

(Reprinted from 26 F. R., 352, January 18, 1961)

Title 10—ATOMIC ENERGY

Chapter I—Atomic Energy Commission

PART 20—STANDARDS FOR PROTECTION AGAINST RADIATION

Disposal of Radioactive Waste Material

On February 4, 1960, the Commission issued for public comment a proposed amendment to 10 CFR Part 20 designed to prohibit issuance of licenses which would authorize the disposal of radioactive waste material on privately owned sites by persons engaged in commercial radioactive waste disposal activities. The comments received by the Commission with respect to the proposed amendment have been considered by the Commission and are on file in the Commission's Public Document Room. The only changes which have been made in the proposed amendment as published in the *Federal Register* are that the amended section has been changed from 20.304 to 20.302, and that the words "Federal or State governments" have been changed to read "Federal government or by a State government."

Pursuant to the Administrative Procedure Act, notice is hereby given that the following amendment to Title 10, Chapter I, Part 20, "Standards for Protection Against Radiation," is adopted to be effective 30 days after publication in the *Federal Register*.

Section 20.302 is amended by the addition of the following statement at the end of the section:

The Commission will not approve any application for a license to receive licensed material from other persons for disposal on land not owned by the Federal government or by a State government.

Dated at Germantown, Md., this 6th day of January 1961.

For the Atomic Energy Commission.

WOODROW B. MCCOY,
Secretary.

F.R. Doc. 61-464; Filed, Jan. 17, 1961;
8:45 a.m.]

Rules and Regulations

Title 10—ATOMIC ENERGY

Chapter I—Atomic Energy Commission

PART 20—STANDARDS FOR PROTECTION AGAINST RADIATION

Statement of considerations. The Atomic Energy Commission's regulation 10 CFR, Part 20 is hereby republished for the purpose of incorporating into one document all amendments to the regulation to date, including the amendment published in the FEDERAL REGISTER on September 7, 1960, to become effective January 1, 1961.

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AUTHORITY: 10 CFR 20.1 to 20.601 issued under sec. 161, 48 Stat. 946, as amended; 42 U. S. C. 2201.

GENERAL PROVISIONS

§ 20.1 Purpose.

(a) The regulations in this part establish standards for protection against radiation hazards arising out of activities under licenses issued by the Atomic Energy Commission and are issued pursuant to the Atomic Energy Act of 1954 (68 Stat. 919).

(b) The use of radioactive material or other sources of radiation not licensed by the Commission is not subject to the regulations in this part. However, it is the purpose of the regulations in this part to control the possession, use, and transfer of licensed material by any licensee in such a manner that exposure to such material and to radiation from such material, when added to exposures to unlicensed radioactive material and to other unlicensed sources of radiation in the possession of the licensee, and to radiation therefrom, does not exceed the standards of radiation protection prescribed in the regulations in this part.

§ 20.2 Scope.

The regulations in this part apply to all persons who receive, possess, use or transfer byproduct material, source material, or special nuclear material under a general or specific license issued by the Commission pursuant to the regulations in Part 30, 40, or 70 of this chapter.

§ 20.3 Definitions.

(a) As used in this part:

(1) "Act" means the Atomic Energy Act of 1954 (68 Stat. 919) including any amendments thereto;

(2) "Airborne radioactive material" means any radioactive material dispersed in the air in the form of dusts, fumes, mists, vapors, or gases;

(3) "Byproduct material" means any radioactive material (except special nuclear material) yielded in or made radioactive by exposure to the radiation incident to the process of producing or utilizing special nuclear material;

(4) "Calendar quarter" means any period determined according to either of the following subdivisions:

(i) January 1 to March 31, inclusive; April 1 to June 30, inclusive; July 1 to September 30, inclusive; October 1 to December 31, inclusive; or

(ii) The first period in a calendar year of 13 complete, consecutive calendar weeks; the second period in a calendar year of 13 complete, consecutive calendar weeks; the third period in a calendar year of 13 complete, consecutive calendar weeks; the fourth period in a calendar year of 13 complete, consecutive

calendar weeks. If at the end of a calendar year there are any days not falling within a complete calendar week of that year, such days shall be included (for purposes of this part) within the last complete calendar week of that year. If at the beginning of any calendar year there are days not falling within a complete calendar week of that year, such days shall be included (for purposes of this part) within the last complete calendar week of the previous year.

No licensee shall change the method observed by him of determining calendar quarters for purposes of this part except at the beginning of a calendar year.

(5) "Commission" means the Atomic Energy Commission or its duly authorized representatives;

(6) "Government agency" means any executive department, commission, independent establishment, corporation, wholly or partly owned by the United States of America which is an instrumentality of the United States, or any board, bureau, division, service, office, officer, authority, administration, or other establishment in the executive branch of the Government;

(7) "Individual" means any human being;

(8) "Licensed material" means source material, special nuclear material, or byproduct material received, possessed, used, or transferred under a general or specific license issued by the Commission pursuant to the regulations in this chapter;

(9) "License" means a license issued under the regulations in Part 30, 40, or 70 of this chapter. "Licensee" means the holder of such license;

(10) "Occupational dose" includes exposure of an individual to radiation (i) in a restricted area; or (ii) in the course of employment in which the individual's duties involve exposure to radiation; provided, that "occupational dose" shall not be deemed to include any exposure of an individual to radiation for the purpose of medical diagnosis or medical therapy of such individual.

(11) "Person" means (i) any individual, corporation, partnership, firm, association, trust, estate, public or private institution, group, Government agency other than the Commission, any State, any foreign government or nation or any political subdivision of any such government or nation, or other entity; and (ii) any legal successor, representative, agent, or agency of the foregoing;

(12) "Radiation" means any or all of the following: alpha rays, beta rays, gamma rays, X-rays, neutrons, high-speed electrons, high-speed protons, and other atomic particles; but not sound or radio waves, or visible, infrared, or ultraviolet light;

(13) "Radioactive material" includes any such material whether or not subject to licensing control by the Commission;

(14) "Restricted area" means any area access to which is controlled by the licensee. "Restricted area" shall not in-

clude any areas used as residential quarters, although a separate room or rooms in a residential building may be set apart as a restricted area;

(15) "Source material" means any material except special nuclear material, which contains by weight one-twentieth of one percent (0.05 percent or more of (i) uranium, (ii) thorium, or (iii) any combination thereof;

(16) "Special nuclear material" means (i) plutonium, uranium 233, uranium enriched in the isotopes 233 or in the isotopes 235, and any other material which the Commission, pursuant to the provisions of section 51 of the act, determines to be special nuclear material, but does not include source material; or (ii) any material artificially enriched by any of the foregoing but does not include source material;

(17) "Unrestricted area" means any area entry into which is not controlled by the licensee, and any area used for residential quarters.

(b) Definitions of certain other words and phrases as used in this part are set forth in other sections, including:

(1) "Airborne radioactivity area" defined in § 20.209;

(2) "Radiation area" and "high radiation area" defined in § 20.202;

(3) "Personnel monitoring equipment" defined in § 20.202;

(4) "Survey" defined in § 20.201;

(5) Units of measurement of dose (rad, rem) defined in § 20.4;

(6) Units of measurement of radioactivity defined in § 20.5.

§ 20.4 Units of radiation dose.

(a) "Dose," as used in this part, is the quantity of radiation absorbed, per unit of mass, by the body or by any portion of the body. When the regulations in this part specify a dose during a period of time, the dose means the total quantity of radiation absorbed, per unit of mass, by the body or by any portion of the body during such period of time. Several different units of dose are in current use. Definitions of units as used in this part are set forth in paragraphs (b) and (c) of this section.

(b) The rad, as used in this part, is a measure of the dose of any ionizing radiation to body tissue in terms of the energy absorbed per unit mass of the tissue. One rad is the dose corresponding to the absorption of 100 ergs per gram of tissue. (One millirad (mrad) = 0.001 rad.)

(c) The rem, as used in this part, is a measure of the dose of any ionizing radiation to body tissue in terms of its estimated biological effect relative to a dose of one roentgen (r) of X-rays. (One millirem (mrem) = 0.001 rem.) The relation of the rem to other dose units depends upon the biological effect under consideration and upon the conditions of irradiation. For the purpose of the regulations in this part, any of the following is considered to be equivalent to a dose of one rem:

- (1) A dose of 1 r due to X- or gamma radiation;
- (2) A dose of 1 rad due to X-, gamma, or beta radiation;
- (3) A dose of 0.1 rad due to neutrons or high energy protons;
- (4) A dose of 0.05 rad due to particles

heavier than protons and with sufficient energy to reach the lens of the eye;

If it is more convenient to measure the neutron flux, or equivalent, than to determine the neutron dose in rads, as provided in subparagraph (3) of this paragraph, one rem of neutron radiation may, for purposes of the regulations in this part, be assumed to be equivalent to 14 million neutrons per square centimeter incident upon the body; or, if there exists sufficient information to estimate with reasonable accuracy the approximate distribution in energy of the neutrons, the incident number of neutrons per square centimeter equivalent to one rem may be estimated from the following table:

NEUTRON FLUX DOSE EQUIVALENT

Neutron energy (MeV)	Number of neutrons per square centimeter equivalent to a dose of 1 rem (neutrons/cm ²)	Average flux to deliver 100 millirem in 40 hours (neutrons/cm ² per sec.)
Thermal.....	900×10 ⁶	670
0.001.....	720×10 ⁶	500
0.005.....	820×10 ⁶	570
0.02.....	400×10 ⁶	280
0.1.....	120×10 ⁶	80
0.5.....	45×10 ⁶	30
1.0.....	28×10 ⁶	20
2.0.....	20×10 ⁶	15
5.0.....	15×10 ⁶	12
10.....	14×10 ⁶	11
10 to 20.....	14×10 ⁶	10

(d) For determining exposures to X or gamma rays up to 3 Mev, the dose limits specified in §§ 20.101 to 20.104, inclusive, may be assumed to be equivalent to the "air dose". For the purpose of this part "air dose" means that the dose is measured by a properly calibrated appropriate instrument in air at or near the body surface in the region of highest dosage rate.

§ 20.5 Units of radioactivity.

(a) Radioactivity is commonly, and for purposes of the regulations in this part shall be, measured in terms of disintegrations per unit time or in curies. One curie (c) = 3.7×10^{10} disintegrations per second (dps) = 2.2×10^6 disintegrations per minute (dpm). A commonly used submultiple of the curie is the microcurie (μc). One μc = 0.000001 c = 3.7×10^4 dps = 2.2×10^3 dpm.

(b) For purposes of the regulations in this part, it may be assumed that the daughter activity concentrations in the following table are equivalent to an air concentration of 10^{-7} microcuries of Radon 222 per milliliter of air in equilibrium with the daughters RaA, RaB, RaC, and RaC'.

Maximum time between collection and measurement (hours)	Alpha-emitting daughter activity collected per milliliter of air	Total alpha disintegrations per minute per cc.
0.5.....	1.2×10^{-6}	0.14
1.....	4.5×10^{-6}	0.10
2.....	1.3×10^{-5}	0.028
3.....	0.5×10^{-5}	0.0072

The duration of sample collection and the duration of measurement should be sufficiently short compared to the time between collection and measurement, as not to have a statistically significant effect upon the results.

(c) Natural uranium and natural thorium. (1) For purposes of the regulations in this part, one curie of natural uranium (U-natural in Appendix B or C) means the sum of 3.7×10^{10} disintegrations per second from U-238 plus 3.7×10^8 dis/sec from U-234 plus 9×10^4 dis/sec from U-235. Also, a curie of natural thorium (thorium-natural in Appendix B or C) means the sum of 3.7×10^{10} dis/sec from Th-232 plus 3.7×10^8 dis/sec from Th-230.

(2) For the purpose of the regulations in this part, one curie of natural uranium (U-natural in Appendix B or C) is equivalent to 3,000 kilograms, or 6,615 pounds of natural uranium; and one curie of natural thorium (thorium-natural in Appendix B or C) is equivalent to 9,000 kilograms or 19,800 pounds of natural thorium.

§ 20.6 Interpretations.

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.

§ 20.7 Communications.

All communications and reports concerning the regulations in this part, and applications filed under them, should be addressed to the Atomic Energy Commission, Washington 25, D.C., Attention: Division of Licensing and Regulation. Communications and reports may be delivered in person at the Commission's offices at 1717 H Street NW, Washington, D.C., or its offices at Germantown, Md.

§ 20.101 Exposure of individuals to radiation in restricted areas.

(a) Except as provided in paragraph (b) of this section, no licensee shall possess, use, or transfer licensed material in such a manner as to cause any individual in a restricted area to receive in any period of one calendar quarter from radioactive material and other sources of radiation in the licensee's possession a dose in excess of the limits specified in the following table:

Dose per calendar quarter

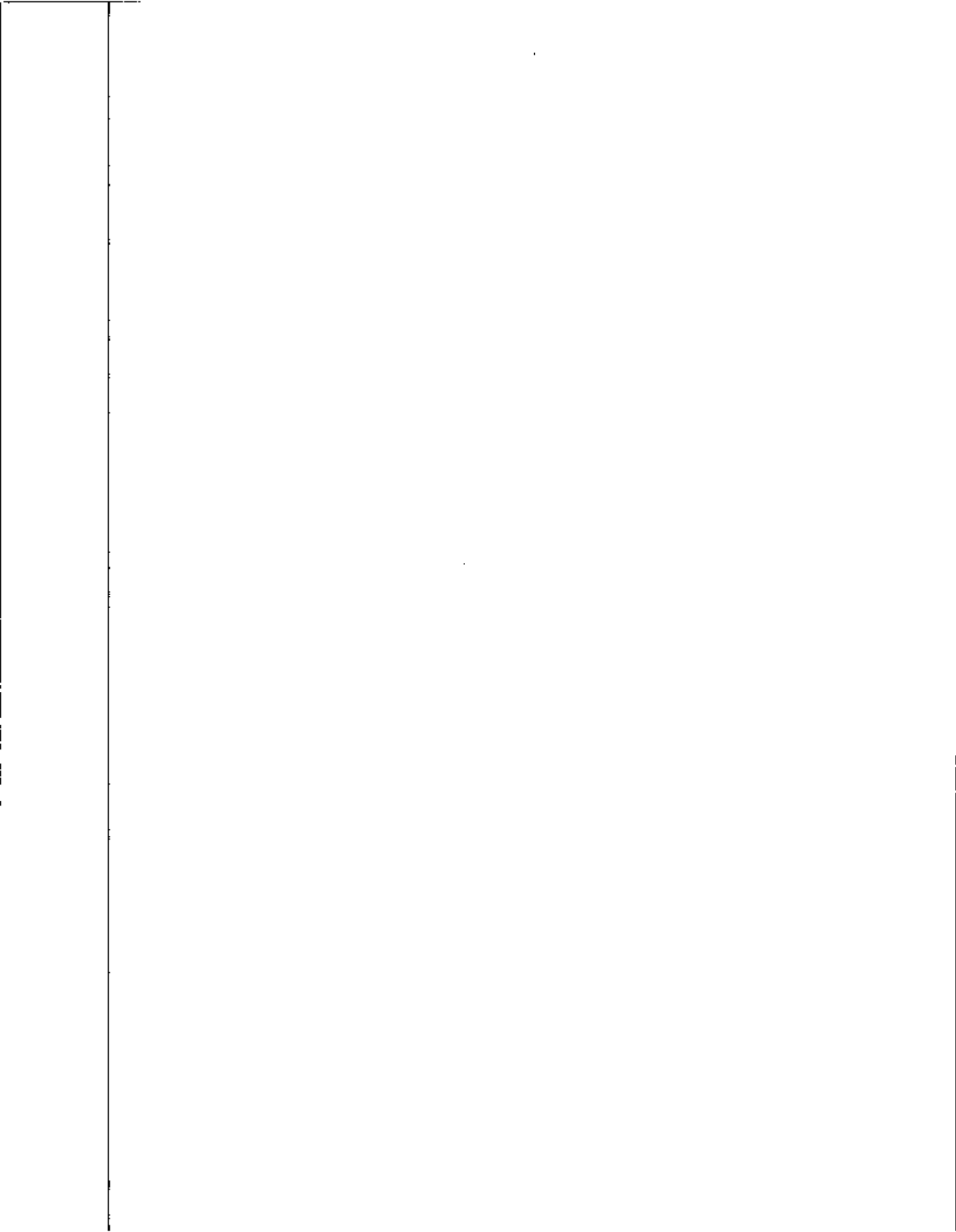
1. Whole body; head and trunk; active blood-forming organs; lens of eye; or gonads..... 1%
2. Hands and forearms; feet and ankles..... 10%
3. Skin of whole body..... 7%

(b) A licensee may permit an individual in a restricted area to receive a dose to the whole body greater than that permitted under paragraph (a) of this section, provided:

(1) During any calendar quarter the dose to the whole body from radioactive material and other sources of radiation in the licensee's possession shall not exceed 3 rads; and

(2) The dose to the whole body, when added to the accumulated occupational dose to the whole body, shall not exceed 5 (N-15) rads where "N" equals the individual's age in years at his last birthday; and

(3) The licensee has determined the individual's accumulated occupational dose to the whole body on Form AEC-4.



(Reprinted from 25 F. R., 13952, December 30, 1960)

Title 10—ATOMIC ENERGY**Chapter I—Atomic Energy
Commission****PART 20—STANDARDS FOR PROTECTION
AGAINST RADIATION****Statement of Considerations**

On September 7, 1960 the Commission published in the *FEDERAL REGISTER* amendments to 10 CFR Part 20 to become effective January 1, 1961. The amendments were designed to bring the Commission's radiation protection standards into accord with the most recent recommendations of the Federal Radiation Council and the National Committee on Radiation Protection and Measurements. Subsequent to publication of the amendments on September 7, 1960, the Commission has received several comments from interested parties requesting clarification and corrections of certain sections of the regulation. The following amendments are designed to clarify and correct the regulation in the following respects:

1. Section 20.3(a)(4) of the regulation permits licensees to determine calendar quarters either (1) as successive 3-month calendar periods starting on January 1 of a year or (2) as successive periods of 13 complete consecutive weeks starting with the first complete calendar week of the year. Film badge processors have indicated that method (1) of determining calendar quarters would present problems to the industry in that every user of film badges on a monthly basis would be required to start his use on the first day of each month, thereby resulting a large influx of badges to be processed at that time of the month with only a few badges during the balance of the month. They have indicated that method (2) of determining calendar quarters is also unsatisfactory in that users of film badges on a two-week calendar basis could not keep records for a 13-week calendar quarter. Since the purpose of the regulation in defining a calendar quarter is limited to assuring that the exposure of individuals during a period of approximately 3 months is restricted to specified amounts, § 20.3(a)(4)(i) is amended to permit 3-month

"calendar quarters" to start on any date within January, April, July or October rather than only on the first of the month; and to permit "calendar quarters" determined on a weekly basis to consist of alternating 14-week and 12-week periods, rather than only 13-week periods.

2. Section 20.206(c) requires Form AEC-3, (Notice to Employees), to be posted in every establishment where licensed activities are carried on regardless of whether any restricted areas which require radiation protection control measures exist in such establishment. Some licensees have pointed out that this requirement is unduly burdensome since posting of a Notice in unrestricted areas will result in many employees not working in restricted areas, nor even engaged in work with licensed material, becoming needlessly concerned as to the applicability of the poster to their activities. Since the purpose of the Notice is solely to assure that an employee working in or frequenting a restricted area would be made aware of the information contained in the poster, § 20.206(c) is amended to require posting in such locations as to assure that employees working in or frequenting restricted areas will observe the Notice on the way to or from work.

