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PAGE CHANGE

DOE 5480.1 Chg 3

5-1-81

SUBJECT: ENVIRONMENTAL PROTECTION, SAFETY, AND HEALTH PROTECTION
PROGRAM FOR DOE OPERATIONS

1. PURPOSE. This Page Change transmits a revised Attachment 1, a Table of Contents, and Chapter III of DOE 5480.1, ENVIRONMENTAL PROTECTION, SAFETY, AND HEALTH PROTECTION PROGRAM FOR DOE OPERATIONS, of 5-5-80.

2. EXPLANATION OF CHANGES.

- a. Attachment 1 has been revised to delete ERDAM 0529, which is replaced by the issuance of Chapter III.
- b. The Table of Contents has been revised to incorporate the added Chapter.
- c. Chapter III, SAFETY REQUIREMENTS FOR THE PACKAGING OF FISSILE AND OTHER RADIOACTIVE MATERIALS, is added.

3. FILING INSTRUCTIONS.

<u>Remove Page</u>	<u>Dated</u>	<u>Insert Page</u>	<u>Dated</u>
Atch 1, page 1 (and 2)	4-29-81	Atch 1, page 1 (and 2)	5-1-81
i and ii	12-18-80	i and ii	5-1-81
iii and iv	4-29-81	iii thru v	5-1-81
		III-1 thru III-20	5-1-81

b. After filing the attached pages, this transmittal may be discarded.

BY ORDER OF THE SECRETARY OF ENERGY:



William S. Heffelfinger
Director of Administration

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INITIATED BY:
Operational and Environmental
Safety Division

REFERENCES

Pending the issuances of additional supplementary chapters to this Order, the following may be used as guideline procedures and standards in the discharge of the Department's environmental protection, safety, and health protection program.

1. ERDAM 0511, RADIOACTIVE WASTE MANAGEMENT, of 9-19-73, which provides for minimizing radioactive exposure and associated risk to man and environment.
2. ERDAM 0527, RESPONSE TO ACCIDENTS INVOLVING NUCLEAR WEAPONS IN THE CUSTODY OF THE DOD, of 2-15-72, which provides for compliance with the AEC-DOD Memorandum of Understanding, of 6-10-70.
3. ERDAM 0528, CONTRACTOR OCCUPATIONAL MEDICAL PROGRAM, of 8-21-75, which establishes a program to protect contractor employees against health hazards in their work environment.
4. ERDAM 0550, OPERATIONAL SAFETY STANDARDS, of 3-26-73, which provides for assurance that all aspects of operations are conducted in accordance with specifically identified operational safety standards.

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CHAPTER XIII - AVIATION SAFETY (to be issued)

CHAPTER III

SAFETY REQUIREMENTS FOR THE PACKAGING OF FISSILE
AND OTHER RADIOACTIVE MATERIALS

1. PURPOSE. The purpose of this chapter is to establish requirements for the packaging of fissile and other radioactive materials.
2. SCOPE. This chapter applies to all Headquarters divisions, offices, field organizations, and contractors who are involved with the shipment of radioactive material and who are exempt from the licensing requirements of the Code of Federal Regulations, Title 10, Part 71. (Reference the Code of Federal Regulations, Title 10, Part 70.11, which exempts the Department of Energy and its contractors from the regulations of the Nuclear Regulatory Commission.)
3. REFERENCES.
 - a. Code of Federal Regulations, Title 10, Part 71, "Packaging of Radioactive Material for Transport."
 - b. Department of Transportation Regulations.
 - (1) Code of Federal Regulations, Title 49, Parts 100-189, "Hazardous Materials Regulations."
 - (2) Code of Federal Regulations, Title 46, Part 146, "Transportation or Storage of Military Explosives on Board Vessels."
 - c. International Atomic Energy Agency Safety Series No. 6, "Regulations for the Safe Transport of Radioactive Material," 1973 Revised Edition.
 - d. International Air Transport Association Restricted Article Regulations.
 - e. U.S. Air Force AFM-71-4, "Preparation of Hazardous Materials for Military Air Shipment."
 - f. American National Standards Institute Standard N14.5-1977, "American National Standard for Leakage Tests on Packages for Shipment of Radioactive Materials."
4. DEFINITIONS.
 - a. Carrier. Any person engaged in the transportation of passengers or property, as common, contract, or private carrier, or freight forwarder, as those terms are used in the Interstate Commerce Act, as amended, or by the U.S. Postal Service.

