be expected to decrease by a factor of 100.

As shipped, spent fuel is classified as large quantity, Fissile Class material. Met Ed has contractual arrangements with the General Electric Co. under which GE will provide fuel recovery services for irradiated fuel discharged from TMI. Under that agreement, GE will arrange for the shipment of all spent fuel from the TMI site to the reprocessing facility, presently anticipated to be GE's Midwest Fuel Recovery Plant located near Morris, Illinois. It is anticipated that for both units at TMI, 15 rail carload shipments per year with 7 fuel elements per cask and 1 cask per carload will be required, and that shipment will be made in GE-designed and owned spent fuel casks. As has been described in detail heretofore, the licensing of a spent fuel cask requires that GE's design meet very stringent regulatory standards. On September 24, 1973, AEC by amendment 71-6 to GE's special nuclear materials license SNM-1270, authorized GE to employ the IF-300 spent fuel cask in the transport of irradiated fuel. GE's shipments of spent fuel from TMI 1 are not subject to AEC's requirements related to physical security in Part 73, since the spent fuel will be "special nuclear material which is not readily separable from other radioactive material and which has a total external radiation dose rate in excess of 100 rems per hour at a distance of 3 feet from any accessible surface without intervening shielding" (10 CFR §73.13(b)). Met Ed, under the Commission's regulations set down in 10 CFR §71.3 must satisfy certain licensing requirements before it can deliver any spent fuel to a carrier for transport to GE's reprocessing facility. Met Ed in a timely fashion will seek compliance with Part 71 by satisfying the general license requirements detailed in 10 CFR §71.12(b), including proper notification, by letter to the Director, Division of Materials

Licensing, of the information specified in §71.12(b)(1)(iii).

Both Met Ed in its Environmental Report and the AEC in the Final Environmental Statement for TMI have assessed the environmental impact due to the related transportation of irradiated fuel. It is Met Ed's position, in view of the shielding design of the shipping cask, including thick stainless steel inner and outer walls, several inches of depleted uranium for gamma shielding and a water jacket for additional neutron shielding, the internal cooling system capable of dissipating heat from fission products, and the demanding cumulative-effect safety tests required to be met by the container, that there will be no significant environmental effects from shipping irradiated fuel.

The AEC has estimated that the radiation level at 3 feet from the rail car carrying appropriately contained irradiated fuel will be about 25 mrem/hr. Based on this estimate, a member of the general public who spends 3 minutes at an average distance of 3 feet from the rail car might receive a dose of as much as 1.3 mrem. The AEC Statement also states that although the temperature of the air which contacts the spent fuel cask may be increased a few degrees, no appreciable thermal effects on the environment will result.

The radioactive waste material produced at TMI that will require packaging and transport from the site to an AEC licensed depository will be made up of compressible wastes (such as paper, rags, clothing and charcoal filters), incompressible wastes (such as spent filter cartridges), evaporator concentrates, spent resins, and used filter precoat. Subject to the packaging requirements already discussed, it is anticipated that those wastes will be shipped by truck--normally either in DOT standard carbon steel 55 gallon drums or in 50 cubic foot capacity disposable radioactive waste liners, unshielded or within shielded containers depending upon the level of radioactivity of the particular wastes.

Met Ed has selected as its contractor to handle the removal of radioactive wastes from the TMI site, ATCOR, Inc., an AEC licensee authorized to possess radioactive waste materials during transit in approved containers. It is expected that ATCOR, Inc., will ship radwaste by truck from TMI 1 to one of two AEC licensed disposal sites located in West Valley, New York and Moorehead, Kentucky. Selection of the most probable routing of such shipments is the responsibility of the radwaste contractor. No additional licenses are required of Met Ed under present regulations and the safeguarding requirements of Part 73 are not applicable since only trace quantities, if any, of special nuclear material are involved in radwaste shipment.

It has been estimated by AEC that for the 50 to 200 truckloads of solid radioactive wastes expected to be shipped offsite from both units at TMI, an individual truck

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driver who was to drive 25 truckloads in a year, might receive 400 mrem during the year. Similarly it is estimated that a member of the general public who spends 3 minutes at an average distance of 3 feet from the truck might receive a dose of as much as 1.2 mrem.

In summary, it is Met Ed's position that assurance the public health and safety will be protected in the transit of radioactive materials to and from TMI 1 is provided through industry's compliance with strict comprehensive regulatory requirements directed principally at the packaging of radioactive materials. Met Ed, like all other licensees concerned, is committed to abide by these regulatory requirements and will do so. Compliance with the criteria and standards embodied in the regulations furthermore can be expected to assure that any environmental effects from the transportation of fresh fuel to the site, spent fuel from the site to a reprocessing facility, and radioactive wastes from TMI to a licensed AEC disposal site will be minimal.

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TABLE QUANTITY LIMITS AS RELATED TO PACKAGE REQUIREMENTS

Transport Group	Examples	Exempt Quantity (curies)	Type A Package (curies)	Type B* Package (curies)
I	^{239}Pu, ^{242}Cm, ^{252}Cf	10^{-5}	10^{-3}	20
II	^{210}Bi, ^{90}Sr, ^{210}Po	10^{-4}	5×10^{-2}	20
III	^{137}Cs, ^{192}Ir, ^{131}Ir	10^{-3}	3	200
IV	^{76}As, ^{14}C, ^{45}Ca	10^{-3}	20	200
V	Noble gasses, ^{85}Kr	10^{-3}	20	5,000
VI	^{37}Ar, ^{133}Xe, ^{85}Kr uncompressed	10^{-3}	1,000	50,000
VII	Tritium - as a gas or in luminous paint	25	1,000	50,000
Special Form	Co^{60} radiography source, Pu-Be neutron source	10^{-3}	20	5,000

*A Large Quantity is defined as any quantity in excess of a Type B quantity.

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