3. Section 20.3(a)(14) of the regulation defines "Restricted area" in part as any area access to which is controlled by the licensee. Some licensees have requested clarification of the definition since access is controlled to many areas which have no relation to radioactive material. The definition has been changed by adding the phrase "for purposes of protection of individuals from exposure to radiation and radioactive materials". A corresponding change has been made in the definition of an unrestricted area in § 20.3(a)(17).

4. The Appendix "B" note in the regulation specifies methods of general applicability for determining limits for concentrations where there is a mixture in air or water of more than one radionuclide. It was not contemplated that these methods would necessarily apply in determining concentration limits for unique complex mixtures such as uranium ore dust. The concentration limit for the mixture of radionuclides in

uranium ore dust calculated in accordance with these methods is lower by a factor of about 4 than previous concentration limits used for uranium ore dust. The uranium mill licensees have questioned the applicability of the Appendix "B" note methods for deriving a limit for uranium ore dust. The reduction in the limit for uranium ore dust is due to the fractional contribution of the unusually low limit for the radionuclide Thorium-230. The limit for Thorium-230 is based on a retention half-time in the lung of 4 years for pure thorium compounds. However, Thorium-230 does not appear in uranium ore dust as pure thorium compounds. The radionuclides in uranium ore dust of major health concern consist primarily of particles of insoluble uranium, which account for about 99.99 percent of the radionuclides with respect to mass, in secular equilibrium with the daughter products Thorium-230 and Radium-226 which are probably interspersed in a matrix within the uranium particle. Because of the unique physical and chemical state of the mixture of radionuclides in uranium ore dust, it does not appear appropriate to use the retention time for pure Thorium-230 as the basis for establishing a limit for ore dust. Rather, it appears desirable to use a single retention time for the mixture based upon the characteristics of the dust particle in which the radionuclides are fixed in insoluble form.

Accordingly, Appendix "B" note has been modified by adding paragraph 4 to establish concentration limits which are specifically applicable to uranium ore dust in air. It is assumed in deriving the new limits that the retention half-life of the individual radionuclides are governed not by their individual characteristics in the pure chemical state but by the characteristics of the dust particles in which the radionuclides are contained. For this purpose, a half-life of 120 days is used. This follows the practice of the International Commission on Radiological Protection and the National Committee on Radiation Protection in using a 120 day half-life for all insoluble materials in the lung except thorium and plutonium. This problem is under study by the Commission and by the Federal Radiation Council and the

limits specified should be considered interim values pending the result of such studies. Appropriate revisions will be made in the limits if the studies indicate a need therefor.

Inasmuch as these amendments are intended to relieve from rather than to impose restrictions under regulations currently in effect and will not adversely affect the public health and safety, the Commission has found that general notice of proposed rule-making and public procedure thereon are unnecessary and good cause exists why these amendments should be made effective as of January 1, 1961, the effective date of previously published amendments to Part 30.

Notice is hereby given that effective January 1, 1961, Part 20, Title 10, Code of Federal Regulations, "Standards for Protection Against Radiation," as amended on September 7, 1960 (25 F.R. 8595) is further amended in the following respects:

1. Amend § 20.3(a)(4)(i) to read as follows:

(i) The first period of any year may begin on any date in January; provided that the second, third and fourth periods accordingly begin on the same date in April, July, and October, respectively, and that the fourth period extend into January of the succeeding year, if necessary to complete a three-month quarter. During the first year of use of this method of determination by a licensee, the first period for that year shall also include any additional days in January preceding the starting date for the first period.

2. After the first sentence in § 20.3(a)(4)(ii) add the following sentence: "Alternatively, the four periods may consist of the first 14 complete, consecutive calendar weeks; the next 12 complete, consecutive calendar weeks; the next 14 complete, consecutive calendar weeks; and the last 12 complete, consecutive calendar weeks."

3. Amend § 20.3(a)(14) to read as follows:

(14) "Restricted area" means any area access to which is controlled by the licensee for purposes of protection of individuals from exposure to radiation and radioactive materials. "Restricted area" shall not include any areas used as residential quarters, although a separate room or rooms in a residential building may be set apart as a restricted area;

4. Amend § 20.3(a)(17) to read as follows:

(17) "Unrestricted area" means any area access to which is not controlled by the licensee for purposes of protection of individuals from exposure to radiation and radioactive materials, and any area used for residential quarters.

5. Amend § 20.206(c) to read as follows:

(c) Form AEC-3, "Notice to Employees", shall be conspicuously posted in a sufficient number of places in every establishment where employees are employed in activities licensed by the Commission to permit employees working in or frequenting any portion of a restricted area to observe a copy on the way to or from their place of employment.

6. Add the following paragraph 4 to the note in Appendix "B":

4. If the mixture of radionuclides consists of uranium and its daughter products in ore dust prior to chemical processing of the uranium ore, the values specified below may be used in lieu of those determined in accordance with paragraph 1 above or those specified in paragraphs 2 and 3 above.

a. For purposes of Table I, Col. 1— 1×10^{-4} $\mu\text{Ci/ml}$ gross alpha activity; or 2.5×10^{-4} $\mu\text{Ci/ml}$ natural uranium; or 75 micrograms per cubic meter of air natural uranium.

b. For purposes of Table II, Col. 1— 8×10^{-4} $\mu\text{Ci/ml}$ gross alpha activity; or 8×10^{-4} $\mu\text{Ci/ml}$ natural uranium; or 3 micrograms per cubic meter of air natural uranium.

Dated at Germantown, Md., this 23d day of December 1960.

For the Atomic Energy Commission,
Woodford B. McCool,
Secretary.

[F.R. Doc. 60-12107; Filed, Dec. 29, 1960;
8:40 a.m.]

or on a clear and legible record containing all the information required in that form; and has otherwise complied with the requirements of § 20.102. As used in paragraph (b), "Dose to the whole body" shall be deemed to include any dose to the whole body, gonads, active blood-forming organs, head and trunk, or lens of eye.

§ 20.102 Determination of accumulated dose.

(a) This section contains requirements which must be satisfied by licensees who propose, pursuant to paragraph (b) of § 20.101, to permit individuals in a restricted area to receive exposure to radiation in excess of the limits specified in paragraph (a) of § 20.101.

(b) Before permitting any individual in a restricted area to receive exposure to radiation in excess of the limits specified in paragraph (a) of § 20.101, each licensee shall:

(1) Obtain a certificate on Form AEC-4, or on a clear and legible record containing all the information required in that form, signed by the individual showing each period of time after the individual attained the age of 18 in which the individual received an occupational dose of radiation; and

(2) Calculate on Form AEC-4 in accordance with the instructions appearing therein, or on a clear and legible record containing all the information required in that form, the previously accumulated occupational dose received by the individual and the additional dose allowed for that individual under § 20.101(b).

(c) (1) In the preparation of Form AEC-4, or a clear and legible record containing all the information required in that form, the licensee shall make a reasonable effort to obtain reports of the individual's previously accumulated occupational dose. For each period for which the licensee obtains such reports, the licensee shall use the dose shown in the report in preparing the form. In any case where a licensee is unable to obtain reports of the individual's occupational dose for a previous complete calendar quarter, it shall be assumed that the individual has received the occupational dose specified in whichever of the following columns apply:

Part of body	Column 1 Assumed exposure in rads for calendar quarters prior to Jan. 1, 1961	Column 2 Assumed exposure in rads for calendar quarters beginning Jan. 1, 1961
Whole body, gonads, active blood-forming organs, head and trunk, lens of eye.	3%	1%

(2) The licensee shall retain and preserve records used in preparing Form AEC-4.

If calculation of the individual's accumulated occupational dose for all periods prior to January 1, 1961 yields a result higher than the applicable accumulated dose value for the individual as of that date, as specified in paragraph (b) of § 20.101, the excess may be disregarded.

§ 20.103 Exposure of individuals in concentrations of radioactive material in restricted areas.

(a) No licensee shall possess, use or transfer licensed material in such a manner as to cause any individual in a restricted area to be exposed to airborne radioactive material possessed by the licensee in an average concentration in excess of the limits specified in Appendix B, Table I, of this part. "Exposure" as used in this section means that the individual is present in an airborne concentration. No allowance shall be made for the use of protective clothing or equipment, or particle size, except as authorized by the Commission pursuant to paragraph (c) of this section.

(b) The limits given in Appendix B, Table I, of this part are based upon exposure to the concentrations specified for forty hours in any period of seven consecutive days. In any such period where the number of hours of exposure is less than forty, the limits specified in the table may be increased proportionately. In any such period where the number of hours of exposure is greater than forty, the limits specified in the table shall be decreased proportionately.

(c) (1) Except as authorized by the Commission pursuant to this paragraph, no allowance shall be made for particle size or the use of protective clothing or equipment in determining whether an individual is exposed to an airborne concentration in excess of the limits specified in Appendix B, Table I.

(2) The Commission may authorize a licensee to expose an individual in a restricted area to airborne concentrations in excess of the limits specified in Appendix B, Table I, upon receipt of an application demonstrating that the concentration is composed in whole or in part of particles of such size that such particles are not respirable; and that the individual will not inhale the concentrations in excess of the limits established in Appendix B, Table I. Each application under this subparagraph shall include an analysis of particle sizes in the concentrations; and a description of the methods used in determining the particle sizes.

(3) The Commission may authorize a licensee to expose an individual in a restricted area to airborne concentrations in excess of the limits specified in Appendix B, Table I, upon receipt of an application demonstrating that the individual will wear appropriate protective equipment and that the individual will not inhale, ingest or absorb quantities of radioactive material in excess of those which might otherwise be permitted under this part for employees in restricted areas during a 40-hour week. Each application under this subparagraph shall contain the following information:

(i) A description of the protective equipment to be employed, including the efficiency of the equipment for the material involved;

(ii) Procedures for the fitting, maintenance and cleaning of the protective equipment; and

(iii) Procedures governing the use of the protective equipment, including supervisory procedures and length of time

the equipment will be used by the individuals in each work week. The proposed periods for use of the equipment by any individual should not be of such duration as would discourage observance by the individual of the proposed procedures; and

(iv) The average concentrations present in the areas occupied by employees.

§ 20.104 Exposure of minors.

(a) No licensee shall possess, use or transfer licensed material in such a manner as to cause any individual within a restricted area who is under 18 years of age, to receive in any period of one calendar quarter from radioactive material and other sources of radiation in the licensee's possession a dose in excess of 10 percent of the limits specified in the table in paragraph (a) of § 20.101.

(b) No licensee shall possess, use or transfer licensed material in such a manner as to cause any individual within a restricted area, who is under 18 years of age to be exposed to airborne radioactive material possessed by the licensee in an average concentration in excess of the limits specified in Appendix B, Table II of this part. For purposes of this paragraph, concentrations may be averaged over periods not greater than a week.

(c) The provisions of paragraph (c) of § 20.103, shall apply to exposures subject to paragraph (b) of this section.

§ 20.105 Permissible levels of radiation in unrestricted areas.

(a) There may be included in any application for a license or for amendment of a license proposed limits upon levels of radiation in unrestricted areas resulting from the applicant's possession or use of radioactive material and other sources of radiation. Such applications should include information as to anticipated average radiation levels and anticipated occupancy times for each unrestricted area involved. The Commission will approve the proposed limits if the applicant demonstrates that the proposed limits are not likely to cause any individual to receive a dose to the whole body in any period of one calendar year in excess of 0.5 rem.

(b) Except as authorized by the Commission pursuant to paragraph (a) of this section, no licensee shall possess, use or transfer licensed material in such a manner as to create in any unrestricted area from radioactive material and other sources of radiation in his possession:

(1) Radiation levels which, if an individual were continuously present in the area, could result in his receiving a dose in excess of two millirems in any one hour; or

(2) Radiation levels which, if an individual were continuously present in the area, could result in his receiving a dose in excess of 100 millirems in any seven consecutive days.

§ 20.106 Concentrations in effluents to unrestricted areas.

(a) There may be included in any application for a license or for amendment of a license proposed limits upon concentrations of licensed and other radioactive material released into air or water in unrestricted areas as a result

of the applicant's proposed activities. Such applications should include information as to anticipated average concentrations and anticipated occupancy times for each unrestricted area involved. The Commission will approve the proposed limits if the applicant demonstrates that it is not likely that any individual will be exposed to concentrations in excess of the limits specified in Appendix B, Table II, of this part. For purposes of this paragraph concentrations may be averaged over periods not greater than one year.

(b) Except as authorized by the Commission pursuant to § 20.202 or paragraph (a) of this section, no licensee shall possess, use or transfer licensed material in such a manner as to release into air or water in any unrestricted area any concentration of radioactive material in excess of the limits specified in Appendix B, Table II, of this part. For purposes of this paragraph, concentrations may be averaged over periods not greater than one year.

(c) For purposes of this section, determinations as to the concentration of radioactive material shall be made with respect to the point where such material leaves the restricted area. Where the radioactive material is discharged through a stack, tube, pipe, or similar conduit, the determination may be made with respect to the point where the material leaves such conduit.

(d) The provisions of this section do not apply to disposal of radioactive material into sanitary sewerage systems (see § 20.243).

§ 20.167 Medical diagnosis and therapy.

Nothing in the regulations in this part shall be interpreted as limiting the intentional exposure of patients to radiation for the purpose of medical diagnosis or medical therapy.

§ 20.108 Orders requiring furnishing of bio-assay services.

Where necessary or desirable in order to aid in determining the extent of an individual's exposure to concentrations of radioactive material, the Commission may incorporate appropriate provisions in any license, directing the licensee to make available to the individual appropriate bio-assay services and to furnish a copy of the reports of such services to the Commission.

PRECAUTIONARY PROCEDURES

§ 20.201 Surveys.

(a) As used in the regulations in this part, "survey" means an evaluation of the radiation hazards incident to the production, use, release, disposal, or presence of radioactive materials or other sources of radiation under a specific set of conditions. When appropriate, such evaluation includes a physical survey of the location of materials and equipment, and measurements of levels of radiation or concentrations of radioactive material present.

(b) Each licensee shall make or cause to be made such surveys as may be necessary for him to comply with the regulations in this part.

§ 20.202 Personnel monitoring.

(a) Each licensee shall supply appropriate personnel monitoring equipment

to, and shall require the use of such equipment by:

(1) Each individual who enters a restricted area under such circumstances that he receives, or is likely to receive, a dose in any calendar quarter in excess of 25 percent of the applicable value specified in paragraph (a) of § 20.101.

(2) Each individual under 18 years of age who enters a restricted area under such circumstances that he receives, or is likely to receive, a dose in any calendar quarter in excess of 5 percent of the applicable value specified in paragraph (a) of § 20.101.

(3) Each individual who enters a high radiation area.

(b) As used in this part,

(1) "Personal monitoring equipment" means devices designed to be worn or carried by an individual for the purpose of measuring the dose received (e. g., film badges, pocket chambers, pocket dosimeters, film rings, etc.);

(2) "Radiation area" means any area, accessible to personnel, in which there exists radiation, originating in whole or in part within licensed material, at such levels that a major portion of the body could receive in any one hour a dose in excess of 5 millirem, or in any 5 consecutive days a dose in excess of 100 millirems;

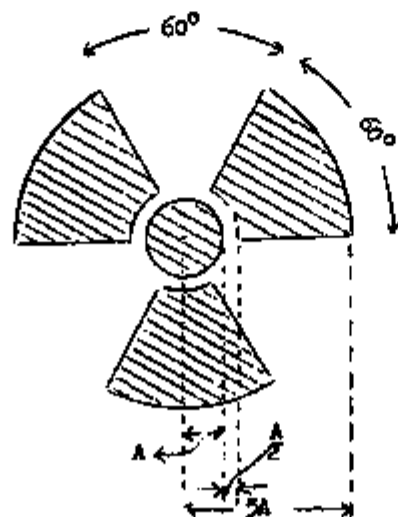
(3) "High radiation area" means any area, accessible to personnel, in which there exists radiation originating in whole or in part within licensed material at such levels that a major portion of the body could receive in any one hour a dose in excess of 100 millirem.

§ 20.203 Caution signs, labels, and symbols.

(a) General. (1) Except as otherwise authorized by the Commission, symbols prescribed by this section shall use the conventional radiation caution colors (magenta or purple on yellow background). The symbol prescribed by this section is the conventional three-bladed design:

RADIATION SYMBOL

1. Cross-hatched area is to be magenta or purple.
2. Background is to be yellow.



(2) In addition to the contents of signs and labels prescribed in this section, licensees may provide on or near such signs and labels any additional information which may be appropriate in aiding individuals to minimize exposure to radiation or to radioactive material.

(b) Radiation areas. Each radiation area shall be conspicuously posted with a sign or signs bearing the radiation caution symbol and the words:

CAUTION: RADIATION AREA

(c) High radiation areas. (1) Each high radiation area shall be conspicuously posted with a sign or signs bearing the radiation caution symbol and the words:

CAUTION: HIGH RADIATION AREA

(2) Each high radiation area shall be equipped with a control device which shall either cause the level of radiation to be reduced below that at which an individual might receive a dose of 100 millirem in one hour upon entry into the area or shall energize a conspicuous visible or audible alarm signal in such a manner that the individual entering and the licensee or a supervisor of the activity are made aware of the entry. In the case of a high radiation area established for a period of 30 days or less, such control device is not required.

(d) Airborne radioactivity areas. (1) As used in the regulations in this part, "airborne radioactivity area" means (i) any room, enclosure, or operating area in which airborne radioactive materials, composed wholly or partly of licensed material, exist in concentrations in excess of the amounts specified in Appendix B, Table I, Column 1 of this part; or (ii) any room, enclosure, or operating area in which airborne radioactive material composed wholly or partly of licensed material exists in concentrations which, averaged over the number of hours in any week during which individuals are in the area, exceed 25 percent of the amounts specified in Appendix B, Table I, Column 1 of this part.

(2) Each airborne radioactivity area shall be conspicuously posted with a sign or signs bearing the radiation caution symbol and the words:

CAUTION: AIRBORNE RADIOACTIVITY AREA

(e) Additional requirements. (1) Each area or room in which licensed material is used or stored and which contains any radioactive material (other than natural uranium or thorium) in an amount exceeding 10 times the quantity of such material specified in Appendix C of this part shall be conspicuously posted with a sign or signs bearing the radiation caution symbol and the words:

CAUTION: RADIOACTIVE MATERIAL(S)

(2) Each area or room in which natural uranium or thorium is used or stored in an amount exceeding one hundred times the quantity specified in Appendix C of this part shall be conspicuously posted with a sign or signs

* Or "Danger".

bearing the radiation caution symbol and the words:

CAUTION¹
RADIOACTIVE MATERIAL(S)

(7) Containers. (1) Each container in which is transported, stored, or used a quantity of any licensed material (other than natural uranium or thorium) greater than the quantity of such material specified in Appendix C of this part shall bear a durable, clearly visible label bearing the radiation caution symbol and the words:

CAUTION¹
RADIOACTIVE MATERIAL

(2) Each container in which natural uranium or thorium is transported, stored, or used in a quantity greater than ten times the quantity specified in Appendix C of this part shall bear a durable, clearly visible label bearing the radiation caution symbol and the words:

CAUTION¹
RADIOACTIVE MATERIAL

(3) Notwithstanding the provisions of subparagraphs (1) and (2) a label shall not be required:

(1) If the concentration of the material in the container does not exceed that specified in Appendix B, Table I, Column 2 of this part; or

(2) For laboratory containers, such as beakers, flasks, and test tubes, used transiently in laboratory procedures, when the user is present.