- b. Close Reflection by Water. Immediate contact by water of sufficient thickness to reflect a maximum number of neutrons.
- c. Containment Vessel. The receptacle on which principal reliance is placed to retain the radioactive material during transport.
- d. Fissile Classification. Classification of a package or shipment of fissile materials according to the controls needed to provide nuclear criticality safety during transportation as follows:
 - (1) Fissile Class I. Packages that may be transported in unlimited numbers and in any arrangement and that require no nuclear criticality safety controls during transportation. For purposes of nuclear criticality safety control, a transport index is not assigned to Fissile Class I packages. However, the external radiation levels may require a transport index number.
 - (2) Fissile Class II. Packages that may be transported in any arrangement but in numbers that do not exceed a transport index of 50. For purposes of nuclear criticality safety control, individual packages may have a transport index of not less than 0.1 and not more than 10. However, the external radiation levels may require a higher transport index number but not to exceed 10. Such shipments require no nuclear criticality safety control by the shipper during transportation.
 - (3) Fissile Class III. Shipments of packages that do not meet the requirements of Fissile Class I and II and that are controlled in transportation by special arrangements between the shipper and the carrier to provide nuclear criticality safety.
- e. Fissile Materials. Uranium-233, uranium-235, plutonium-238, plutonium-239, plutonium-241, neptunium-237, and curium-244.
- f. Limited Quantities of Radioactive Materials excepted from packaging, marking, labeling are described in Code of Federal Regulations, Title 49, Part 173.391.
- g. Low Specific Activity Material is material of low radioactivity level such as uranium ores and chemical concentrates of those ores. The low specific activity definition is in Code of Federal Regulations, Title 49, Part 173.389c. The shipping requirements are explained in Code of Federal Regulations, Title 49, Part 173.392.

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- h. Maximum Normal Operating Pressure. The maximum gauge pressure that is expected to develop in the containment vessel under the normal conditions of transport.
- i. Moderator. A material used to reduce the kinetic energy of neutrons by scattering collisions without appreciable neutron capture.
- j. Optimum Interspersed Hydrogenous Moderation. The occurrence of hydrogenous material between containment vessels to such an extent that the maximum nuclear reactivity results.
- k. Package. Packaging and its radioactive contents.
- l. Packaging. One or more receptacles and wrappers and their contents excluding fissile material and other radioactive material, but including absorbent material, spacing structures, thermal insulation, radiation shielding, devices for cooling and for absorbing mechanical shock, external fittings, neutron moderators, nonfissile neutron absorbers, and other supplementary equipment.
- m. Primary Coolant. A gas, liquid, or solid, or combination of them, in contact with radioactive material, or, if the material is in special form, in contact with its capsule, and used to remove decay heat.
- n. Special Form. To qualify as special form the radioactive material must either be in massive solid form or encapsulated. Special tests which are required of special form material are explained in the Code of Federal Regulations, Title 49, Part 173.398a.
- o. Transport Index. The number placed on a package to designate the degree of control to be exercised by the carrier during transportation. The transport index to be assigned to a package of radioactive material shall be determined by either paragraph (1) or (2) below, whichever is larger. The number expressing the transport index shall be rounded up to the next higher tenth; e.g., 1.01 becomes 1.1.
 - (1) The highest radiation dose rate in millirem per hour at 3 feet from any accessible external surface of the package.
 - (2) The transport index of each Fissile Class II package is calculated by dividing the number 50 by the number of such Fissile Class II packages that may be transported together as determined under the limitations of Code of Federal Regulations Title 10, Part 71.39.
- p. For other definitions (such as Type A or Type B quantities for packaging) refer to Code of Federal Regulations, Title 49, Parts 173.389 to 173.398 of the Department of Transportation regulations.

5. RESPONSIBILITIES AND AUTHORITIES.

- a. The Director, Operational and Environmental Safety Division, Office of Environment:
- (1) Administers the program for design review and issuance of Department of Energy Certificates of Compliance for Type B packaging.
 - (2) Assists field offices in securing waivers or exemptions for hazardous materials issued by the Department of Transportation. (Reference Code of Federal Regulations, Title 49, Parts 107.101-107.123, and 173.22a.)
 - (3) Prepares guidance criteria and procedures for application of package testing and quality assurance standards.
 - (4) Coordinates Department of Energy participation in the development and revision of transportation regulations.
 - (5) Provides a central point of coordination with the Nuclear Regulatory Commission for developing safety standards for transporting nuclear materials and design approvals bridging contractor and licensee packaging requirements.
 - (6) Conducts periodic appraisal to determine the adequacy of the implementation of this chapter except as provided in item 5d.
- b. Heads of Offices and Divisions, Headquarters, provide program guidance, instruction, and standards to assure the safe packaging of fissile and other radioactive materials, including:
- (1) Directing cognizant Heads of Field Organizations to require modifications of equipment, procedures, or practices and to coordinate budget requirements.
 - (2) Imposing additional requirements for packaging standards.
 - (3) Curtailing or suspending the use of specific packages, when necessary.
 - (4) Participating at their option in reviewing safety analysis reports.
- c. Heads of Field Organizations, consistent with guidance instructions, standards, and criteria issued pursuant to paragraph b above:

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- (1) Grant Department of Energy approval when required for packages that meet the standards of this chapter, and that are to be used for the transportation of fissile or other radioactive materials in greater than Type A quantities, and issue Certificates of Compliance for approved designs.
 - (2) Perform an objective evaluation of contractors' safety analysis reports for packaging designs.
 - (3) Grant Department of Energy approval for shipments made under the National Security Exemption provided to the Department of Energy and the Department of Defense under the Code of Federal Regulations, Title 49, Part 173.7b.
 - (4) Grant such alternatives to the requirements set forth in this chapter as will provide equivalent protection to life or property and to the common defense and security; and within 30 days after granting an alternative, provide the Director, Operational and Environmental Safety Division, a detailed report of the reasons for granting it. The granting of such alternatives is in no way to be construed as the granting of exemptions or exceptions from or to the Department of Transportation or other regulatory agency requirements.
 - (5) Conduct periodic appraisals to determine the adequacy of contractor performance in the implementation of this chapter, except as provided in item 5d.
- d. The Deputy Assistant Secretary for Naval Reactors is responsible for administering the program for design review and issuance of Department of Energy Certificates of Compliance for Naval Reactors packagings. The Deputy Assistant Secretary assumes the responsibility for conducting appraisals and the responsibilities of the Headquarters Office and Division Directors and Heads of Field Organizations for auditing the performance in appropriate programs.
6. EXEMPT QUANTITIES OF FISSILE MATERIALS. The following limited quantities of fissile material are exempt from the packaging requirements in the Code of Federal Regulations, Title 49, Part 173.396. This material must be packaged in accordance with other provisions for external radiation levels to meet Department of Transportation regulations.
- a. Not more than 15 grams of fissile material.
 - b. Thorium or uranium containing not more than 0.72 percent by weight of fissile material.
 - c. Uranium compounds, other than metal (e.g., uranium tetrafluoride, uranium hexafluoride, or uranium oxide in bulk form, not pelleted

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or fabricated into shapes), or aqueous solutions of uranium, in which the total amount of uranium-233 and plutonium present does not exceed 1 percent by weight of the uranium-235 content, and the total fissile content does not exceed 1 percent by weight of the total uranium content.

- d. Homogenous hydrogenous solutions or mixtures containing not more than:
- (1) 500 grams of any fissile material, provided the atomic ratio of hydrogen to fissile material is greater than 7600.
 - (2) 800 grams of uranium-235 provided that the atomic ratio of hydrogen to fissile material is greater than 5200 and the content of other fissile material is not more than 1 percent by weight of the total uranium-235 content.
 - (3) 500 grams of uranium-233 and uranium-235, provided that the atomic ratio of hydrogen to fissile material is greater than 5200 and the content of plutonium is not more than 1 percent by weight of the total uranium-233 and uranium-235 content.
- e. Less than 350 grams of fissile material, provided that there is not more than 5 grams of fissile material in any cubic foot within the package.

7. REQUIREMENTS.

- a. Federal Regulations. When offered to the carrier, each shipment of radioactive materials shall be in compliance with this chapter and the applicable safety regulations of the Department of Transportation, and follow the applicable packaging standards of the Nuclear Regulatory Commission (Code of Federal Regulations, Title 10, Parts 71.31 - 71.42), that as presently set forth provide a reasonable set of technical standards.
- b. Special Plutonium Air Shipment Requirements.
- (1) Departmental shipments of less than 10 microcuries of plutonium are exempt from specification packaging and marking and can be carried aboard any aircraft providing the conditions of Code of Federal Regulations, Title 49, Part 173.391 are met.
 - (2) Up to Type A2 quantities of plutonium may be shipped by air in a Type A packaging.
 - (3) More than Type A2 quantities of plutonium must be air shipped in the certified packaging, USA/0361/BF, or in a newly designed

packaging meeting the NUREG-0360 criteria. The form of more than 20 curies of plutonium must meet the standards of the Code of Federal Regulations, Title 10, Part 71.42.

- (4) Heads of Field Organizations shall notify the Director, Operational and Environmental Safety Division, when any air shipments of plutonium are completed. This information has been requested by Congress.

c. Other Regulations.