(4) Where containers are used for storage, the labels required in this paragraph shall state also the quantities and kinds of radioactive materials in the containers and the date of measurement of the quantities.

§ 20.204 Exceptions from posting requirements.

Notwithstanding the provisions of § 20.203,

(A) A room or area is not required to be posted with a caution sign because of the presence of a sealed source provided the radiation level twelve inches from the surface of the source container or housing does not exceed five millirem per hour.

(B) Rooms or other areas in hospitals are not required to be posted with caution signs because of the presence of patients containing byproduct material provided that there are personnel in attendance who shall take the precautions necessary to prevent the exposure of any individual to radiation or radioactive material in excess of the limits established in the regulations in this part.

(C) Caution signs are not required to be posted at areas or rooms containing radioactive materials for periods of less than eight hours provided that (1) the materials are constantly attended during such periods by an individual who shall take the precautions necessary to prevent the exposure of any individual to radiation or radioactive materials in excess of the limits established in the regulations in this part and; (2) such area or room is subject to the licensee's control.

§ 20.205 Exemptions for radioactive materials packaged for shipment.

Radioactive materials packaged and labeled in accordance with regulations of

the Interstate Commerce Commission shall be exempt from the labeling and posting requirements of § 20.203 during shipment, provided that the inside containers are labeled in accordance with the provisions of § 20.203(f).

§ 20.206 Instruction of personnel; posting of notices to employees.

(a) All individuals working in or frequenting any portion of a restricted area shall be informed of the occurrence of radioactive materials or of radiation in such portions of the restricted area; shall be instructed in the safety problems associated with exposure to such materials or radiation and in precautions or procedures to minimize exposure; shall be instructed in the applicable provisions of Commission regulations and licenses for the protection of personnel from exposures to radiation or radioactive materials; and shall be advised of reports of radiation exposure which employees may request pursuant to these regulations.

(b) Each licensee shall post a current copy of the regulations in this part, a copy of the license, and a copy of operating procedures applicable to work under the license conspicuously in a sufficient number of places in every establishment where employees are employed in activities licensed by the Commission to permit them to observe such documents on the way to or from their place of employment or shall keep such documents available for employees' examination upon request.

(c) Form AEC-3 "Notice to Employees" shall be conspicuously posted in a sufficient number of places in every establishment where employees are employed in activities licensed by the Commission to permit them to observe a copy on the way to or from their place of employment.

Note: Copies of Form AEC-3 "Notice to Employees" may be obtained by writing to the Manager, appropriate AEC Operations Office or the Director, Division of Licensing and Regulation, Washington 25, D.C.

§ 20.207 Storage of licensed materials.

Licensed materials stored in an unrestricted area shall be secured against unauthorized removal from the place of storage.

WASTE DISPOSAL

§ 20.301 General requirements.

No licensee shall dispose of licensed material except:

(a) By transfer to an authorized recipient as provided in the regulations in Part 30, 40, or 70 of this chapter, whichever may be applicable; or

(b) As authorized pursuant to § 20.302; or

(c) As provided in § 20.303 or § 20.304, applicable respectively to the disposal of licensed material by release into sanitary sewerage systems or burial in soil, or in § 20.106 (Concentrations in Effluents to Unrestricted Areas).

§ 20.302 Method for obtaining approval of proposed disposal procedures.

Any licensee or applicant for a license may apply to the Commission for approval of proposed procedures to dispose of licensed material in a manner not otherwise authorized in the regulations

in this chapter. Each application should include a description of the licensed material and any other radioactive material involved, including the quantities and kinds of such material and the levels of radioactivity involved, and the proposed manner and conditions of disposal. The application should also include an analysis and evaluation of pertinent information as to the nature of the environment, including topographical, geological, meteorological, and hydrological characteristics; usage of ground and surface waters in the general area; the nature and location of other potentially affected facilities; and procedures to be observed to minimize the risk of unexpected or hazardous exposures.

§ 20.303 Disposal by release into sanitary sewerage systems.

No licensee shall discharge licensed material into a sanitary sewerage system unless:

(a) It is readily soluble or dispersible in water; and

(b) The quantity of any licensed or other radioactive material released into the system by the licensee in any one day does not exceed the larger of subparagraphs (1) or (2) of this paragraph:

(1) The quantity which, if diluted by the average daily quantity of sewage released into the sewer by the licensee, will result in an average concentration equal to the limits specified in Appendix B, Table I, Column 2 of this part; or

(2) Ten times the quantity of such material specified in Appendix C of this part; and

(c) The quantity of any licensed or other radioactive material released in any one month, if diluted by the average monthly quantity of water released by the licensee, will not result in an average concentration exceeding the limits specified in Appendix B, Table I, Column 2 of this part; and

(d) The gross quantity of licensed and other radioactive material released into the sewerage system by the licensee does not exceed one curie per year.

Excreta from individuals undergoing medical diagnosis or therapy with radioactive material shall be exempt from any limitations contained in this section.

§ 20.304 Disposal by burial in soil.

No licensee shall dispose of licensed material by burial in soil unless:

(a) The total quantity of licensed and other radioactive materials buried at any one location and time does not exceed, at the time of burial, 1,000 times the amount specified in Appendix C of this part; and

(b) Burial is at a minimum depth of four feet; and

(c) Successive burials are separated by distances of at least six feet and not more than 12 burials are made in any year.

§ 20.305 Treatment or disposal by incineration.

No licensee shall treat or dispose of licensed material by incineration except as specifically approved by the Commission, pursuant to §§ 20.106(a) and 20.302.

¹ Or "Danger."

RECORDS, REPORTS, AND NOTIFICATIONS

§ 20.401 Records of surveys, radiation monitoring, and disposal.

(a) Each licensee shall maintain records showing the radiation exposures of all individuals for whom personnel monitoring is required under § 20.202 of the regulations in this part. Such records shall be kept on Form AEC-5, in accordance with the instructions contained in that form, or on clear and legible records containing all the information required by Form AEC-5. The doses entered on the forms or records shall be for periods of time not exceeding one calendar quarter.

(b) Each licensee shall maintain records in the same units used in the appendices to this part, showing the results of surveys required by § 20.201 (b), and disposals made under §§ 20.202, 20.203, and 20.204.

(c) Records of individual radiation exposure which must be maintained pursuant to the provisions of this subsection shall be preserved until December 31, 1966 or until a date five years after termination of the individual's employment, whichever is later. Records which must be maintained pursuant to this part may be maintained in the form of microfilm.

Note: Prior to December 31, 1966 the Commission may amend this paragraph to assure the further preservation of records which it determines should not be destroyed.

§ 20.402 Reports of theft or loss of licensed material.

Each licensee shall report by telephone and telegraph to the Manager of the nearest Atomic Energy Commission Operations Office listed in Appendix D, immediately after its occurrence becomes known to the licensee, any loss or theft of licensed material in such quantities and under such circumstances that it appears to the licensee that a substantial hazard may result to persons in unrestricted areas.

§ 20.403 Notifications of incidents.

(a) Immediate notification. Each licensee shall immediately notify the Manager of the appropriate Atomic Energy Commission Operations Office shown in Appendix D by telephone and telegraph of any incident involving byproduct, source or special nuclear material possessed by him and which may have caused or threatens to cause:

(1) Exposure of the whole body of any individual to 25 rems or more of radiation; exposure of the skin of the whole body of any individual of 150 rems or more of radiation; or exposure of the feet, ankles, hands or forearms of any individual to 375 rems or more of radiation; or

(2) The release of radioactive material in concentrations which, if averaged over a period of 24 hours, would exceed 5,000 times the limits specified for such materials in Appendix B, Table II; or

(3) A loss of one working week or

more of the operation of any facilities affected; or

(4) Damage to property in excess of \$100,000.

(b) Twenty-four hour notification. Each licensee shall within 24 hours notify the Manager of the appropriate Atomic Energy Commission Operations Office listed in Appendix D by telephone and telegraph of any incident involving licensed material possessed by him and which may have caused or threatens to cause:

(1) Exposure of the whole body of any individual to 5 rems or more of radiation; exposure of the skin of the whole body of any individual to 30 rems or more of radiation; or exposure of the feet, ankles, hands, or forearms to 75 rems or more of radiation; or

(2) The release of radioactive material in concentrations which, if averaged over a period of 24 hours, would exceed 500 times the limits specified for such materials in Appendix B, Table II; or

(3) A loss of one day or more of the operation of any facilities affected; or

(4) Damage to property in excess of \$1,000.

§ 20.404 Report to former employees of exposure to radiation.

At the request of a former employee each licensee shall furnish to the former employee a report of the former employee's exposure to radiation as shown in records maintained by the licensee pursuant to § 20.401(a). Such report shall be furnished within 30 days from the time the request is made; shall cover each calendar quarter of the individual's employment involving exposure to radiation, or such lesser period as may be requested by the employee. The report shall also include the results of any calculations and analyses of radioactive material deposited in the body of the employee and made pursuant to the provisions of § 20.108. The report shall be in writing and contain the following statement:

This report is furnished to you under the provisions of the Atomic Energy Commission regulations entitled "Standards for Protection Against Radiation" (10 CFR Part 20). You should preserve this report for future reference.

(b) The former employee's request should include appropriate identifying data, such as social security number and dates and locations of employment.

§ 20.405 Reports of overexposures and excessive levels and concentrations.

(a) In addition to any notification required by § 20.403, each licensee shall make a report in writing within 30 days to the Director, Division of Licensing and Regulation, U.S. Atomic Energy Commission, Washington 25, D.C., of (1) each exposure of an individual to radiation or concentrations of radioactive material in excess of any applicable limit in this part or in the licensee's license; (2) any incident for which notification is required by § 20.403; and (3) levels of radiation or concentrations of

radioactive material (not involving excessive exposure of any individual) in an unrestricted area in excess of ten times any applicable limit set forth in this part or in the licensee's license. Each report required under this paragraph shall describe the extent of exposure of persons to radiation or to radioactive material; levels of radiation and concentrations of radioactive material involved; the cause of the exposure, levels or concentrations; and corrective steps taken or planned to assure against a recurrence. The licensee shall transmit a copy of each report to the Manager of the appropriate Atomic Energy Commission Operations Office listed in Appendix D.

(b) In any case where a licensee is required pursuant to the provisions of this section to report to the Commission any exposure of an individual to radiation or to concentrations of radioactive material, the licensee shall also notify such individual of the nature and extent of exposure. Such notice shall be in writing and shall contain the following statement:

This report is furnished to you under the provisions of the Atomic Energy Commission regulations entitled "Standards for Protection Against Radiation" (10 CFR Part 20). You should preserve this report for future reference.

§ 20.406 Notice to employees of exposure to radiation.

At the request of any employee, each licensee shall advise such employee annually of the employee's exposure to radiation as shown in records maintained by the licensee pursuant to § 20.401(a).

EXCEPTIONS AND ADDITIONAL REQUIREMENTS

§ 20.501 Applications for exemptions.

The Commission may, upon application by any licensee or upon 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 result in undue hazard to life or property.

§ 20.502 Additional requirements.

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.

ENFORCEMENT

§ 20.601 Violations.

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 willfully violates any provision of the act 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.

APPENDIX A (Reserved)

CONCENTRATIONS IN AIR AND WATER ABOVE NATURAL BACKGROUND

[See notes at end of appendix]

Element (atomic number)	Isotope	Table I			Table II		
		Column 1 Air (cpm)	Column 2 Water (cpm)	Column 3 Air (cpm)	Column 4 Water (cpm)	Column 5 Air (cpm)	Column 6 Water (cpm)
Actinium (89)	Ac 227	3X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰
	Ac 228	4X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰
	Ac 229	4X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰
Americium (95)	Am 241	3X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰
	Am 242	4X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰
	Am 243	4X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰
Antimony (51)	Sb 122	3X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰
	Sb 123	4X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰
	Sb 125	4X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰
Argon (18)	Ar 36	3X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰
	Ar 38	4X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰
	Ar 40	4X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰
Arsenic (33)	As 74	3X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰
	As 75	4X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰
	As 76	4X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰
Astatine (85)	At 210	3X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰
	At 211	4X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰
	At 212	4X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰
Barium (56)	Ba 134	3X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰
	Ba 135	4X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰
	Ba 137	4X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰
Berkelium (97)	Bk 247	3X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰
	Bk 248	4X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰
	Bk 249	4X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰
Beryllium (4)	Be 7	3X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰
	Be 9	4X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰
	Be 10	4X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰
Bismuth (83)	Bi 208	3X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰
	Bi 209	4X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰
	Bi 210	4X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰
Boron (5)	B 10	3X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰
	B 11	4X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰
	B 12	4X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰
Bromine (35)	Br 79	3X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰
	Br 80	4X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰
	Br 81	4X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰
Cadmium (48)	Cd 106	3X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰
	Cd 112	4X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰
	Cd 114	4X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰
Calcium (20)	Ca 40	3X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰
	Ca 42	4X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰
	Ca 44	4X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰
Californium (98)	Cf 250	3X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰
	Cf 251	4X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰
	Cf 252	4X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰
Carbon (6)	C 12	3X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰
	C 13	4X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰
	C 14	4X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰
Cerium (58)	Ce 136	3X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰
	Ce 138	4X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰
	Ce 140	4X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰

See footnotes at end of table.

CONCENTRATIONS IN AIR AND WATER ABOVE NATURAL BACKGROUND—continued

[See notes at end of appendix]

Element (atomic number)	Isotope	Table I			Table II		
		Column 1 Air (cpm)	Column 2 Water (cpm)	Column 3 Air (cpm)	Column 4 Water (cpm)	Column 5 Air (cpm)	Column 6 Water (cpm)
Cesium (55)	Cs 131	3X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰
	Cs 134	4X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰
	Cs 137	4X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰
Chlorine (17)	Cl 35	3X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰
	Cl 36	4X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰
	Cl 37	4X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰
Chromium (24)	Cr 50	3X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰
	Cr 51	4X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰
	Cr 52	4X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰
Cobalt (27)	Co 57	3X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰
	Co 58	4X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰
	Co 60	4X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰
Copper (29)	Cu 63	3X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰
	Cu 64	4X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰
	Cu 65	4X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰
Curium (96)	Cm 246	3X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰
	Cm 247	4X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰
	Cm 248	4X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰
Dysprosium (63)	Dy 162	3X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰
	Dy 163	4X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰
	Dy 164	4X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰
Erbium (68)	Er 166	3X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰
	Er 167	4X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰
	Er 168	4X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰
Europium (63)	Eu 152	3X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰
	Eu 154	4X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰
	Eu 155	4X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰
Fluorine (9)	F 18	3X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰
	F 19	4X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰
	F 20	4X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰
Gadolinium (64)	Gd 152	3X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰
	Gd 154	4X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰
	Gd 155	4X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰
Gallium (31)	Ga 67	3X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰
	Ga 69	4X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰
	Ga 71	4X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰
Germanium (32)	Ge 70	3X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰
	Ge 72	4X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰
	Ge 73	4X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰
Gold (79)	Au 196	3X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰	6X10 ⁻¹⁰
	Au 197	4X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰
	Au 198	4X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰	8X10 ⁻¹⁰

See notes at end of synopsis

CONCERNED ABOUT THE
[the notes at end of appendix]