- (1) International Atomic Energy Agency Regulations. Each shipment of fissile and other radioactive materials consigned to a foreign country must meet the requirements set forth in International Atomic Energy Agency Safety Series No. 6, "Regulations for the Safe Transport of Radioactive Materials." Specifically, "Requirements for Packaging and for Delivery of Packages to Transport," must be met to be in compliance with this chapter. Packaging must be approved by appropriate national competent authorities. (Code of Federal Regulations, Title 49, Part 393 a, b.)
- (2) International Air Transport Association Restricted Article Regulations. Each shipment of fissile and other radioactive materials consigned to a foreign country must meet the requirements set forth in International Air Transport Association Restricted Article Regulations when shipped via commercial aircraft.
- (3) U.S. Air Force AFM-71-4, "Packaging and Handling of Dangerous Materials for Transport by Military Aircraft." Each shipment of fissile and other radioactive materials must meet the requirements set forth in AFM-71-4 when shipped via U.S. Air Force aircraft.

d. Package Standards for Radioactive Materials in Amounts Greater than Type A Quantities.

- (1) Packages of radioactive materials shall be prepared for shipment and transported in accordance with the provisions of this chapter. Department of Transportation specification containers for Type B and fissile materials are considered to meet the standards of this chapter and no specific Department of Energy Certificates of Compliance are required for this use when lading meets the specification. Packaging having a current Nuclear Regulatory Commission Certificate of Compliance can be used after registering with the Nuclear Regulatory Commission as a user.
- (2) Nuclear weapons and their components shall be packaged and transported in accordance with the standards in this chapter or

with other standards in Order DOE 5610.1, which provide a degree of safety at least equivalent to that provided by the Department of Energy and Department of Transportation regulations.

- (3) Packages shipped under the National Security Exemption of the Code of Federal Regulations, Title 49, Part 173.7b must be in compliance with the standards in this chapter and must also comply with the provisions of other pertinent Department of Energy orders.
 - (4) A quality assurance program must be established and implemented to assure that packages for radioactive materials are fabricated, maintained, and used in accordance with the regulations and approved design features.
- e. Department of Energy Certificates of Compliance for Packages of Radioactive Materials in Excess of Type A Quantities. Upon determination that a package design does in fact meet the requirements of this chapter, a Department of Energy Certificate of Compliance will be issued by the Department to the contractor.
 - f. Department of Energy as Consignor. When a Department of Energy field organization serves as the actual consignor, rather than a contractor, independent internal procedures shall be established by the responsible Head of the Field Organization to assure compliance with the standards contained in this chapter.
 - g. Waivers and Exemptions. Packages that do not meet the standards in the Department of Transportation Hazardous Materials Regulations and that do not qualify for shipment under the National Security Exemption may be shipped only under the provisions of a waiver or exemption issued by the Department of Transportation, or on public vehicles or aircraft if approved under the provisions of paragraph 5c, above. Applications for an exemption shall be prepared in accordance with the Code of Federal Regulations, Title 49, Part 107.103 and shall be forwarded through the Operational and Environmental Safety Division to the Department of Transportation.
8. PACKAGE STANDARDS.
- a. General Standards for All Packaging.
 - (1) Reference the Code of Federal Regulations, Title 10, Part 71.31.
 - (2) For determination of transport indexes for packaging, see paragraph 4o of this chapter.
 - (3) Excluded from the standards, testing requirements, packaging certification, and documentation described in this chapter are

low specific activity shipments consigned as exclusive use. The requirements for this type of shipment are contained in Code of Federal Regulations, Title 49, Part 173.392.

- (4) Type A packaging requirements are contained in Code of Federal Regulations, Title 49, Part 173.393 and Part 173.395.
- b. Structural Standards for Type B and Large Quantity Packaging.
Packaging used to ship a quantity of radioactive material larger than Type A shall be designed and constructed in compliance with the structural standards of this section. Standards different from those specified in this section may be approved by the Head of the Field Organization or other designated official if the controls proposed to be exercised by the shipper are demonstrated to be adequate to assure the safety of the shipment.
- (1) Load Resistance. Regarded as a simple beam support at its end along any major axis, packaging shall be capable of withstanding a static load, normal to and uniformly distributed along its length, equal to 5 times its fully loaded weight, without generating stress in any material of the packaging in excess of its yield strength.
 - (2) External Pressure. Packaging shall be adequate to assure that the containment vessel will suffer no loss of contents if subjected to an external pressure of 25 pounds per square inch gauge.
- c. Criticality Standards for Fissile Material Packages.
- (1) A package used for the transport of fissile material shall be so designed and constructed and its contents so limited that it would be subcritical if it is assumed that water leaks into the containment vessel, and:
 - (a) Water moderation of the contents occurs to the most reactive credible extent consistent with the chemical and physical form of its contents.
 - (b) The containment vessel is fully reflected on all sides by water.
 - (2) A package used for the transport of fissile material shall be so designed and constructed and its contents so limited that it would be subcritical if it is assumed that any contents of the package that are liquid during normal transport leak out of the containment vessel, and that the fissile material is then:
 - (a) In the most reactive credible configuration consistent with the chemical and physical form of the material.

- (b) Moderated by water outside of the containment vessel to the most reactive credible extent.
 - (c) Fully reflected on all sides by water.
 - (3) The Head of the Field Organization or other designated official may approve exceptions to the requirements of this section where the containment vessel incorporates special design features that would preclude leakage of liquids in spite of any single packaging error, and appropriate measures are taken before each shipment to verify the leak tightness of each containment vessel.
- d. Evaluation of a Single Package.
- (1) The effect of the transport environment on the safety of any single package of radioactive material shall be evaluated as follows:
 - (a) The ability of a package to withstand conditions likely to occur in normal transport shall be assessed by subjecting a single package of scale model, by test or other assessment, to the normal conditions of transport as specified in paragraph 8e below.
 - (b) The effect on a package of conditions likely to occur in an accident shall be assessed by subjecting a sample package or scale model, by test or other assessment, to the hypothetical accident conditions as specified in paragraph 8f below.
 - (2) Taking into account controls to be exercised by the shipper, the Head of the Field Organization or other designated official may permit the shipment to be evaluated together with or without the transporting vehicle for the purpose of one or more tests.
 - (3) Normal conditions of transport and hypothetical accident conditions different from those specified in paragraph 8e and 8f below, may be approved by the Head of the Field Organization or other designated official if the controls proposed to be exercised by the shipper are demonstrated to be adequate to assure the safety of the shipment.
- e. Standards for Normal Conditions of Transport for a Single Package.
- (1) A package used for the shipment of fissile material or more than Type A quantity of radioactive material shall be so designed and constructed, and its contents so limited, that under the normal conditions of transport specified in paragraph 11:
 - (a) There will be no release of radioactive materials from the containment vessel.

- (b) The effectiveness of the packaging will not be substantially reduced.
 - (c) There will be no mixture of gases or vapors in the package that could, through any credible increases of pressure or an explosion, significantly reduce the effectiveness of the package.
 - (d) Radioactive contamination of the liquid or gaseous primary coolant will not exceed 10^{-7} curies of activity of Group I radionuclides per milliliter, 5×10^{-6} curies of activity of Group II radionuclides per milliliter, 3×10^{-4} curies of activity of Group III and Group IV radionuclides per milliliter.
 - (e) There will be no loss of coolant or loss of operation of any mechanical cooling device.
- (2) A package used for the shipment of fissile material shall be designed and constructed, and its contents so limited, that under normal conditions of transport specified in paragraph 11, considered individually:
- (a) The package will be subcritical.
 - (b) The geometric form of the package contents would not be substantially altered.
 - (c) There will be no leakage of water into the containment vessel. This requirement need not be met if, in the evaluation of undamaged packages under paragraphs 8h, 8i, or 8j below, it has been assumed that moderation is present to such an extent as to cause maximum reactivity consistent with the chemical and physical form of the material.
 - (d) There will be no substantial reduction in the effectiveness of the packaging, including:
 - 1 Reduction by more than 5 percent in the total effective volume of the packaging on which nuclear safety is assessed.
 - 2 Reduction by more than 5 percent in the effective spacing on which nuclear safety is assessed between the center of the containment vessel and the outer surface of the packaging.
 - 3 Occurrence of any aperture in the outer surface of the packaging large enough to permit the entry of a 4-inch cube.

- (3) A package used for the shipment of more than Type A quantity of radioactive material shall be so designed and constructed, and its contents so limited, that under normal conditions of transport specified in paragraph 11 considered individually, the containment vessel would not be vented directly to the atmosphere.

f. Standards for Hypothetical Accident Conditions for a Single Package.