Element (element number)	Isotope	Table I				Table II				Element (element number)	Isotope	Table I				Table II			
		Column 1		Column 2		Column 1		Column 2				Column 1		Column 2		Column 1		Column 2	
		Alt. (a.u.)	W. (a.u.)	Alt. (a.u.)	W. (a.u.)	Alt. (a.u.)	W. (a.u.)	Alt. (a.u.)	W. (a.u.)			Alt. (a.u.)	W. (a.u.)	Alt. (a.u.)	W. (a.u.)	Alt. (a.u.)	W. (a.u.)	Alt. (a.u.)	W. (a.u.)
Hydrogen (1)	1H	1.0000	1.0000	1.0000	1.0000	Hydrogen (1)	1H	1.0000	1.0000	1.0000	1.0000	Hydrogen (1)	1H	1.0000	1.0000	1.0000	1.0000		
Helium (2)	3He	3.0160	3.0160	3.0160	3.0160	Helium (2)	3He	3.0160	3.0160	3.0160	3.0160	Helium (2)	3He	3.0160	3.0160	3.0160	3.0160		
Helium (2)	4He	4.0026	4.0026	4.0026	4.0026	Helium (2)	4He	4.0026	4.0026	4.0026	4.0026	Helium (2)	4He	4.0026	4.0026	4.0026	4.0026		
Lithium (3)	6Li	6.0151	6.0151	6.0151	6.0151	Lithium (3)	6Li	6.0151	6.0151	6.0151	6.0151	Lithium (3)	6Li	6.0151	6.0151	6.0151	6.0151		
Lithium (3)	7Li	7.0160	7.0160	7.0160	7.0160	Lithium (3)	7Li	7.0160	7.0160	7.0160	7.0160	Lithium (3)	7Li	7.0160	7.0160	7.0160	7.0160		
Beryllium (4)	9Be	9.0122	9.0122	9.0122	9.0122	Beryllium (4)	9Be	9.0122	9.0122	9.0122	9.0122	Beryllium (4)	9Be	9.0122	9.0122	9.0122	9.0122		
Boron (5)	10B	10.0129	10.0129	10.0129	10.0129	Boron (5)	10B	10.0129	10.0129	10.0129	10.0129	Boron (5)	10B	10.0129	10.0129	10.0129	10.0129		
Boron (5)	11B	11.0093	11.0093	11.0093	11.0093	Boron (5)	11B	11.0093	11.0093	11.0093	11.0093	Boron (5)	11B	11.0093	11.0093	11.0093	11.0093		
Carbon (6)	12C	12.0000	12.0000	12.0000	12.0000	Carbon (6)	12C	12.0000	12.0000	12.0000	12.0000	Carbon (6)	12C	12.0000	12.0000	12.0000	12.0000		
Carbon (6)	13C	13.0034	13.0034	13.0034	13.0034	Carbon (6)	13C	13.0034	13.0034	13.0034	13.0034	Carbon (6)	13C	13.0034	13.0034	13.0034	13.0034		
Carbon (6)	14C	14.0032	14.0032	14.0032	14.0032	Carbon (6)	14C	14.0032	14.0032	14.0032	14.0032	Carbon (6)	14C	14.0032	14.0032	14.0032	14.0032		
Nitrogen (7)	14N	14.0031	14.0031	14.0031	14.0031	Nitrogen (7)	14N	14.0031	14.0031	14.0031	14.0031	Nitrogen (7)	14N	14.0031	14.0031	14.0031	14.0031		
Nitrogen (7)	15N	15.0001	15.0001	15.0001	15.0001	Nitrogen (7)	15N	15.0001	15.0001	15.0001	15.0001	Nitrogen (7)	15N	15.0001	15.0001	15.0001	15.0001		
Oxygen (8)	16O	15.9949	15.9949	15.9949	15.9949	Oxygen (8)	16O	15.9949	15.9949	15.9949	15.9949	Oxygen (8)	16O	15.9949	15.9949	15.9949	15.9949		
Oxygen (8)	17O	16.9993	16.9993	16.9993	16.9993	Oxygen (8)	17O	16.9993	16.9993	16.9993	16.9993	Oxygen (8)	17O	16.9993	16.9993	16.9993	16.9993		
Oxygen (8)	18O	17.9991	17.9991	17.9991	17.9991	Oxygen (8)	18O	17.9991	17.9991	17.9991	17.9991	Oxygen (8)	18O	17.9991	17.9991	17.9991	17.9991		
Fluorine (9)	19F	18.9984	18.9984	18.9984	18.9984	Fluorine (9)	19F	18.9984	18.9984	18.9984	18.9984	Fluorine (9)	19F	18.9984	18.9984	18.9984	18.9984		
Neon (10)	20Ne	19.9926	19.9926	19.9926	19.9926	Neon (10)	20Ne	19.9926	19.9926	19.9926	19.9926	Neon (10)	20Ne	19.9926	19.9926	19.9926	19.9926		
Neon (10)	21Ne	20.9938	20.9938	20.9938	20.9938	Neon (10)	21Ne	20.9938	20.9938	20.9938	20.9938	Neon (10)	21Ne	20.9938	20.9938	20.9938	20.9938		
Neon (10)	22Ne	21.9914	21.9914	21.9914	21.9914	Neon (10)	22Ne	21.9914	21.9914	21.9914	21.9914	Neon (10)	22Ne	21.9914	21.9914	21.9914	21.9914		
Sodium (11)	23Na	22.9898	22.9898	22.9898	22.9898	Sodium (11)	23Na	22.9898	22.9898	22.9898	22.9898	Sodium (11)	23Na	22.9898	22.9898	22.9898	22.9898		
Magnesium (12)	24Mg	23.9850	23.9850	23.9850	23.9850	Magnesium (12)	24Mg	23.9850	23.9850	23.9850	23.9850	Magnesium (12)	24Mg	23.9850	23.9850	23.9850	23.9850		
Magnesium (12)	25Mg	24.9858	24.9858	24.9858	24.9858	Magnesium (12)	25Mg	24.9858	24.9858	24.9858	24.9858	Magnesium (12)	25Mg	24.9858	24.9858	24.9858	24.9858		
Magnesium (12)	26Mg	25.9826	25.9826	25.9826	25.9826	Magnesium (12)	26Mg	25.9826	25.9826	25.9826	25.9826	Magnesium (12)	26Mg	25.9826	25.9826	25.9826	25.9826		
Aluminum (13)	27Al	26.9815	26.9815	26.9815	26.9815	Aluminum (13)	27Al	26.9815	26.9815	26.9815	26.9815	Aluminum (13)	27Al	26.9815	26.9815	26.9815	26.9815		
Silicon (14)	28Si	27.9769	27.9769	27.9769	27.9769	Silicon (14)	28Si	27.9769	27.9769	27.9769	27.9769	Silicon (14)	28Si	27.9769	27.9769	27.9769	27.9769		
Silicon (14)	29Si	28.9765	28.9765	28.9765	28.9765	Silicon (14)	29Si	28.9765	28.9765	28.9765	28.9765	Silicon (14)	29Si	28.9765	28.9765	28.9765	28.9765		
Silicon (14)	30Si	29.9738	29.9738	29.9738	29.9738	Silicon (14)	30Si	29.9738	29.9738	29.9738	29.9738	Silicon (14)	30Si	29.9738	29.9738	29.9738	29.9738		
Phosphorus (15)	31P	30.9738	30.9738	30.9738	30.9738	Phosphorus (15)	31P	30.9738	30.9738	30.9738	30.9738	Phosphorus (15)	31P	30.9738	30.9738	30.9738	30.9738		
Sulfur (16)	32S	31.9721	31.9721	31.9721	31.9721	Sulfur (16)	32S	31.9721	31.9721	31.9721	31.9721	Sulfur (16)	32S	31.9721	31.9721	31.9721	31.9721		
Sulfur (16)	33S	32.9715	32.9715	32.9715	32.9715	Sulfur (16)	33S	32.9715	32.9715	32.9715	32.9715	Sulfur (16)	33S	32.9715	32.9715	32.9715	32.9715		
Sulfur (16)	34S	33.9678	33.9678	33.9678	33.9678	Sulfur (16)	34S	33.9678	33.9678	33.9678	33.9678	Sulfur (16)	34S	33.9678	33.9678	33.9678	33.9678		
Sulfur (16)	36S	35.9671	35.9671	35.9671	35.9671	Sulfur (16)	36S	35.9671	35.9671	35.9671	35.9671	Sulfur (16)	36S	35.9671	35.9671	35.9671	35.9671		
Chlorine (17)	35Cl	34.9689	34.9689	34.9689	34.9689	Chlorine (17)	35Cl	34.9689	34.9689	34.9689	34.9689	Chlorine (17)	35Cl	34.9689	34.9689	34.9689	34.9689		
Chlorine (17)	37Cl	36.9659	36.9659	36.9659	36.9659	Chlorine (17)	37Cl	36.9659	36.9659	36.9659	36.9659	Chlorine (17)	37Cl	36.9659	36.9659	36.9659	36.9659		
Argon (18)	36Ar	35.9676	35.9676	35.9676	35.9676	Argon (18)	36Ar	35.9676	35.9676	35.9676	35.9676	Argon (18)	36Ar	35.9676	35.9676	35.9676	35.9676		
Argon (18)	38Ar	37.9627	37.9627	37.9627	37.9627	Argon (18)	38Ar	37.9627	37.9627	37.9627	37.9627	Argon (18)	38Ar	37.9627	37.9627	37.9627	37.9627		
Argon (18)	40Ar	39.9624	39.9624	39.9624	39.9624	Argon (18)	40Ar	39.9624	39.9624	39.9624	39.9624	Argon (18)	40Ar	39.9624	39.9624	39.9624	39.9624		
Potassium (19)	39K	38.9637	38.9637	38.9637	38.9637	Potassium (19)	39K	38.9637	38.9637	38.9637	38.9637	Potassium (19)	39K	38.9637	38.9637	38.9637	38.9637		
Potassium (19)	40K	39.9640	39.9640	39.9640	39.9640	Potassium (19)	40K	39.9640	39.9640	39.9640	39.9640	Potassium (19)	40K	39.9640	39.9640	39.9640	39.9640		
Calcium (20)	40Ca	39.9626	39.9626	39.9626	39.9626	Calcium (20)	40Ca	39.9626	39.9626	39.9626	39.9626	Calcium (20)	40Ca	39.9626	39.9626	39.9626	39.9626		
Calcium (20)	42Ca	41.9586	41.9586	41.9586	41.9586	Calcium (20)	42Ca	41.9586	41.9586	41.9586	41.9586	Calcium (20)	42Ca	41.9586	41.9586	41.9586	41.9586		
Calcium (20)	44Ca	43.9594	43.9594	43.9594	43.9594	Calcium (20)	44Ca	43.9594	43.9594	43.9594	43.9594	Calcium (20)	44Ca	43.9594	43.9594	43.9594	43.9594		
Calcium (20)	46Ca	45.9526	45.9526	45.9526	45.9526	Calcium (20)	46Ca	45.9526	45.9526	45.9526	45.9526	Calcium (20)	46Ca	45.9526	45.9526	45.9526	45.9526		
Scandium (21)	45Sc	44.9559	44.9559	44.9559	44.9559	Scandium (21)	45Sc	44.9559	44.9559	44.9559	44.9559	Scandium (21)	45Sc	44.9559	44.9559	44.9559	44.9559		
Titanium (22)	46Ti	45.9526	45.9526	45.9526	45.9526	Titanium (22)	46Ti	45.9526	45.9526	45.9526	45.9526	Titanium (22)	46Ti	45.9526	45.9526	45.9526	45.9526		
Titanium (22)	47Ti	46.9524	46.9524	46.9524	46.9524	Titanium (22)	47Ti	46.9524	46.9524	46.9524	46.9524	Titanium (22)	47Ti	46.9524	46.9524	46.9524	46.9524		
Titanium (22)	48Ti	47.9472	47.9472	47.9472	47.9472	Titanium (22)	48Ti	47.9472	47.9472	47.9472	47.9472	Titanium (22)	48Ti	47.9472	47.9472	47.9472	47.9472		
Titanium (22)	50Ti	49.9448	49.9448	49.9448	49.9448	Titanium (22)	50Ti	49.9448	49.9448	49.9448	49.9448	Titanium (22)	50Ti	49.9448	49.9448	49.9448	49.9448		
Vanadium (23)	51V	50.9439	50.9439	50.9439	50.9439	Vanadium (23)	51V	50.9439	50.9439	50.9439	50.9439	Vanadium (23)	51V	50.9439	50.9439	50.9439	50.9439		
Chromium (24)	50Cr	49.9461	49.9461	49.9461	49.9461	Chromium (24)	50Cr	49.9461	49.9461	49.9461	49.9461	Chromium (24)	50Cr	49.9461	49.9461	49.9461	49.9461		
Chromium (24)	52Cr	51.9405	51.9405	51.9405	51.9405	Chromium (24)	52Cr	51.9405	51.9405	51.9405	51.9405	Chromium (24)	52Cr	51.9405	51.9405	51.9405	51.9405		
Chromium (24)	54Cr	53.9398	53.9398	53.9398	53.9398	Chromium (24)	54Cr	53.9398	53.9398	53.9398	53.9398	Chromium (24)	54Cr	53.9398	53.9398	53.9398	53.9398		
Manganese (25)	55Mn	54.9380	54.9380	54.9380	54.9380	Manganese (25)	55Mn	54.9380	54.9380	54.9380	54.9380	Manganese (25)	55Mn	54.9380	54.9380	54.9380	54.9380		
Iron (26)	54Fe	53.9396	53.9396	53.9396	53.9396	Iron (26)	54Fe	53.9396	53.9396	53.9396	53.9396	Iron (26)	54Fe	53.9396	53.9396	53.9396	53.9396		
Iron (26)	56Fe	55.9349	55.9349	55.9349	55.9349	Iron (26)	56Fe	55.9349	55.9349	55.9349	55.9349	Iron (26)	56Fe	55.9349	55.9349	55.9349	55.9349		
Iron (26)	57Fe	56.9353	56.9353	56.9353	56.9353	Iron (26)	57Fe	56.9353	56.9353	56.9353	56.9353	Iron (26)	57Fe	56.9353	56.9353	56.9353	56.9353		
Iron (26)	58Fe	57.9333	57.9333	57.9333	57.9333	Iron (26)	58Fe	57.9333	57.9333	57.9333	57.9333	Iron (26)	58Fe	57.9333	57.9333	57.9333	57.9333		
Cobalt (27)	59Co	58.9332	58.9332	58.9332	58.9332	Cobalt (27)	59Co	58.9332	58.9332	58.9332	58.9332	Cobalt (27)	59Co	58.9332	58.9332	58.9332	58.9332		
Nickel (28)	58Ni	57.9353	57.9353	57.9353	57.9353	Nickel (28)	58Ni	57.9353											

See footnotes at end of tables.

CONCENTRATION IN AIR AND WATER ABOVE NATURAL BACKGROUND—continued

(the ratio of end to temperature)

Element (atomic number)	Isotope	Table I		Table II	
		Column 1	Column 2	Column 1	Column 2
		Air (atm)	Water (cm ³ /ml)	Air (atm)	Water (cm ³ /ml)
Protactinium (81)	Pa 231	5X10 ⁻⁷	4X10 ⁻³	2X10 ⁻¹	1X10 ⁻¹
Radium (86)	Ra 226	2X10 ⁻⁷	3X10 ⁻³	5X10 ⁻¹	1X10 ⁻¹
	Ra 228	2X10 ⁻⁷	2X10 ⁻³	5X10 ⁻¹	7X10 ⁻¹
	Ra 226	2X10 ⁻⁷	1X10 ⁻³	5X10 ⁻¹	5X10 ⁻¹
	Ra 226	2X10 ⁻⁷	7X10 ⁻³	2X10 ⁻¹	2X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	5X10 ⁻¹
Radium (86)	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
Radium (86)	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
Radium (86)	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
Radium (86)	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
Radium (86)	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
Radium (86)	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
Radium (86)	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
Radium (86)	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
Radium (86)	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
Radium (86)	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
Radium (86)	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
Radium (86)	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
Radium (86)	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
Radium (86)	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
Radium (86)	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
Radium (86)	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
Radium (86)	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
Radium (86)	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
Radium (86)	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
Radium (86)	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
Radium (86)	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
Radium (86)	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
Radium (86)	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
Radium (86)	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
Radium (86)	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
Radium (86)	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
Radium (86)	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
Radium (86)	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
Radium (86)	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
Radium (86)	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
Radium (86)	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ⁻¹	1X10 ⁻¹
	Ra 226	2X10 ⁻⁷	2X10 ⁻³	1X10 ^{-1</}	

see footnotes at end of table

CONCENTRATIONS IN AIR AND WATER ABOVE NATURAL BACKGROUNDS—continued

(See notes at end of appendix)

Element (atomic number)	Isotope		Table I		Table II	
			Column 1	Column 2	Column 1	Column 2
			Air (cc/ml)	Water (cc/ml)	Air (cc/ml)	Water (cc/ml)
Strontium (38)	86	3	5X10 ⁻¹⁰	6X10 ⁻¹⁰	1X10 ⁻¹¹	1X10 ⁻¹¹
	87	1	5X10 ⁻¹⁰	1X10 ⁻¹⁰	2X10 ⁻¹¹	4X10 ⁻¹¹
	88	1	6X10 ⁻¹⁰	2X10 ⁻¹⁰	2X10 ⁻¹¹	7X10 ⁻¹¹
	89	1	2X10 ⁻¹⁰	1X10 ⁻¹⁰	2X10 ⁻¹¹	5X10 ⁻¹¹
Sulfur (16)	32	2	6X10 ⁻¹⁰	2X10 ⁻¹⁰	1X10 ⁻¹¹	2X10 ⁻¹¹
	34	1	2X10 ⁻¹⁰	2X10 ⁻¹⁰	2X10 ⁻¹¹	4X10 ⁻¹¹
Tantalum (73)	182	1	4X10 ⁻¹⁰	1X10 ⁻¹⁰	1X10 ⁻¹¹	4X10 ⁻¹¹
	180	1	2X10 ⁻¹⁰	1X10 ⁻¹⁰	7X10 ⁻¹¹	4X10 ⁻¹¹
Technetium (43)	98m	1	4X10 ⁻¹⁰	4X10 ⁻¹⁰	2X10 ⁻¹¹	1X10 ⁻¹¹
	98	1	2X10 ⁻¹⁰	2X10 ⁻¹⁰	1X10 ⁻¹¹	1X10 ⁻¹¹
	96	1	6X10 ⁻¹⁰	2X10 ⁻¹⁰	2X10 ⁻¹¹	1X10 ⁻¹¹
	94	1	2X10 ⁻¹⁰	2X10 ⁻¹⁰	2X10 ⁻¹¹	1X10 ⁻¹¹
	92m	1	2X10 ⁻¹⁰	1X10 ⁻¹⁰	2X10 ⁻¹¹	2X10 ⁻¹¹
	92	1	2X10 ⁻¹⁰	1X10 ⁻¹⁰	1X10 ⁻¹¹	2X10 ⁻¹¹
	90	1	1X10 ⁻¹⁰	2X10 ⁻¹⁰	2X10 ⁻¹¹	1X10 ⁻¹¹
	88m	1	4X10 ⁻¹⁰	2X10 ⁻¹⁰	1X10 ⁻¹¹	2X10 ⁻¹¹
	88	1	2X10 ⁻¹⁰	2X10 ⁻¹⁰	1X10 ⁻¹¹	2X10 ⁻¹¹
	86m	1	4X10 ⁻¹⁰	2X10 ⁻¹⁰	1X10 ⁻¹¹	2X10 ⁻¹¹
	86	1	1X10 ⁻¹⁰	2X10 ⁻¹⁰	2X10 ⁻¹¹	2X10 ⁻¹¹
	84	1	2X10 ⁻¹⁰	1X10 ⁻¹⁰	7X10 ⁻¹¹	2X10 ⁻¹¹
Tellurium (52)	128m	1	6X10 ⁻¹⁰	5X10 ⁻¹⁰	2X10 ⁻¹¹	2X10 ⁻¹¹
	128	1	4X10 ⁻¹⁰	5X10 ⁻¹⁰	1X10 ⁻¹¹	3X10 ⁻¹¹
	127m	1	1X10 ⁻¹⁰	2X10 ⁻¹⁰	2X10 ⁻¹¹	1X10 ⁻¹¹
	127	1	1X10 ⁻¹⁰	2X10 ⁻¹⁰	3X10 ⁻¹¹	6X10 ⁻¹¹
	126m	1	4X10 ⁻¹⁰	2X10 ⁻¹⁰	1X10 ⁻¹¹	5X10 ⁻¹¹
	126	1	2X10 ⁻¹⁰	2X10 ⁻¹⁰	2X10 ⁻¹¹	3X10 ⁻¹¹
	125m	1	2X10 ⁻¹⁰	2X10 ⁻¹⁰	2X10 ⁻¹¹	2X10 ⁻¹¹
	125	1	2X10 ⁻¹⁰	2X10 ⁻¹⁰	2X10 ⁻¹¹	2X10 ⁻¹¹
	124m	1	4X10 ⁻¹⁰	2X10 ⁻¹⁰	1X10 ⁻¹¹	2X10 ⁻¹¹
	124	1	2X10 ⁻¹⁰	1X10 ⁻¹⁰	2X10 ⁻¹¹	2X10 ⁻¹¹
	122	1	2X10 ⁻¹⁰	2X10 ⁻¹⁰	2X10 ⁻¹¹	2X10 ⁻¹¹
	120	1	1X10 ⁻¹⁰	6X10 ⁻¹⁰	4X10 ⁻¹¹	2X10 ⁻¹¹
Terbium (64)	160	1	1X10 ⁻¹⁰	1X10 ⁻¹⁰	3X10 ⁻¹¹	4X10 ⁻¹¹
	159	1	2X10 ⁻¹⁰	1X10 ⁻¹⁰	1X10 ⁻¹¹	2X10 ⁻¹¹
Thallium (81)	208	1	2X10 ⁻¹⁰	1X10 ⁻¹⁰	1X10 ⁻¹¹	4X10 ⁻¹¹
	207	1	2X10 ⁻¹⁰	1X10 ⁻¹⁰	1X10 ⁻¹¹	4X10 ⁻¹¹
	206	1	2X10 ⁻¹⁰	2X10 ⁻¹⁰	1X10 ⁻¹¹	2X10 ⁻¹¹
	205	1	2X10 ⁻¹⁰	2X10 ⁻¹⁰	1X10 ⁻¹¹	2X10 ⁻¹¹
	204	1	2X10 ⁻¹⁰	2X10 ⁻¹⁰	2X10 ⁻¹¹	2X10 ⁻¹¹
	203	1	2X10 ⁻¹⁰	2X10 ⁻¹⁰	2X10 ⁻¹¹	2X10 ⁻¹¹
	202	1	2X10 ⁻¹⁰	2X10 ⁻¹⁰	2X10 ⁻¹¹	2X10 ⁻¹¹

The denominator in each of the above ratios was obtained by multiplying the figure in the table by 1,000 as provided in § 20.204.

APPENDIX D

UNITED STATES ATOMIC ENERGY COMMISSION OPERATION OFFICES

Operations office	Operations office address	Telephone
1. New York Operations Office.....	378 Hudson Street, New York 14, N.Y.	Yukon 9-1000.
2. Oak Ridge Operations Office.....	P.O. Box E, Oak Ridge, Tenn.....	Oak Ridge 5-5455 or 4-6841, Ext. 7807.
3. Savannah River Operations Office.....	P.O. Box A, Aiken, S.C.....	Aiken, S.C., Midway 9-6211; or Augusta, Ga., Park 4-6311, Ext. 3333.
4. Albuquerque Operations Office.....	P.O. Box 5400, Albuquerque, N. Mex.	Alpine 6-4411, Ext. 38947.
5. Chicago Operations Office.....	6800 South Cass Avenue, Argonne, Ill.	Clearwater 7-7711, Ext. 2111 or 511.
6. Idaho Operations Office.....	P.O. Box 2108, Idaho Falls, Idaho.....	Jackson 2-6648.
7. San Francisco Operations Office.....	2111 Bancroft Way, Berkeley 4, Calif.	Thornwell 1-6628.
8. Hanford Operations Office.....	P.O. Box 240, Richland, Wash.....	Whitehall 2-1111, Ext. 6-5441.

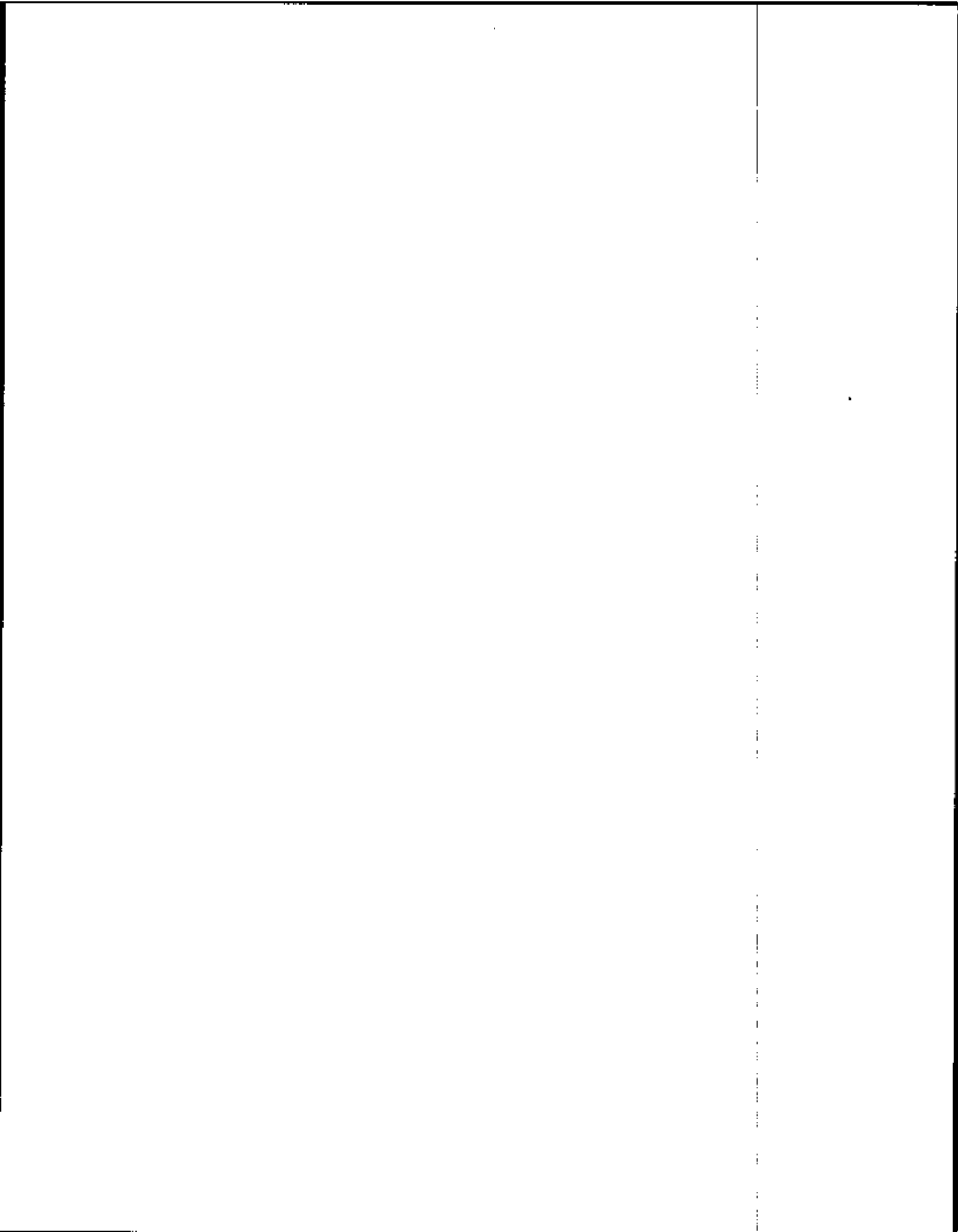
Note: The record keeping and reporting requirements contained in this part have been approved by the Bureau of the Budget in accordance with the Federal Reports Act of 1942.

Dated at Germantown, Md., this 8th day of November 1948.

For the Atomic Energy Commission,

W. B. McCook,
Secretary.

[P.R. Doc. 40-10276; Filed, Nov. 16, 1948;
8:45 a.m.]



(AEC Reprint Containing Amendments Issued Through October 17, 1957)

TITLE 10—ATOMIC ENERGY**Chapter I—Atomic Energy Commission****PART 30—LICENSING OF BYPRODUCT MATERIAL**

This amendment to Title 10 CFR, Part 30, Radiolotope Distribution, is published for the purpose of bringing it into conformity with the Atomic Energy Act of 1954 (68 Stat. 919) and to establish a simplified and less restrictive procedure relating to the export of byproduct material. In addition, changes have been incorporated in §§ 30.71 and 30.72 to permit the distribution of certain additional types of sealed sources and quantities and types of byproduct material to persons who do not hold specific licenses.

Except as required to accomplish the foregoing purposes, the changes effected by this revision are designed to simplify and clarify provisions of the existing regulations and not to effect substantial changes in the Commission's procedures and requirements relating to the licensing of byproduct material. In light of these considerations, the Atomic Energy Commission has found that general notice of proposed rule-making and public procedure thereon are unnecessary and would be contrary to the public interest.

The Commission has under consideration further amendments to Part 30 which will be published in accordance with procedures designed to afford the customary opportunity for public participation.

All interested persons who desire to submit written comments and suggestions relating to the following amendment should send them to the U. S. Atomic Energy Commission, Washington 25, D. C., Attention of the Director, Division of Civilian Application.

Effective thirty days after publication in the Federal Register, Part 30, Title 10, CFR, "Radiolotope Distribution Regulation" is hereby amended to read as follows:

GENERAL PROVISIONS

- Sec.
30.1 Purpose.
30.2 Scope.
30.3 License requirements.
30.4 Definitions.
30.5 Interpretations.

EXEMPTIONS

- Sec.
30.6 Persons operating Commission-owned facilities.
30.7 Carriers.
30.8 Other exemptions.

GENERAL LICENSES—APPLICATIONS FOR LICENSES

- 30.20 Types of licenses.
30.21 General licenses.
30.22 Applications for specific licenses.
30.23 General requirements for issuance of specific licenses.
30.24 Special requirements for issuance of specific licenses.

LICENSES

- 30.31 Issuance of specific licenses for use of byproduct material.
30.32 Terms and conditions of licenses.
30.33 Exports of byproduct material.
30.34 Expiration.
30.35 Renewal of license.
30.36 Amendments of licenses at request of licensee.
30.37 Commission action on applications to renew or amend.
30.38 Inalienability of licenses.
30.39 Persons possessing byproduct material on effective date of regulations in this part.

RECORDS, REPORTS AND INSPECTIONS

- 30.41 Records.
30.42 Reports of exports.
30.43 Inspection.
30.44 Tests.

MODIFICATION AND REVOCATION OF LICENSES

- 30.51 Modification and revocation of licenses.
30.52 Right to withhold or recall byproduct material.

ENFORCEMENT

- 30.61 Violations.

SCHEDULES

- 30.71 Schedule A.
30.72 Schedule B.

ATTORNEY: §§ 30.1 to 30.72 issued under sec. 161, 68 Stat. 948; 42 U. S. C. 2201, Interpret or apply secs. 81, 82, 182, 183, 68 Stat. 955, 963, 964. 42 U. S. C. 3111, 3112, 2232, 2233. For the purposes of sec. 223, 68 Stat. 958; 42 U. S. C. 2273, §§ 30.21 (b) and 30.32 (c) issued under sec. 161b, 68 Stat. 948; 42 U. S. C. 2201 (b) and §§ 30.41, 30.42 and 30.43 issued under sec. 161p, 68 Stat. 959; 42 U. S. C. 2201p.

GENERAL PROVISIONS

§ 30.1 Purpose. The regulations in this part are promulgated by the Atomic Energy Commission, pursuant to the Atomic Energy Act of 1954 (68 Stat. 919),

to provide for the licensing of byproduct material.

§ 30.2 Scope. Except as provided in §§ 30.6 to 30.8, the regulations in this part apply to all persons in the United States.

§ 30.3 License requirements. No person subject to the regulations in this part shall manufacture, produce, transfer, receive, acquire, own, possess, use, import or export byproduct material except as authorized in a specific or general license issued pursuant to the regulations in this part.

§ 30.4 Definitions. As used in this part:

(a) "Act" means the Atomic Energy Act of 1954, including any amendments thereto;

(b) "Byproduct material" means any radioactive material (except special nuclear material) yielded in or made radioactive by exposure to the radiation incident to the process of producing or utilizing special nuclear material;

(c) "Commission" means the Atomic Energy Commission and its duly authorized representatives;

(d) "Curie" means that amount of radioactive material which disintegrates at the rate of 37 billion atoms per second;

(e) "Human use" means the internal or external administration of byproduct material, or the radiation therefrom, to human beings;

(f) "License," except where otherwise specified means a license issued pursuant to the regulations in this part;

(g) "Microcurie" means that amount of radioactive material which disintegrates at the rate of 37 thousand atoms per second;

(h) "Person" means (1) any individual, corporation, partnership, firm, association, trust, estate, public or private institution, group, Government agency other than the Commission, any State or any political subdivision of, or any political entity within a State, any foreign government or nation or any political subdivision of any such government or nation, or other entity; and (2) any legal successor, representative, agent, or agency of the foregoing;

(i) "Physician" means an individual licensed by a state or territory of the United States, the District of Columbia or the Commonwealth of Puerto Rico to

dispense drugs in the practice of medicine;

(j) "Production facility" means production facility as defined in the regulations contained in Part 50 of this chapter;

(k) "Research and development" means (1) theoretical analysis, exploration, or experimentation; or (2) the extension of investigative findings and theories of a scientific or technical nature into practical application for experimental and demonstration purposes, including the experimental production and testing of models, devices, equipment, materials and processes. "Research and development" as used in this part does not include the internal or external administration of byproduct material, or the radiation therefrom, to human beings;

(l) "Sealed source" means any byproduct material that is encased in, and is to be used in, a container in a manner intended to prevent leakage of the byproduct material;

(m) "Source material" means source material as defined in the regulations contained in Part 49 of this chapter;

(n) "Special nuclear material" means special nuclear material as defined in the regulations contained in Part 70 of this chapter;

(o) "United States," when used in a geographical sense, includes all territories and possessions of the United States, the Canal Zone and Puerto Rico.

(p) "Utilization facility" means a utilization facility as defined in the regulations contained in Part 60 of this chapter;

(q) Other terms defined in section 11 of the act shall have the same meaning when used in the regulations in this part.

§ 30.5 Interpretations. 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.

EXEMPTIONS

§ 30.6 Persons operating Commission-owned facilities. Any person is exempt from the requirements for a license set forth in section 81 or 83 of the act and from the regulations in this Part to the extent that such person operates Commission-owned plants and laboratories on behalf of the Commission. In any such case, such person's obligations with respect to the byproduct material are covered by the applicable contract between such person and the Commission.

§ 30.7 Carriers. Common and contract carriers and the United States Post Office Department are exempt from the regulations in this part and the requirements for a license set forth in section 81 of the act to the extent that they transport byproduct material in the regular course of their business as carriers.

§ 30.8 Other exemptions. The Com-

mission may upon the application of any interested person, or upon its own initiative, exempt certain classes or quantities of byproduct material or kinds of uses or users from the requirements for a license set forth in section 81 of the act and in the regulations in this part, when it makes a finding that the exemption of such classes or quantities of such material or such kinds of uses or users will not constitute an unreasonable risk to the common defense and security and to the health and safety of the public.

GENERAL LICENSES; APPLICATIONS FOR LICENSES

§ 30.20 Types of licenses. (a) Licenses for byproduct material are of two types: general and specific. The general licenses provided in § 30.21 are effective without the filing of applications with the Commission or the issuance of licensing documents to particular persons. Specific licenses are issued to named persons upon applications filed pursuant to the regulations in this part.

§ 30.21 General licenses. (a) A general license is hereby issued:

(1) To transfer, receive, acquire, own, possess and use byproduct material incorporated in a device or equipment which is listed in § 30.71 and has been manufactured pursuant to a specific license issued by the Commission.

(2) To transfer, receive, acquire, own, possess, use and import the quantities of byproduct materials listed in § 30.72, provided that no person shall at any one time possess or use, pursuant to the general licensing provisions of this paragraph, more than a total of ten such scheduled quantities.

(b) The general licenses provided in this section are subject to the provisions of §§ 30.32 to 30.73, inclusive of the regulations in this part and are subject to the regulations contained in Part 20 of this chapter. In addition, persons who transfer, receive, acquire, own, possess, use or import scheduled items and quantities of byproduct material pursuant to the general licenses provided in paragraph (a) of this section.

(1) Shall not effect an increase in the radioactivity of said scheduled items or quantities by adding other radioactive material thereto, by combining byproduct material from two or more such items or quantities, or by altering them in any other manner so as to increase thereby the rate of radiation therefrom;

(2) Shall not administer externally or internally, or direct the administration of, said scheduled items or quantities or any part thereof to a human being for any purpose, including, but not limited to, diagnostic, therapeutic, and research purposes.

(3) Shall not add, or direct the addition of, said scheduled items or quantities or any part thereof to any food, beverage, cosmetic, drug, or other product designed for ingestion or inhalation by, or application to, a human being;

(4) Shall not include said scheduled

*Attention is directed particularly to the provisions of the regulations in Part 20 of this chapter which relate to the labelling of containers.

items or quantities or any part thereof in any device, instrument, apparatus (including component parts and accessories thereto) intended for use in diagnosis, treatment or prevention of disease in human beings or animals or otherwise intended to affect the structure or any function of the body of human beings or animals.

§ 30.22 Applications for specific licenses. (a) Applications for specific licenses shall be filed on Form AEC 313, "Application for By-Product Material License", with the United States Atomic Energy Commission, Post Office Box 2, Oak Ridge, Tennessee, Attention: Isotopes Division, and shall set forth the information called for by the form. Information contained in previous applications, statements or reports filed with the Commission may be incorporated by reference, provided that such references are clear and specific.

(b) The Commission may at any time after the filing of the original application, and before the expiration of the license, require further statements in order to enable the Commission to determine whether the application should be granted or denied or whether a license should be modified or revoked.

(c) Each application shall be signed by the applicant or licensee or a person duly authorized to act for and on his behalf.

(d) An application for license filed pursuant to the regulations in this part will be considered also as an application for licenses authorizing other activities for which licenses are required by the act, provided that the application specifies the additional activities for which licenses are requested and complies with regulations of the Commission as to applications for such licenses.

§ 30.23 General requirements for issuance of specific licenses. An application for a specific license will be approved if:

(a) The application is for a purpose authorized by the act; and

(b) The applicant's proposed equipment and facilities are adequate to protect health and minimize danger to life or property; and

(c) The applicant is qualified by training and experience to use the material for the purpose requested in such manner as to protect health and minimize danger to life or property; and

(d) The applicant satisfies any applicable special requirements contained in § 30.24.

§ 30.24 Special requirements for issuance of specific licenses—(a) Human use in institutions. An application by an institution for a specific license for human use will be approved if:

(1) The applicant satisfies the general requirements specified in § 30.23; and

(2) The applicant has appointed a medical isotopes committee of at least three members to evaluate all proposals for research, diagnosis, and therapeutic use of radiolabeled materials within that institution. Membership of the committee should include physicians expert in in-

ternal medicine, hematology, therapeutic radiology, and a person experienced in assay of radioisotopes and protection against ionizing radiations; and

(3) The applicant possesses adequate facilities for the clinical care of patients; and

(4) The physician designated on the application as the individual user has substantial experience in the proposed use, the handling and administration of radioisotopes and, where applicable, the clinical management of radioactive patients; and

(5) If the application is for a license to use unspecified quantities or multiple types of byproduct material, the applicant has previously received a reasonable number of licenses for a variety of byproduct materials for a variety of human uses.

(b) *Licensing of individual physicians for human use.* An application by an individual physician for a specific license for human use will be approved if the applicant:

(1) Satisfies the general requirements specified in § 30.23;

(2) The applicant has access to a hospital possessing adequate facilities to hospitalize and monitor the applicant's radioactive patients whenever it is advisable; and

(3) The applicant has extensive experience in the proposed use, the handling and administration of radioisotopes, and where applicable, the clinical management of radioactive patients. (The physician shall furnish suitable evidence of such experience with his application. A statement from the medical isotope committee in the institution where he acquired his experience, indicating its amount and nature, may be submitted as evidence of such experience.)

(c) *"Human use" of sealed sources.* An application for a specific license for use of a sealed source for human use will be approved if:

(1) The applicant satisfies the general requirements specified in § 30.23; and

(2) The applicant or, if the application is made by an institution, the individual user (i) has specialized training in the therapeutic use of the radioactive device considered (teletherapy unit, beta applicator, etc.) or has experience equivalent to such training; and (ii) is a physician.

(d) *Multiple quantities or types of byproduct material for use in research and development.* An application for a specific license for multiple quantities or types of byproduct material for use in research and development will be approved if:

(1) The applicant satisfies the general requirements specified in § 30.23; and

(2) The applicant has received a reasonable number of licenses for a variety of radioisotopes for a variety of research and development uses; and

(3) The applicant has established an isotope committee (composed of such persons as a radiological safety officer, a representative of the business office, and one or more persons trained or experienced in the safe use of radioactive ma-

terials) which will review and approve, in advance of purchase of radioisotopes, proposals for such uses; and

(4) The applicant has appointed a radiological safety officer who will advise on or be available for advice and assistance on radiological safety problems.

(e) *Multiple quantities or types of byproduct material for use in processing.* An application for a specific license for multiple quantities or types of byproduct material for use in processing for distribution to other authorized persons will be approved if:

(1) The applicant satisfies the general requirements specified in § 30.23; and

(2) The applicant has received a reasonable number of licenses for processing and distribution of a variety of radioisotopes; and

(3) The applicant has appointed a radiological safety officer who will advise on or be available for advice and assistance on radiological safety problems.