- (1) A package used for the shipment of more than Type A quantity of radioactive material shall be so designed and constructed and its contents so limited that if subjected to the sequence of the hypothetical accident conditions specified in paragraph 12, it will meet the following conditions:
 - (a) The reduction of shielding would not be sufficient to increase the external radiation dose rate to more than 1000 millirems per hour at 3 feet from the external surface of the package.
 - (b) No radioactive material would be released from the package except for gases and contaminated coolant containing total radioactivity exceeding neither:
 - 1 0.1 percent of the total radioactivity of the package contents.
 - 2 0.01 curie of Group I radionuclides, 0.5 curies of Group II radionuclides, 10 curies of Group III and Group IV radionuclides, and 1000 curies of inert gases irrespective of transport group.
- (2) A package used for the shipment of fissile material shall be so designed and constructed, and its contents so limited, that if subjected to the sequence of the hypothetical accident conditions specified in paragraph 12, the package would be subcritical. In determining whether this standard is satisfied, it shall be assumed that:
 - (a) The fissile material is in the most reactive credible configuration consistent with the damaged condition of the package and the chemical and physical form of the contents.
 - (b) Water moderation occurs to the most reactive credible extent consistent with the damaged condition of the package and the chemical and physical form of the contents.
 - (c) There is reflection by water on all sides and as close as is consistent with the damaged condition of the package.

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- g. Criticality Standards for Packaging Fissile Materials. The fissile characteristics of each package and array of packages shall be evaluated for criticality and the assignment of the proper fissile Class I, II, or III. The packaging standards of the Nuclear Regulatory Commission (Reference Section 3a of this chapter) are an acceptable set of technical standards to assist this evaluation.
9. QUALITY ASSURANCE PROCEDURES FOR THE FABRICATION, ASSEMBLY, AND TESTING OF OFFSITE SHIPPING CONTAINERS.
 - a. Establishment and Maintenance of Procedures. Each field organization shall require its contractors to establish and to maintain a quality assurance program to:
 - (1) Assure that the requisite standards of quality are met in the fabrication, assembly, and testing of each package.
 - (2) Assure that packages in use continue to meet the requisite standards of quality.
 - b. Elements of a Quality Assurance Program. For guidance in developing a comprehensive quality assurance program, see the Code of Federal Regulations, Title 10, Part 71, Appendix E, "Quality Assurance Criteria for Shipping Packages of Radioactive Material." Reference should also be made to Chapter II of this Order. The contractor's programs shall consist of a formal system of procedural and organizational arrangements that:
 - (1) Require that specific responsibilities be assigned to designated units (including those of the vendor, the fabricator, and the contractor) for assuring specified quality at all stages of construction.
 - (2) Designate codes, standards, and specifications for materials, equipment, methods of fabrication, testing, and performance.
 - (3) Provide for quality control of materials, equipment, and services in instances where these have not already been established by existing standards and specifications.
 - (4) Provide that quality assurance records are maintained in an auditable file during the service life of the container.
 - (5) Provide for a quality control method of determining that packagings procured for use from other sources, including contractors and subcontractors or from Nuclear Regulatory Commission licensees, meet the requirements of this chapter.

- (6) Establish acceptance criteria in terms of measurable characteristics and the effects of appropriate tests prescribed in paragraphs 11, 12, 14 and required in paragraph 8(c).
- (7) Provide for a program of routine maintenance inspection and, where necessary, retesting to assure that reusable containers continue to meet the applicable design standards.
- (8) Provide for required training, testing, and certification of manufacturing and inspection personnel involved in special processes, such as welding and nondestructive examination, and for the required certification of equipment and procedures used in the performance of special processes.
- (9) Field organizations provide for a periodic audit of the contractors' programs and new packaging to assess effectiveness of the quality assurance program.

10. OPERATING PROCEDURES.

- a. Establishment and Maintenance of Procedures. The shipper shall establish and maintain:
 - (1) Operating procedures adequate to assure that the determinations and controls required by this section are accomplished.
 - (2) Regular and periodic inspection procedures adequate to assure that the procedures required by paragraph (1) above are followed.
- b. Assumptions as to Unknown Properties. When the isotopic abundance, mass, concentration, degree of irradiation, degree of moderation, or other pertinent property of fissile material in any package is not known, the shipper shall package the fissile material as if the unknown properties have such credible values as will cause the maximum nuclear reactivity. Any special instructions needed to safely open the package are to be made available to the consignee.
- c. Preliminary Determinations.
 - (1) Prior to the first use of any packaging for the shipment of more than a Type A quantity of radioactive material or fissile materials, such packaging shall be inspected to ascertain that there are no cracks, pinholes, uncontrolled voids, or other defects that could significantly reduce its effectiveness.
 - (2) Prior to the first use of any packaging for the shipment of more than a Type A quantity of radioactive or fissile materials, where the maximum normal operating pressure will exceed 5 pounds per square inch

gauge, the containment vessel shall be tested to assure that it will not leak at an integral pressure 50 percent higher than the maximum normal operating pressure.