LICENSES

§ 30.21 *Issuance of specific licenses for use of byproduct material.* (a) Upon a determination that an application meets the requirements of the Act and the regulations of the Commission, the Commission will issue a specific license authorizing the possession and use of byproduct material (Form AEC 374, "Byproduct Material License").

(b) The Commission may incorporate in any license at the time of issuance, or thereafter by appropriate rule, regulation or order, such additional requirements and conditions with respect to the licensee's receipt, possession, use and transfer of byproduct material as it deems appropriate or necessary in order to:

(1) Promote the common defense and security;

(2) Protect health or to minimize danger to life or property;

(3) Protect restricted data;

(4) Require such reports and the keeping of such records, and to provide for such inspections of activities under the license as may be necessary or appropriate to effectuate the purposes of the act and regulations thereunder.

§ 30.22 *Terms and conditions of licenses.* (a) Each license issued pursuant to the regulations in this part shall be subject to all the provisions of the act, now or hereafter in effect, and to all valid rules, regulations and orders of the Commission.

(b) Neither the license nor any right under the license shall be assigned or otherwise transferred in violation of the provisions of the act.

(c) Each person licensed by the Commission pursuant to the regulations in this part shall confine his possession and use of byproduct material to the locations and purposes authorized in the license. Except as otherwise provided in the license, a license issued pursuant to the regulations in this part shall carry with it the right to receive, acquire, own, possess and import byproduct material and to transfer such material to other licensees within the United States authorized to receive such material.

(d) Each license issued pursuant to the regulations in this part shall be

deemed to contain the provisions set forth in section 183a, d., inclusive, of the act, whether or not said provisions are expressly set forth in the license.

§ 30.23 *Exports of byproduct material.* (a) No licensee shall export byproduct material from the United States except as authorized pursuant to this section.

(b) Any licensee may export byproduct material covered by his license to any foreign country except countries or areas now or hereafter listed as Subgroup A countries or destinations in § 371.3 of the Comprehensive Export Schedule of the United States Department of Commerce (15 CFR 371.3). *Provided*, That the authority conferred by this paragraph shall apply only to byproduct material having an atomic number from 3 to 83, inclusive.

(c) The Commission may upon application by an interested person issue a license authorizing the export of byproduct material to a country or area listed as a Subgroup A country or destination in § 371.3 of the Comprehensive Export Schedule of the United States Department of Commerce (15 CFR 371.3), or the export of byproduct material not having an atomic number from 3 to 83, inclusive; *Provided*, That the Commission will not issue a license authorizing such export if, in the opinion of the Commission, the proposed export would be inimical to the common defense and security.

§ 30.24 *Expiration.* Except as provided in § 30.25 (b), each specific license shall expire at the end of the day, in the month and year stated therein.

§ 30.25 *Renewal of license.* (a) Applications for renewal of a specific license shall be filed in accordance with § 30.22.

(b) In any case in which a licensee, not less than thirty (30) days prior to expiration of his existing license, has filed an application in proper form for renewal or for a new license, such existing license shall not expire until the application for a renewal has been finally determined by the Commission.

§ 30.26 *Amendment of licenses at request of licensee.* Applications for amendment of a license shall be filed in accordance with § 30.22 and shall specify the respects in which the licensee desires his license to be amended and the grounds for such amendment.

§ 30.27 *Commission action on applications to renew or amend.* In considering an application by a licensee to renew or amend his license the Commission will apply the applicable criteria set forth in §§ 30.23 and 30.24.

§ 30.28 *Inalienability of licenses.* No license issued or granted pursuant to the regulations in this part shall be transferred, assigned or in any manner disposed of, either voluntarily or involuntarily, directly or indirectly, through transfer of control of any license to any person, unless the Commission shall, after securing full information, find that the transfer is in accordance with the provisions of this act, and shall give its consent in writing.

§ 30.29 *Persons possessing byproduct material on effective date of regulations*

in this part. (a) Any person who on the effective date of the regulations in this part possesses byproduct material pursuant to an authorization heretofore issued by the Commission shall be deemed to possess such material pursuant to a license issued under the regulations in this part which shall expire ninety days after receipt from the Commission of a notice of expiration of such license. Such license shall be deemed to include all terms and conditions incorporated in such authorization which are not inconsistent with or otherwise provided for in the regulations in this part.

(b) Any authorization heretofore issued pursuant to the regulations in this part shall be deemed to be a valid license during the period prior to the expiration date set forth in said authorization. Such license shall be deemed to include all terms and conditions incorporated in such authorization which are not inconsistent with or otherwise provided for in the regulations in this part.

RECORDS, REPORTS AND INSPECTIONS

§ 30.41 *Records.* (a) Each person who receives byproduct material pursuant to a license issued pursuant to the regulations in this part shall keep records showing the receipt, transfer, export and disposal of such byproduct material.

§ 30.42 *Reports of exports.* Each licensee who exports byproduct material from the United States shall, within 90 days from the date of such export, submit a report to the United States Atomic Energy Commission, Post Office Box E, Oak Ridge, Tennessee, Attention: Isotopes Division, containing his name and address, the name and address of the consignee, the name and quantity of the byproduct material involved, and the date of shipment.

§ 30.43 *Inspection.* (a) Each licensee shall afford to the Commission at all reasonable times opportunity to inspect byproduct material and the premises and facilities wherein byproduct material is used or stored.

(b) Each licensee shall make available to the Commission for inspection, upon reasonable notice, records kept by him pursuant to the regulations in this chapter.

§ 30.44 *Tests.* Each 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, including tests of:

- (a) Byproduct material,
- (b) Facilities wherein byproduct material is utilized or stored,
- (c) Radiation detection and monitoring instruments, and
- (d) Other equipment and devices used in connection with the utilization or storage of byproduct material.

MODIFICATION AND REVOCATION OF LICENSES

§ 30.51 *Modification and revocation of licenses.* (a) The terms and conditions of each license shall be subject to amendment, revision or modification by reason

of amendments to the act, or by reason of rules, regulations and orders issued in accordance with the terms of the act.

(b) Any license may be revoked, suspended or modified, in whole or in part, for any material false statement in the application or any statement of fact required under section 182 of the act, or because of conditions revealed by such application or statement of fact or any report, record or inspection or other means which would warrant the Commission to refuse to grant a license on an original application, or for violation of, or failure to observe any of the terms and provisions of the act or of any rule, regulation or order of the Commission.

(c) Except in cases of willfulness or those in which the public health, interest or safety requires otherwise, no license shall be modified, suspended or revoked unless, prior to the institution of proceedings therefor, facts or conduct which may warrant such action shall have been called to the attention of the licensee in writing and the licensee shall have been accorded an opportunity to demonstrate or achieve compliance with all lawful requirements.

§ 30.52 *Right to withhold or recall byproduct material.* The Commission may withhold, recall or order the withholding or recall of byproduct material from any licensee who is not equipped to observe or fails to observe such safety standards to protect health as may be established by the Commission, or who uses such materials in violation of law or regulation of the Commission, or in a manner other than as disclosed in the application therefor or approved by the Commission.

ENFORCEMENT

§ 30.61 *Violations.* 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 willfully violates any provision of the act 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.

SCHEDULES

§ 30.71 *Schedule A.* The following devices and equipment incorporating byproduct material, when manufactured, tested and labeled by the manufacturer in accordance with the specifications contained in a specific license issued to him pursuant to the regulations in this part, are placed under a general license pursuant to § 30.21 (a) (1).

(a) *Static elimination device.* Devices designed for use as static eliminators which contain, as a sealed source or sources, byproduct material consisting of a total of not more than 500 microcuries of Polonium 210 per device.

(b) *Spark gap and electronic tubes.* Spark gap tubes and electronic tubes which contain byproduct material consisting of not more than 5 microcuries per tube of Cesium 137, or Nickel 63, or Krypton 85 gas, or not more than one microcurie per tube of Cobalt 60.

(c) *Light meter.* Devices designed for use in measuring or determining light intensity which contain, as a sealed source or sources, byproduct material consisting of a total of not more than 200 microcuries of Strontium 90 per device.

(d) *Ion generating tube.* Devices designed for ionization of air which contain, as a sealed source or sources, byproduct material consisting of a total of not more than 500 microcuries of Polonium 210 per device or of a total of not more than 50 millicuries of Hydrogen 3 (tritium) per device.

§ 30.72 *Schedule B.* The following quantities of byproduct material are generally licensed pursuant to § 30.21 (a) (2).

Byproduct material	Column No. 1	Column No. 11
	Not as a product (unless stated)	As a product (unless stated)
Antimony (Sb 124).....	1	10
Arsenic 70 (As 70).....	30	10
Arsenic 77 (As 77).....	30	10
Bismuth 140-140-140.....	1	10
Beryllium (Be 7).....	50	10
Cadmium 100-Silver 100 (Cd Ag 100).....	10	10
Calcium 40 (Ca 40).....	10	10
Carbon 14 (C 14).....	50	10
Cerium 144-144-144 (Ce 144).....	1	10
Cesium-Barium 137 (Cs Ba 137).....	1	10
Chlorine 36 (Cl 36).....	1	10
Chromium 51 (Cr 51).....	50	10
Cobalt 60 (Co 60).....	1	10
Copper 64 (Cu 64).....	50	10
Europium 154 (Eu 154).....	1	10
Fluorine 18.....	50	10
Gallium 72 (Ga 72).....	10	10
Germanium 71 (Ge 71).....	50	10
Gold 198 (Au 198).....	10	10
Gold 199 (Au 199).....	10	10
Hydrogen 3 (Tritium) (H 3).....	250	10
Iodine 131 (I 131).....	1	10
Iodine 131 (I 131).....	10	10
Iodine 131 (I 131).....	10	10
Iron 56 (Fe 56).....	50	10
Iron 59 (Fe 59).....	1	10
Lanthanum 140 (La 140).....	10	10
Lanthanum 140 (La 140).....	1	10

Note: The reporting and record-keeping requirements contained herein have been approved by the Bureau of the Budget in accordance with The Federal Reports Act of 1942.

Dated at Washington, D. C., this 28th day of December 1955.

K. E. Fields,
General Manager.

[F. R. Doc. 58-137; Filed, Jan. 10, 1956;
6:00 p. m.]

MISCELLANEOUS AMENDMENTS

FEDERAL REGISTER

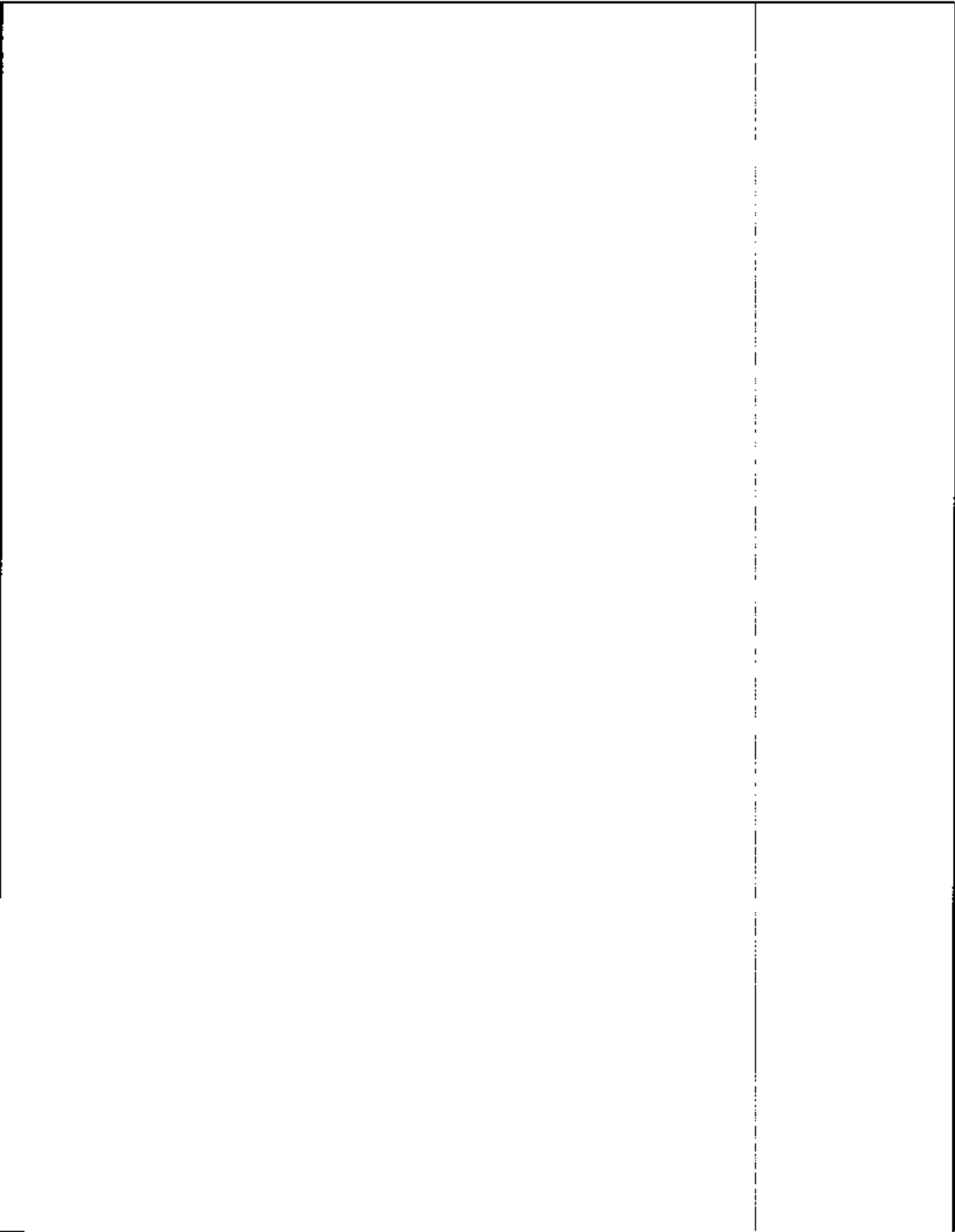
Tuesday, September 25, 1956

[F. R. Doc. 56-7088; Filed, Sept. 24, 1956;
8:45 a. m.]

FEDERAL REGISTER

Wednesday, October 3, 1956

[F. R. Doc. 56-7072; Filed, Oct. 2, 1956;
8:55 a. m.]



(Reprinted from 24, Federal Register, 1089, February 12, 1959)

Title 10—ATOMIC ENERGY**Chapter I—Atomic Energy Commission****PART 30—LICENSING OF BYPRODUCT MATERIAL****General Licensing of Devices**

On January 10, 1958, the Commission issued for public comment a proposed amendment to Part 30 providing for a general license authorizing the possession and use under specified conditions of certain types of measuring, gauging or controlling devices containing byproduct material. Experience has indicated a need for a simplified procedure to allow users of such devices to possess and use byproduct material, when contained in such devices, without obtaining a specific license. The Commission will continue to exercise control over the manufacture and distribution of the devices through its specific licensing procedures. The general license will be applicable only to devices that are manufactured, tested, and labeled in accordance with specifications contained in a specific license authorizing supply of such devices to generally licensed persons.

Each applicant for a specific license to supply to general licensees devices designed and manufactured for the purpose of detecting, measuring, gauging or controlling thickness, density, level, interface location, radiation, leakage, qualitative or quantitative chemical composition, or for producing light or an ionized atmosphere will be required to furnish sufficient information to assure that, among other things, the device can be safely operated by persons not having any training in radiological protection and that under normal conditions of use no person would be likely to receive more than a limited specified radiation exposure. Furthermore, the specifically licensed supplier will be required to apply quality control procedures to assure that the device meets the required specifications. In most cases, testing of a prototype of the device will also be required prior to the issuance of a license authorizing distribution to general licensees. Specific licensees will be obliged to report to the Commission on all transfers of the devices to generally licensed persons; thereby enabling the Commission to make appropriate inspections of the use of the devices.

Under the amendment the general licensees will be required to comply with certain restrictions which, in general will require that testing and servicing of the devices be accomplished by the manufacturer or other persons holding specific licenses. To assure that the general licensee is informed of the obligations imposed on him, the specifically licensed supplier will be required to furnish a copy of the general license provisions as

contained in Title 10, Code of Federal Regulations, Chapter I, Part 30, "Licensing of Byproduct Material" to each generally licensed person to whom he transfers a device containing byproduct material.

Because this amendment establishes additional procedures for authorizing the distribution of devices containing byproduct material, and immediate effectiveness will not adversely affect any person, the Commission has found that good cause exists why this amendment should be made effective without the customary period of prior notice.

Pursuant to the Administrative Procedure Act, Public Law 404, 79th Congress, 2d Session, Title 10, Code of Federal Regulations, Chapter I, Part 30, "Licensing of Byproduct Material," is amended as follows, effective upon filing with the Federal Register Division:

1. Add a new paragraph (c) to § 30.21 to read as follows:

(c) (1) A general license is hereby issued to own, receive, acquire, possess and use byproduct material when contained in devices designed and manufactured for the purpose of detecting, measuring, gauging or controlling thickness, density, level, interface location, radiation, leakage, or qualitative or quantitative chemical composition or for producing light or an ionized atmosphere, when such devices are manufactured in accordance with the specifications contained in a specific license issued to the supplier pursuant to § 30.24(f); *Provided, That:*

(i) The general license contained in this paragraph shall apply only to devices distributed under and in accordance with a specific license which states that such devices when manufactured pursuant to the terms of the specific license may be distributed by the licensee pursuant to this paragraph;

(ii) That such devices are labeled in accordance with the provisions of the specific license which authorizes the distribution of the devices; and

(iii) That the device bear a label containing the following statement:

This device, generally licensed pursuant to § 30.21(c) of 10 CFR, Part 30, has been manufactured and distributed pursuant to AEC license No. _____ by _____

(Name of supplier)

(2) Persons who own, receive, acquire, possess or use a device pursuant to the general license contained in subparagraph (1) of this paragraph:

(i) Shall not transfer, abandon or dispose of the device, except by transfer to a person specifically licensed by the Commission to receive such device;

(ii) Shall assure that all labels affixed to the device at the time of receipt and bearing the statement, "Removal of this label is prohibited by regulations of the Atomic Energy Commission," are maintained thereon and shall comply with all instructions contained in such labels;

(iii) Shall have the device tested for leakage of radioactive material and proper operation of the on-off mechanism

and indicator, if any, at no longer than six-month intervals; provided that devices containing only krypton need not be tested for leakage, and devices containing only tritium need not be tested for any purpose;

(iv) Shall have the tests required by subdivision (iii) of this subparagraph and all other services involving the radioactive material, its shielding and containment, performed by the supplier or other person holding a specific license to manufacture, install or service such devices;

(v) Shall maintain records of all tests performed on the devices as required under this section, including the dates and results of the tests and the names of the specific licensees conducting the tests;

(vi) Upon the occurrence of a failure of or damage to, or any indication of a possible failure of or damage to, the shielding or containment of the radioactive material or the on-off mechanism or indicator, shall immediately suspend operation of the device until it has been repaired by the supplier or other person holding a specific license to manufacture, install or service such devices, or disposed of by transfer to a person specifically licensed to receive the byproduct material contained in the device; and

(vii) Shall be exempt from the requirements of Part 30 of this chapter, except that such persons shall comply with the provisions of §§ 20.403 and 20.405.

(3) The general license provided in this paragraph is subject to the provisions of §§ 30.22 to 30.72, inclusive: *Provided, That* persons who possess byproduct material pursuant to this general license shall not export such byproduct material without a specific license from the Commission authorizing such export.

2. Add a new paragraph (f) to § 30.24 to read as follows:

(f) *Distribution of devices to persons generally licensed under § 30.21(c).* An application for a specific license to distribute certain devices of the types enumerated in § 30.21(c) to persons generally licensed under § 30.21(c) will be approved if:

(1) The applicant satisfies the general requirements specified in § 30.23; and

(2) The applicant submits sufficient information relating to the design, manufacture, prototype testing, quality control procedures, labeling, proposed uses and potential hazards of the device to provide reasonable assurance that:

(i) The byproduct material contained in the device will not be lost;

(ii) That no person would receive a radiation exposure to a major portion of his body in excess of 0.5 rem in a year under ordinary circumstances of use;

(iii) The device can be safely operated by persons not having training in radiological protection; and

(iv) The byproduct material within the device would not be accessible to un-

authorized persons.

(8) In describing the label or labels and contents thereon to be affixed to the device, the applicant should separately indicate those instructions and precautions which are necessary to assure safe operation of the device. Such instructions and precautions must be contained on labels bearing the statement, "Removal of this label prohibited by regulations of the Atomic Energy Commission."

3. Add a new paragraph (e) in § 30.32 to read as follows:

(e) Each licensee authorized under § 30.24(f) to distribute certain devices to generally licensed persons:

(1) Shall report to the Director, Division of Licensing and Regulation all transfers of such devices to persons generally licensed under § 30.21(e). Such report shall identify each general licensee by name and address, the type of device transferred, and the quantity and type of byproduct material contained in the device. The report shall be submitted within 30 days after the end of each calendar quarter in which such a device is transferred to generally licensed persons; and

(2) Shall furnish to each general licensee to whom he transfers such device a copy of the general license contained in § 30.21(e).

(Sec. 161, 66 Stat. 948; 42 U.S.C. 2201)

Dated at Germantown, Md., this 9th day of February 1959.

For the Atomic Energy Commission.

A. R. LUNSKY,
General Manager.

[F.R. Doc. 66-1809; Filed, Feb. 10, 1959;
2:16 p.m.]

(Reprinted from 25 F. R., 12169, November 29, 1960)

Title 10—ATOMIC ENERGY**Chapter I—Atomic Energy
Commission****PART 30—LICENSING OF
BYPRODUCT MATERIAL****Licensing Criteria for Radiography.**

On March 15, 1960, the Commission issued for public comment a proposed amendment to 10 CFR Part 30 which would establish special requirements for the issuance of specific licenses for the use of sealed sources of byproduct material in radiography. Comments filed by interested persons have been given careful consideration.

The following rules are published as a document subject to codification, effective 30 days after publication in the *FEDERAL REGISTER*. The requirements of this regulation are in addition to, and not in substitution for, other requirements of the Atomic Energy Commission.

1. Add the following definitions to § 30.4:

(x) "Radiographer" means any individual who performs or who, in attendance at the site where the sealed source or sources are being used, personally supervises radiographic operations and who is responsible to the licensee for assuring compliance with the requirements of the regulations of this part and the conditions of the license.

(y) "Radiographer's assistant" means any individual who, under the personal supervision of a radiographer, uses radiographic exposure devices, sealed sources or related handling tools, or survey instruments in radiography.

(z) "Radiography" means the examination of the structure of materials by nondestructive methods, utilizing sealed sources of byproduct materials.

2. Revise § 30.4(1) to read as follows:

(1) "Sealed source" means any byproduct material that is encased in a capsule designed to prevent leakage or escape of the byproduct material.

3. Add the following paragraph to § 30.24:

(g) *Use of sealed sources in radiography.* An application for a specific license for use of sealed sources in radiography will be approved if:

(1) The applicant satisfies the general requirements specified in § 30.23; and

(2) The applicant will have an adequate program for training radiographers and radiographers' assistants and submit to the Commission a schedule or description of such program which specifies the:

- (i) Initial training;
- (ii) Periodic training;
- (iii) On-the-job training;

(iv) Means to be used by the licensee to determine the radiographer's knowledge and understanding of and ability to comply with Commission regulations and licensing requirements, and the operating and emergency procedures of the applicant;

(v) Means to be used by the licensee to determine the radiographer's assistant's knowledge and understanding of and ability to comply with the operating and emergency procedures of the applicant; and

(3) The applicant has established and submits to the Commission satisfactory written operating and emergency procedures as described in § 31.203 of this chapter; and

(4) The applicant will have an adequate internal inspection system, or other management control, to assure that Commission license provisions, Commission regulations, and the applicant's operating and emergency procedures are followed by radiographers and radiographers' assistants; and

(5) The applicant submits a description of its overall organizational structure pertaining to the radiography program, including specified delegations of authority and responsibility for operation of the program; and

(6) The applicant who desires to conduct his own leak tests has established adequate procedures to be followed in leak testing sealed sources, for possible leakage and contamination and submits to the Commission a description of such procedures including:

- (i) Instrumentation to be used,
- (ii) Method of performing test, e.g., points on equipment to be smeared and method of taking smear, and
- (iii) Pertinent experience of the person who will perform the test.

(Sec. 101, 68 Stat. 949; 42 U.S.C. 2201)

Dated at Germantown, Md., this 18th day of November 1960.

For the Atomic Energy Commission.

WOODROW B. MCCOOL,
Secretary.

[F.R. Doc 60-11014; Filed, Nov. 28, 1960;
8:15 a.m.]

(Reprinted from 25 F. R. 7875, August 17, 1960)

Title 10—ATOMIC ENERGY

Chapter I—Atomic Energy Commission

PART 30—LICENSING OF BY PRODUCT MATERIAL

Exempt Concentrations

On October 31, 1958, the Commission issued for public comment a proposed amendment to "Licensing of Byproduct Material," 10 CFR Part 30, which would exempt byproduct material from licensing requirements when contained in products in specified low concentrations. The amendment published below retains the substantive provisions set forth in the proposed rule although changes have been made in the text and concentration values to reflect recent information from the National Committee on Radiation Protection and is consonant with the Radiation Protection Guide approved by the President on May 13, 1960.

The exemption is intended to facilitate the distribution of products subjected to control procedures involving the use of byproduct material. With the exception of the person who introduces the byproduct material into a product, a licensee will not be required in order to receive, use, transfer, or dispose of such products. The licensee who introduces byproduct material into a product may transfer the byproduct material only if the transfer is made in accordance with a license issued pursuant to § 30.24(h) of the amendment. This limitation, however, would not restrict the transfer to a duly licensed person of byproduct material intended for analytical or laboratory purposes or for waste disposal.

The license-exempt concentrations in § 30.73 Schedule C, of the following amendment are equal to the lowest value for each byproduct material given in Table I of National Bureau of Standards Handbook 49 for continuous occupational exposure (168-hour week). The values selected are those for soluble forms which in general are lower than for insoluble forms. The products in which license-exempt concentrations would be permitted are items such as oil, gasoline, plastics, and similar commercial or industrial items where inhalation or ingestion is unlikely. In addition, while the concentration values in NBS 49 are based on continuous exposure for a whole lifetime, such exposure from the products involved here is highly unlikely. It is highly improbable, therefore, that any member of the public will receive an organ dose in excess of a small fraction of 0.5 rem, the Radiation Protection Guide for members of the general population recommended by the President in his memorandum dated May 13, 1960. The proposed exempt concentrations are high enough to make quality control applica-

tions feasible from the measurement standpoint and low enough to assure safety of the public.

The values set forth in the following amendment are established as concentrations which the Commission considers may be exempted from licensing requirements to the extent provided in this amendment. However, applicants for licenses pursuant to § 30.24(h) of the amendment will be required to show that, for their particular purpose, lower concentrations than those specified in § 30.73 are not feasible. The Commission does not propose to license the distribution of products containing byproduct material under this amendment if it is likely that such products will be ingested or inhaled.

Persons licensed under this amendment to distribute products containing byproduct material would be required to file an annual report describing the products transferred and the total amount of each byproduct material in such products transferred during the year. This will keep the Commission informed of the total amount of activity transferred in such concentrations and provide a basis for a continuing evaluation of the addition of radioactivity to the environment.

The scheduled concentrations pertain to the parent activity in those cases where a radioisotope disintegrates into other radioactive isotopes or daughter products. The proposed exemption does not extend to imports of byproduct material. Requirements for the issuance of a license authorizing the transfer of products or materials containing byproduct material are separately stated in § 30.24(h) of the amendment published below.

The Commission has found that the exemption set forth in this amendment will not constitute an unreasonable risk to the common defense and security and to the health and safety of the public.

Section 274 of the Atomic Energy Act of 1954, as amended, establishes, among other things, procedures and criteria for the discontinuance of certain of the Commission's regulatory responsibilities with respect to byproduct, source, and special nuclear materials, and the assumption thereof by the states. Notwithstanding, any agreement between the Commission and any state for the assumption of regulatory responsibilities previously exercised by the Commission, the Commission is authorized under subsection 274c, to require, by rule or order, "that the manufacturer, processor, or producer of any equipment, device, commodity, or other product containing source, byproduct, or special nuclear material shall not transfer possession or control of such product except pursuant to a license issued by the Commission."

Prior to executing any agreement providing for assumption of regulatory re-

sponsibilities by a state, the Commission will consider exercising the authority conferred on it by subsection 274c with respect to distribution of products covered by the following amendments.

Pursuant to the Administrative Procedure Act, Public Law 404, 79th Congress, 2d session, Title 16, Chapter I, Part 30, "Licensing of Byproduct Material," is amended as follows, effective thirty days after publication in the Federal Register:

1. Add a new § 30.9 to read as follows:
§ 30.9. Exempt concentrations.

(a) Except as provided in § 30.22(f), any person is exempt from the requirements for a license set forth in section 81 of the Act and from the regulations in this part to the extent that such person receives, possesses, uses, transfers, owns or acquires products or materials containing byproduct material in concentrations not in excess of those listed in § 30.73.

(b) This section shall not be deemed to authorize the import of byproduct material or products containing byproduct material.

§ 30.24 (Amendment)

2. Add a new § 30.24(h) to read as follows:

(h) *Licensing the transfer of products containing exempt concentrations of byproduct material.* (1) An application for a specific license to transfer possession or control of products or materials containing exempt concentrations of byproduct material which the transferor has introduced into the product or material will be approved if the applicant:

(i) Satisfies the general requirements specified in § 30.23;

(ii) Submits a description of the product or material into which the byproduct material will be introduced, intended use of the byproduct material and the product into which it is introduced, method of introduction, initial concentration of the byproduct material in the product or material, control methods to assure that no more than the specified concentration is introduced into the product or material, estimated time interval between introduction and transfer of the product or material, and estimated concentration of the radioisotope in the product or material at the time of transfer by the licensee; and

(iii) Provides reasonable assurance that the concentrations of the byproduct material at the time of transfer will not exceed the concentrations in § 30.73, that concentration of the byproduct material in concentrations exceeding those in § 30.73 is not likely, that the product or material is not likely to be inhaled or ingested, and that use of lower concentrations is not feasible.

(2) Each person licensed under this paragraph shall file an annual report with the Director, Division of Licensing

and Regulation, describing the kind and quantities of products transferred, the concentration of byproduct material contained and the quantity of byproduct material transferred during the reporting period. Each report shall be filed as of June 30 and shall be filed within 30 days thereafter.

§ 30.32 [Amended]

3. Add a new § 30.32(f) to read as follows:

(f) Notwithstanding the provisions of §§ 30.9 and 30.32(c) of this part, no person licensed by the Commission pursuant to the regulations in this part shall transfer possession or control of any product or material containing concentrations of byproduct material not exceeding those specified in § 30.73 which he has introduced into the product or material unless the transferor has received a license from the Commission pursuant to § 30.34(h) authorizing such transfer. The provisions of this paragraph (f) shall not apply to transfers to duly licensed persons of products or materials containing byproduct material for analytical, laboratory, or waste disposal purposes. This paragraph shall not be deemed to modify any authority granted to any person in a specific license issued by the Commission prior to the effective date of this paragraph.

4. Add a new § 30.73 to read as follows:
§ 30.73 Schedule C.

Element (atomic number)	Isotope	Column I Gas concentration cc/ml	Column II Liquid and solid concentration uc/ml
Antimony (51)	Sb 123		5×10^{-4}
	Sb 124		2×10^{-4}
	Sb 125		1×10^{-4}
Argon (18)	A 37	1×10^{-4}	
	A 41	4×10^{-4}	
Arsenic (33)	As 73		5×10^{-4}
	As 74		2×10^{-4}
	As 75		2×10^{-4}
	As 76		2×10^{-4}
	As 77		2×10^{-4}
Barium (56)	Ba 134		2×10^{-4}
	Ba 140		2×10^{-4}
Beryllium (4)	Be 7		2×10^{-4}
Bismuth (83)	Bi 206		4×10^{-4}
Protactinium (91)	Pa 231		2×10^{-4}
Cadmium (48)	Cd 115m		2×10^{-4}
	Cd 115		2×10^{-4}
	Cd 116m		2×10^{-4}
	Cd 116		2×10^{-4}
	Cd 117		2×10^{-4}
	Cd 118		2×10^{-4}
	Cd 119		2×10^{-4}
	Cd 120		2×10^{-4}
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	Cd 361		2×10^{-4}
	Cd 362		2×10^{-4}
	Cd 363		2×10^{-4}
	Cd 364		2×10^{-4}
	Cd 365		2×10^{-4}
	Cd 366		2×10^{-4}
	Cd 367		2×10^{-4}
	Cd 368		2×10^{-4}
	Cd 369		2×10^{-4}
	Cd 370		2×10^{-4}
	Cd 371		2×10^{-4}
	Cd 372		2×10^{-4}
	Cd 373		2×10^{-4}
	Cd 374		2×10^{-4}
	Cd 375		2×10^{-4}
	Cd 376		2×10^{-4}
	Cd 377		2×10^{-4}
	Cd 378		2×10^{-4}
	Cd 379		2×10^{-4}
	Cd 380		2×10^{-4}
	Cd 381		2×10^{-4}
	Cd 382		2×10^{-4}
	Cd 383		2×10^{-4}
	Cd 384		2×10^{-4}
	Cd 385		2×10^{-4

(Reprinted from 25 F. R., 12730, December 13, 1960)

TITLE 10—ATOMIC ENERGY

Chapter I—Atomic Energy
CommissionPART 30—LICENSING OF
BYPRODUCT MATERIALExemption of Luminous Dial Timepieces
Containing Hydrogen 3
(Tritium)

On July 2, 1960, the Commission issued for public comment a proposed amendment to 10 CFR Part 30 to exempt from licensing and other regulatory controls luminous dial timepieces containing tritium. Comments filed by interested persons have been given careful consideration.

The amendment is designed to relieve from licensing and AEC regulatory controls persons who receive luminous dial timepieces containing tritium in accordance with the standards set forth in the amendment.

The principal changes which have been made in the amendment as published on July 2, 1960, as a notice of proposed rule making are as follows:

(a) The amendment will provide for a preliminary evaluation of luminous dial timepieces to determine if the standards set forth in the amendment will be met rather than merely setting standards which licensees must meet in order to distribute timepieces. A person who applies tritium to timepieces or imports timepieces containing tritium from a foreign manufacturer must obtain a specific license which would authorize the exempt distribution of luminous timepieces.

(b) A requirement has been added to § 30.24 which requires an applicant for a specific license to submit detailed information on the type of luminous products which will be applied to timepieces, the methods which will be used in applying the luminous products to the timepieces, and the prototype and quality control testing which will be carried out to determine that the radioactive material is firmly bound to the hands or dials contained in the timepieces.

(c) A requirement has been added to § 30.24 which requires an applicant for a specific license to carry out specific tests which include (1) bending of hands, (2) a shock test by means of vibration of a timepiece and (3) an immersion test. Any visible flaking or chipping of the

radioactive material or loss of more than five percent of the tritium will be considered a cause for rejection.

Further study is being given by the Commission to exemption of other radionuclides for use as luminescing agents for timepieces.

Notice is hereby given that the following amendments are adopted to be effective 30 days after publication in the *Federal Register*.

1. Add a new § 30.10 to read as follows:
§ 30.10 Certain luminous timepieces.

(a) Except for persons who apply tritium to luminous timepieces or hands or dials and persons who import for sale or distribution luminous timepieces or hands or dials containing tritium, any person is exempt from the requirements for a license set forth in section 51 of the Act and from the regulations in Parts 20 and 30 of this chapter to the extent that such person receives, possesses, uses, transfers, exports, owns or acquires luminous timepieces or hands or dials containing tritium.

(b) Any person who desires to apply tritium to luminous timepieces or hands or dials for sale or distribution, or desires to import for sale or distribution luminous timepieces or hands or dials containing tritium, should apply for a specific license, pursuant to § 30.24 (i), which license states that the luminous timepieces or hands or dials may be distributed by the licensee to persons exempt from the regulations pursuant to paragraph (a) of this section.

§ 30.24 [Amendment]

2. Add a new paragraph (i) to § 30.24 to read as follows:

(i) Certain luminous timepieces. An application for a specific license to apply tritium contained in luminous compounds to timepieces or hands or dials, or to import timepieces or hands or dials containing tritium for use pursuant to § 30.10 will be approved if: (1) The applicant satisfies the general requirements specified in § 30.23 and (2) the applicant submits sufficient information relating to the chemical and physical composition and characteristics of the luminous compound(s), the method of application of each compound, quality control procedures and prototype testing of luminous dials, and

(3) The tritium is bound in the luminous compound in a non-water-soluble and non-labile form and the compound

is bound to the dials or hands. The tritium will be considered to be properly bound to the dials and hands if there is no visible flaking or chipping and the total loss of tritium does not exceed 5 percent of the total tritium when prototype dials and hands are subjected to the following tests in the order specified below:

(a) Attachment of dial to a vibrating fixture and vibration at a rate of not less than 20 cycles per second and a vibration acceleration of not less than 5G for a period of not less than one hour; and

(b) Attachment of the hub ends of the hands to a stamp and bending of hands over a one-inch diameter cylinder; and

(c) Total immersion of this dial and hands used in the tests described in (a) and (b) of this subdivision in 100 milliliters of water at room temperature for a period of 24 consecutive hours and analysis of the test water for its radioactive material content by liquid scintillation counting or other equally sensitive method.

(ii) Not more than a total of 25 millicuries of tritium will be applied per timepiece; and

(iii) Not more than a total of 5 millicuries of tritium will be applied per hand and not more than 15 millicuries will be applied per dial (hands when used shall be considered as part of the dial).

(Secs. 51, 161, 35 Stat. 998, 999; 42 U.S.C. 2111, 2301)

Dated at Germantown, Md., this 2d day of December 1960.

For the Atomic Energy Commission.

Woodrow B. McCormack,
Secretary.

[F.R. Doc. 60-11548; Filed, Dec. 12, 1960; 9:46 a.m.]

(Reprinted from 26 F. R., 284, January 14, 1961)

Title 10—ATOMIC ENERGY**Chapter I—Atomic Energy Commission****PART 40—LICENSING OF SOURCE MATERIAL**

The following amendments to Part 40 constitute an over-all revision of 10 CFR Part 40, "Control of Source Material".