- (3) Packaging shall be marked conspicuously and durably with its model number. Prior to applying the model number, an inspection shall be made to determine that the packaging has been fabricated in accordance with the approved design.
- d. Routine Determinations. Prior to each use of a package for shipment of radioactive or fissile material, the shipper shall ascertain that the package with its contents satisfies the applicable requirements of paragraph 8 including determination that:
- (1) The packaging has not been significantly damaged.
 - (2) Any moderators and nonfissile neutron absorbers, if required, are as authorized.
 - (3) The closure of the package and any sealing gaskets present are free from defects.
 - (4) Any valve through which primary coolant can flow is protected against tampering.
 - (5) The internal gauge pressure of the package will not exceed, during the anticipated period of transport, the maximum normal operating pressure.
 - (6) Contamination of the primary coolant will not exceed, during the anticipated period of transport, the limits in paragraph 8e(1)(d).
- e. Records. The shipper shall maintain for 2 years or more a record of each shipment of fissile material and each shipment of amounts of radioactive material greater than Type A quantities in single packages, showing where applicable:
- (1) Identification of the packaging by model number and the number of the certificate of compliance.
 - (2) Details of any significant defects in the packaging, with the means employed to repair the defects and prevent their recurrence.
 - (3) Volume and identification of coolant.
 - (4) Type and quantity of material in each package, and the total quantity in each shipment.

- (5) For each item of irradiated fissile material:
 - (a) Identification by model number.
 - (b) Irradiation and decay history to the extent appropriate to demonstrate that its nuclear and thermal characteristics comply with approved conditions.
 - (c) Any abnormal or unusual condition relevant to radiation safety.
 - (6) Date of the shipment.
 - (7) For Fissile Class III, any special controls exercised.
 - (8) Name and address of the transferee.
 - (9) Address to which shipment was made.
 - (10) Results of the determination required by paragraphs 10c and 10d above.
- f. Documentation of Technical Backup Support for Specification, Certified, and Exempt Packagings. Packagings that have been certified by the Department of Energy as meeting Department of Transportation regulations and packagings for which specifications have been published by the Department of Transportation may be used by other Department of Energy shippers having authority to ship radioactive or fissile materials. If the Nuclear Regulatory Commission also certifies that the standards of the Code of Federal Regulations, Title 10, Part 71, licensees can be listed as users by the Nuclear Regulatory Commission and ship in the packagings to either Department of Energy contractors or to other licensees. Therefore, it is essential that technical information and limits pertinent to the construction and use of these packagings be available to all potential users. The following are requirements to meet these objectives:
- (1) Heads of Field Organizations shall require contractors under their jurisdiction to prepare a distributable document for each new specification or certified packaging designed, developed, and fabricated for offsite shipment of fissile and other radioactive materials in quantities exceeding Type A. Obsolete packagings no longer in use and containers used for onsite movement of materials are not subject to these documentation requirements unless they are reactivated, altered, or requested for use in offsite shipments. In such instances, the party or parties requiring reactivation or alterations shall prepare or have prepared the appropriate document.
 - (2) Each document shall provide, as a minimum, the information below (following the format in the Code of Federal Regulations, Title 10, Part 71.21-24 for guidance as appropriate):

- (a) A complete physical and technical description of the package.
 - (b) A safety analysis report for packaging including considerations for meeting the requirement for packaging and transport safety, nuclear criticality safety, and radiological safety, Type B packaging should meet the Type B hypothetical accident test conditions.
 - (c) Design and development information including pertinent data, analytical methods, and the results of the prescribed tests.
 - (d) Tables, graphs, drawings, pictures, and technical references as required to give a clear treatment of the subject.
- g. Notification Procedures for Shipment and Nonreceipt of Radioactive Materials. To reduce to a minimum the number of shipments that must ultimately be considered lost, the following procedures shall be implemented:
- (1) Prior to each shipment of fissile radioactive materials, or shipments of more than Type A quantity of radioactive material, the shipper shall notify the consignee of the dates of the shipment and of expected arrival. The shipper shall also notify each consignee of any special loading or unloading instructions prior to his first shipment.
 - (2) The consignee shall be requested to notify the shipper immediately at the end of 4 days after the estimated arrival date if the shipment has not been received. Prompt notification by telephone or teletype should be followed by receipted registered mail to provide a written notice.
 - (3) Lost, strayed, or stolen shipments that are not recovered or accounted for shall be reported to the field office transportation officer as an unusual occurrence. The cognizant field organization head shall determine if an investigation is warranted and advise the Operational and Environmental Safety Division of his or her decision at the time of the unusual occurrence report.
 - (4) For all radioactive material shipments, Type A, Type B, low specific activity, everything, a return receipt shall be requested. The shipper shall follow up on the shipment status if the return receipt is not received within one month.
11. NORMAL CONDITIONS OF TRANSPORT. Each of the following normal conditions of transport is to be applied separately to determine its effect on a package.

- a. Heat. Direct sunlight at an ambient temperature of 130 degrees Fahrenheit in still air.
- b. Cold. An ambient temperature of -40 degrees Fahrenheit in still air and shade.
- c. Pressure. Atmospheric pressure of 0.5 times standard atmospheric pressure.
- d. Vibration. Vibration is normally incident to transport.
- e. Water Spray. A water spray sufficiently heavy to keep the entire exposed surface of the package except the bottom continuously wet during a period of 30 minutes.
- f. Free Drop. Between 1-1/2 and 2-1/2 hours after the conclusion of the water spray test, a free drop through the distance specified below onto a flat essentially unyielding horizontal surface, striking the surface in a position for which maximum damage is expected.

Free Fall Distance

<u>Package Weight (pounds)</u>	<u>Distance (feet)</u>
Less than 10,000	4
10,000 to 20,000	3
20,000 to 30,000	2
More than 30,000	1

- g. Corner Drop. A free drop onto each corner of the package in succession or in the case of a cylindrical package, onto each quarter of each rim, from a height of 1 foot onto a flat essentially unyielding horizontal surface. This test applies only to packages which are constructed primarily of wood or fiberboard, and do not exceed 110 pounds gross weight, and to all Fissile Class II packages.
- h. Penetration. Impact of the hemispherical end of a vertical steel cylinder 1-1/4 inches in diameter and weighting 13 pounds, dropped from a height of 40 inches onto the exposed surface of the package which is expected to be more vulnerable to puncture. The long axis of the cylinder shall be perpendicular to the package surface.
- i. Compression. For packages not exceeding 10,000 pounds in weight, a compressive load equal to either 5 times the weight of the package or 2 pounds per square inch multiplied by the maximum horizontal cross section

of the package, whichever is greater. The load shall be applied during a period of 24 hours, uniformly against the top and bottom of the package in the position in which the package would normally be transported.

12. HYPOTHETICAL ACCIDENT CONDITIONS. The following hypothetical accident test conditions are to be applied sequentially, in the order indicated, to determine their cumulative effect on a package or array of packages:
 - a. Free Drop. A free drop through a distance of 30 feet onto a flat essentially unyielding horizontal surface, striking the surface in a position for which maximum damage is expected.
 - b. Puncture. A free drop through a distance of 40 inches striking in a position for which maximum damage is expected, the top end of a vertical cylindrical mild steel bar mounted on an essentially unyielding horizontal surface. The bar shall be 6 inches in diameter, with the top horizontal and its edge rounded to a radius of not more than 1/4 inch, and of such length as to cause maximum damage to the package, but not less than 8 inches long. The long axis of the bar shall be perpendicular to the unyielding horizontal surface.
 - c. Thermal. Exposure to a thermal test in which the heat input to the package is not less than that which would result from exposure of the whole package to a radiation environment of 1475 degrees Fahrenheit for 30 minutes with an emissivity coefficient of 0.9, assuming the surfaces of the package have an absorption coefficient of 0.8. The package shall not be cooled artificially until 3 hours after the test period unless it can be shown that the temperature on the inside of the package has begun to fall in less than 3 hours.
 - d. Water Immersion (fissile material packages only). Immersion in water to the extent that all portions of the package to be tested are under at least 3 feet of water for a period of not less than 8 hours.
13. TRANSPORT GROUPING OF RADIONUCLIDES. These groupings shall be in accordance with the Code of Federal Regulations, Title 49, Part 173.390.
14. TESTS FOR SPECIAL FORM MATERIAL.
 - a. Free Drop. A free drop through a distance of 30 feet onto a flat essentially unyielding horizontal surface, striking the surface in such a position as to suffer maximum damage.
 - b. Percussion. Impact of the flat circular end of a 1 inch diameter steel rod weighing 3 pounds, dropped through a distance of 40 inches. The capsule or material shall be placed on a sheet of lead, of hardness number 3.5 to 4.5 on the Vickers scale, and not more than 1 inch thick, supported by a smooth essentially unyielding surface.

- c. Heating. Heating in air to a temperature of 1475 degrees Fahrenheit and remaining at that temperature for a period of 10 minutes.
- d. Immersion. Immersion for 24 hours in water at room temperature. The water shall be a pH6 - pH8 with a maximum conductivity of 10 micromhos per centimeter.