Notice of proposed issuance of the following rules was published in the *FEDERAL REGISTER* on September 7, 1960 (25 F.R. 8619). A detailed statement of considerations explaining the provisions of the following amendments was published with the notice of proposed rule making. Comments filed by interested persons have been given careful consideration. The following amendments are the same as those incorporated in the notice of proposed rule making, except that § 40.43 has been revised to take into account long-period facility licenses which incorporate in a single document licenses also for source material which may be used as fuel or blanket material.

Accordingly, effective 30 days after publication in the *FEDERAL REGISTER*, 10 CFR Part 40 is amended to read as follows:

GENERAL PROVISIONS

- Sec.
40.1 Purpose.
40.2 Scope.
40.3 License requirements.
40.4 Definitions.
40.5 Communications.
40.6 Interpretations.

EXEMPTIONS

- 40.11 Exemption for persons acquiring or transferring source material under contract with and for the account of the Commission.
40.12 Carriers.
40.13 Unimportant quantities of source material.
40.14 Specific exemptions.

GENERAL LICENSES

- 40.20 Types of licenses.
40.21 General license to receive title to source material.
40.22 Small quantities of source material.
40.23 General licenses to export.

LICENSE APPLICATIONS

- 40.31 Applications for specific licenses.
40.32 Requirements for approval of applications for specific licenses.
40.33 Standards for issuance of export licenses.

LICENSES

- 40.41 Terms and conditions of licenses.
40.42 Expiration.
40.43 Renewal of licenses.
40.44 Amendment of licenses at request of licensee.
40.45 Commission action on applications to renew or amend.
40.46 Inalienability of licenses.
40.47 License requirement for persons possessing source material on the effective date of the regulation in this part.

TRANSFER OF SOURCE MATERIAL

- 40.51 Transfer of source material.

RECORDS AND INSPECTIONS

- 40.61 Records.
40.62 Inspections.
40.63 Tests.

MODIFICATION AND REVOCATION OF LICENSES

- 40.71 Modification, revocation and termination of licenses.

ENFORCEMENT

- 40.81 Violations.

SCHEDULE

- 40.90 Schedule A.

AUTHORITY: §§ 40.1 to 40.90 issued under sec. 161, 48 Stat. 948, 42 U.S.C. 2201. Interpret or apply secs. 62, 63, 64, 65, 162, 163, 68 Stat. 942, 943, 948, 42 U.S.C. 2002, 2003, 2004, 2005, 2233, 2235. For the purposes of sec. 223, 68 Stat. 948; 42 U.S.C. 2273, sec. 40.61(c) issued under sec. 161b, 68 Stat. 948; 42 U.S.C. 2201(b) and secs. 40.81, 40.82 and 40.83 issued under sec. 161p, 68 Stat. 950; 42 U.S.C. 2201(p).

GENERAL PROVISIONS**§ 40.1 Purpose.**

(a) The regulations in this part establish procedures and criteria for the issuance of licenses to receive title to, receive, possess, use, transfer, deliver, or import into or export from the United States source material and establish and provide for the terms and conditions upon which the Commission will issue such licenses.

(b) The regulations contained in this part are issued pursuant to the Atomic Energy Act of 1954, as amended (68 Stat. 919).

§ 40.2 Scope.

Except as provided in §§ 40.11 to 40.14, inclusive, the regulations in this part apply to all persons in the United States.

§ 40.3 License requirements.

No person subject to the regulations in this part shall receive title to, receive,

possess, use, transfer, deliver, or import into or export from the United States any source material after removal from its place of deposit in nature, except as authorized in a specific or general license issued by the Commission pursuant to the regulations in this part.

§ 40.4 Definitions.

As used in this part:

(a) "Act" means the Atomic Energy Act of 1954 (68 Stat. 919), including any amendments thereto;

(b) "Commission" means the Atomic Energy Commission or its duly authorized representatives;

(c) "Government agency" means any executive department, commission, independent establishment, corporation, wholly or partly owned by the United States of America which is an instrumentality of the United States, or any board, bureau, division, service, office, officer, authority, administration, or other establishment in the executive branch of the Government;

(d) "License", except where otherwise specified, means a license issued pursuant to the regulations in this part;

(e) "Person" means (1) any individual, corporation, partnership, firm, association, trust, estate, public or private institution, group, Government agency other than the Commission, any State or any political subdivision of, or any political entity within a State, any foreign government or nation or any political subdivision of any such government or nation, or other entity; and (2) any legal successor, representative, agent or agency of the foregoing;

(f) "Pharmacist" means an individual registered by a state or territory of the United States, the District of Columbia or the Commonwealth of Puerto Rico to compound and dispense drugs, prescriptions and poisons.

(g) "Physician" means an individual licensed by a state or territory of the United States, the District of Columbia or the Commonwealth of Puerto Rico to dispense drugs in the practice of medicine.

(h) "Source Material" means (1) uranium or thorium, or any combination thereof, in any physical or chemical

found in (2) ores which contain by weight one-twentieth of one percent (0.05 percent) or more of (a) uranium, (b) thorium, or (c) any combination thereof. Source material does not include special nuclear material.

(i) "Special nuclear material" means (1) plutonium, uranium 233, uranium enriched in the isotope 233 or in the isotope 235, and any other material which the Commission, pursuant to the provisions of section 51 of the Act, determines to be special nuclear material; or (2) any material artificially enriched by any of the foregoing;

(j) "United States," when used in a geographical sense, includes all territories and possessions of the United States, the Canal Zone and Puerto Rico;

(k) "Unrefined and unprocessed ore" means ore in its natural form prior to any processing, such as grinding, roasting or beneficiating, or refining;

(l) Other terms defined in section 11 of the Act shall have the same meaning when used in the regulations in this part.

§ 40.5 Communications.

All communications concerning the regulations in this part should be addressed to the Atomic Energy Commission, Washington 25, D.C., Attention: Director, Division of Licensing and Regulation.

§ 40.6 Interpretations.

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.

EXEMPTIONS

§ 40.11 Exemption for persons acquiring or transferring source material under contract with and for the account of the Commission.

The regulations in this part do not apply to any person to the extent that such person receives possession of source material owned by the Atomic Energy Commission, or transfers, delivers, or exports source material owned by the Commission under and in accordance with a contract with and for the account of the Commission. In any such case, such person's obligations with respect to the source material are governed by the applicable contract between such person and the Commission.

§ 40.12 Carriers.

Common and contract carriers, warehousemen, and the United States Post Office Department are exempt from the requirements for a license set forth in section 62 of the Act and from the regulations in this part to the extent that they transport or store source material in the regular course of carriage for another or storage incident thereto.

§ 40.13 Unimportant quantities of source material.

(a) Any person is exempt from the regulations in this part and from the requirements for a license set forth in section 62 of the Act to the extent that

such person receives, possesses, uses, transfers, delivers, or imports into or exports from the United States source material in any chemical mixture compound, solution, or alloy in which the source material is by weight less than one-twentieth of 1 percent (0.05 percent) of the mixture, compound, solution or alloy.

(b) Any person is exempt from the regulations in this part and from the requirements for a license set forth in section 62 of the Act to the extent that such person receives, possesses, uses, transfers, or imports into the United States unrefined and unprocessed ore containing source material; provided, that, except as authorized in a specific license, such person shall not refine or process such ore. The exemption contained in this paragraph shall not be deemed to authorize the export of source material.

(c) Any person is exempt from the regulation in this part and from the requirements for a license set forth in section 62 of the Act to the extent that such person receives, possesses, uses, transfers, or imports into the United States:

(1) Any quantity of thorium contained in (i) incandescent gas mantles; (ii) vacuum tubes; or (iii) welding rods;

(2) Source material contained in the following products: (i) Glazed ceramic tableware, provided that the glaze contains not more than 20 percent source material; (ii) glassware containing not more than 10 percent source material; but not including glass brick, pane glass, ceramic tile or other glass or ceramic used in construction;

(3) Photographic film, negatives, and prints containing uranium or thorium;

(4) Any finished product or part fabricated of, or containing tungsten or magnesium-thorium alloys, provided that the thorium content of the alloy does not exceed 4 percent by weight and that the exemption contained in this subparagraph shall not be deemed to authorize the chemical, physical or metallurgical treatment or processing of any such product or part; and

(5) (i) Uranium contained in aircraft counterweights installed in aircraft; Provided, That any such counterweight has been impressed with a statement, clearly legible after plating, which states "Caution-Radioactive Material-Uranium"; And provided further, That the exemption contained in this paragraph shall not be deemed to authorize the chemical, physical, metallurgical or other treatment or processing of any such counterweight or the installation in, or removal from, an aircraft of any such counterweight, without a specific license from the Commission.

(ii) The exemptions contained in this section shall not be deemed to authorize the manufacture of any of the products described herein.

§ 40.14 Specific exemptions.

The Commission may, upon application of any interested person or upon its own initiative, grant such exemptions from the requirements of the regulation in this part as it determines are authorized by law and will not endanger life or

property, or the national defense and utility and are otherwise in the public interest.

GENERAL LICENSES

§ 40.20 Types of licenses.

Licenses for source material are of two types: general and specific. The general licenses provided in this part are effective without the filing of applications with the Commission or the issuance of licensing documents to particular persons. Specific licenses are issued to named persons upon applications filed pursuant to the regulations in this part.

§ 40.21 General license to receive title to source material.

A general license is hereby issued authorizing the receipt of title to source material without regard to quantity. This general license does not authorize any person to receive, possess, deliver, use, import, export or transfer source material.

§ 40.22 Small quantities of source material.

(a) A general license is hereby issued authorizing use and transfer of not more than fifteen (15) pounds of source material at any one time by persons in the following categories:

(1) Pharmacists using the source material solely for the compounding of medicinals;

(2) Physicians using the source material for medicinal purposes;

(3) Persons receiving possession of source material from pharmacists and physicians in the form of medicinals or drugs;

(4) Commercial and industrial firms, and research, educational and medical institutions for research, development, educational or commercial purposes;

And provided, That no such person shall pursuant to this general license receive more than a total of 150 pounds of source material in any one calendar year; and provided further that the general license contained in this paragraph shall not be deemed to authorize the export of source material, except as authorized in a specific or general license issued pursuant to this part.

(b) Persons who receive, possess, use, or transfer source material pursuant to the general license issued in paragraph (a) of this section are exempt from the provisions of Part 20 of this chapter to the extent that such receipt, possession, use or transfer are within the terms of such general license; Provided, however, That this exemption shall not be deemed to apply to any such person who is also in possession of source material under a specific license issued pursuant to this part.

§ 40.23 General licenses to export.

(a) A general license, designated AEC-GRO-SMA, is hereby issued authorizing the export at any one time of up to three (3) pounds of source material from the United States to any foreign country or destination except countries or areas listed in § 40.90. Each person exporting source material pursuant to this general license shall file with the Collector of

Additional to those on the copy of the Shipper's Export Declaration accompanying each export, and mark such copy for transmittal to the Division of Licensing and Regulation of the United States Atomic Energy Commission, Washington 25, D.C.

(b) A general license, designated AEC-GRO-SMB, is hereby issued authorizing the export of incandescent gas mantles containing thorium, without regard to quantity, from the United States to any foreign country or destination except countries or destinations listed in § 40.99.

LICENSE APPLICATIONS

§ 40.31 Applications for specific licenses.

(a) Applications for specific licenses should be filed in quadruplicate on Form AEC-3, "Application for Source Material License", on Form AEC-7, "Application for Source Material Export License", as appropriate, with the United States Atomic Energy Commission, Washington 25, D.C., Attention: Director, Division of Licensing and Regulation. Applications may also be filed in person at the Commission's Public Document Room at 1717 H Street NW., Washington, D.C., or the Commission's offices at Germantown, Maryland.

(b) The Commission may at any time after the filing of the original application, and before the expiration of the license, require further statements in order to enable the Commission to determine whether the application should be granted or denied or whether a license should be modified or revoked. All applications and statements shall be signed by the applicant or licensee or a person duly authorized to act for and on his behalf.

(c) Applications and documents submitted to the Commission in connection with applications will be made available for public inspection in accordance with the provisions of the regulations contained in Parts 2 and 9 of this chapter.

(d) An application for a license filed pursuant to the regulations in this part will be considered also as an application for licenses authorizing other activities for which licenses are required by the Act: *Provided*, That the application specifies the additional activities for which licenses are requested and complies with regulations of the Commission as to applications for such licenses.

(e) In his application, the applicant may incorporate by reference information contained in previous applications, statements or reports filed by the applicant with the Commission's Division of Licensing and Regulation: *Provided*, That such references are clear and specific.

§ 40.32 Requirements for issuance of specific licenses.

An application for a specific license for purposes other than export will be approved if:

(a) The application is for a purpose authorized by the Act; and

(b) The applicant is qualified by reason of training and experience to use the source material for the purpose re-

quired.

(c) The applicant's proposed equipment, facilities and procedures are adequate to protect health and minimize danger to life or property; and

(d) The issuance of the license will not be inimical to the common defense and security or to the health and safety of the public.

§ 40.33 Requirements for issuance of export licenses.

(a) An application for a license to export uranium will be approved if the Commission determines that:

(1) The proposed export is within the scope of and consistent with the terms of an agreement between the United States and the government of the recipient containing safeguards against diversion of the material to military use; or

(2) The cumulative quantity of uranium specifically licensed for export to the consignee since July 1, 1957, does not exceed one hundred (100) kilograms, provided that the cumulative quantity specifically licensed for export to the recipient country since July 1, 1957, does not exceed one thousand (1,000) kilograms, excluding any amounts exported pursuant to either subparagraph (1) of this paragraph or § 40.23; and

(3) The export will not be inimical to the interests of the United States.

(b) An application for a license to export thorium will be approved if the Commission determines that the export will not be inimical to the interests of the United States.

LICENSES

§ 40.41 Terms and conditions of licenses.

(a) Each license issued pursuant to the regulations in this part shall be subject to all the provisions of the Act, now or hereafter in effect, and to all rules, regulations and orders of the Commission.

(b) Neither the license nor any right under the license shall be assigned or otherwise transferred in violation of the provisions of the Act.

(c) Each person licensed by the Commission pursuant to the regulations in this part shall confine his possession and use of source material to the locations and purposes authorized in the license. Except as otherwise provided in the license, a license issued pursuant to the regulations in this part shall carry with it the right to receive, possess, use and import source material and to deliver or transfer such material to other licensees within the United States authorized to receive such material.

(d) Each license issued pursuant to the regulations in this part shall be deemed to contain the provisions set forth in sections 183a to 183d, of the Act, whether or not said provisions are expressly set forth in the license.

(e) The Commission may incorporate in any license at the time of issuance, or thereafter by appropriate rule, regulation or order, such additional requirements and conditions with respect to

the licensee's ship, plant, or other master, import and export of source material as it deems appropriate or necessary in order to:

(1) Promote the common defense and security;

(2) Protect health or to minimize danger to life or property;

(3) Protect restricted data;

(4) Require such reports and the keeping of such records and to provide for such inspections of activities under the license as may be necessary or appropriate to effectuate the purposes of the Act and regulations thereunder.

§ 40.42 Expiration.

Except as provided in § 40.43(b), and except as may be provided in licenses issued for operation of production or utilization facilities pursuant to Part 59 of this chapter, each specific license shall expire no later than three years from the last day of the month in which it is issued.

§ 40.43 Renewal of licenses.

(a) Applications for renewal of a specific license shall be filed in accordance with § 40.31.

(b) In any case in which a licensee, not less than thirty (30) days prior to expiration of his existing license, has filed an application in proper form for renewal or for a new license, such existing license shall not expire until the application for renewal or for a new license has been finally determined by the Commission.

§ 40.44 Amendment of licenses at request of licensee.

Applications for amendment of a license shall be filed in accordance with § 40.31 and shall specify the respects in which the licensee desires his license to be amended and the grounds for such amendment.

§ 40.45 Commission action on applications to renew or amend.

In considering an application by a licensee to renew or amend his license, the Commission will apply the applicable criteria set forth in §§ 40.32 and 40.33.

§ 40.46 Inalienability of licenses.

No license issued or granted pursuant to the regulations in this part shall be transferred, assigned or in any manner disposed of, either voluntarily or involuntarily, directly or indirectly, through transfer of control of any license to any person, unless the Commission shall, after securing full information, find that the transfer is in accordance with the provisions of this Act, and shall give its consent in writing.

§ 40.47 License requirement for persons possessing source material on the effective date of this amendment.

(a) Any person who on the effective date of this amendment possesses source material received pursuant to a specific license issued by the Commission shall be deemed to possess such material pursuant to a license issued under the regulations in this part. Such license shall be deemed to include all terms and conditions incorporated in the previous

license which are not inconsistent with, or otherwise provided for in the regulations in this part and shall expire 90 days from the effective date of this amendment or on the expiration date contained in the previous license, whichever is later.

(b) Any person who on the effective date of this amendment possesses source material received pursuant to a general license issued by the Commission shall be deemed to possess such material pursuant to a license issued under the regulations in this part. To the extent that such possession is not authorized under an exemption or general license pursuant to §§ 40.11 through 40.14 or §§ 40.20 through 40.23, respectively, the license granted pursuant to this paragraph shall expire ninety (90) days from the effective date of this amendment.

TRANSFER OF SOURCE MATERIAL

§ 40.51 Transfer of source material.

(a) No licensee shall transfer source material except as authorized pursuant to this section.

(b) Any licensee may transfer source material:

- (1) To the Commission;
- (2) To a specific or general licensee whose license authorizes him to receive such material;
- (3) To any person exempt from the regulations in this part to the extent permitted under such exemption; or
- (4) As otherwise authorized by the Commission in writing.

RECORDS AND INSPECTIONS

§ 40.61 Records.

(a) Each person who receives source material pursuant to a license issued pursuant to the regulations in this part shall keep records showing the receipt, transfer, export and disposal of such source material.

§ 40.62 Inspections.

(a) Each licensee shall afford to the Commission at all reasonable times opportunity to inspect source material and the premises and facilities wherein source material is used or stored.

(b) Each licensee shall make available to the Commission for inspection, upon reasonable notice, records kept by him pursuant to the regulations in this chapter.

§ 40.63 Tests.

Each 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, including tests of:

- (a) Source material;
- (b) Facilities wherein source material is utilized or stored;
- (c) Radiation detection and monitoring instruments; and
- (d) Other equipment and devices used in connection with the utilization or storage of source material.

MODIFICATION AND REVOCATION OF LICENSES

§ 40.71 Modification, revocation and termination of licenses.

(a) The terms and conditions of each license shall be subject to amendment, revision, or modification by reason of amendments to the Act, or by reason of rules, regulations, or orders issued in accordance with the Act.

(b) Any license may be revoked, suspended, or modified, in whole or in part, for any material false statement in the application or any statement of fact required under section 182 of the Act, or because of conditions revealed by such application or statement of fact or any report, record, or inspection or other means which would warrant the Commission to refuse to grant a license on an original application, or for violation of, or failure to observe any of, the terms and conditions of the Act, or the license, or of any rule, regulation or order of the Commission.

(c) Except in cases of willfulness or those in which the public health, interest or safety requires otherwise, no license shall be modified, suspended, or revoked unless, prior to the institution of proceedings therefor, facts or conduct which may warrant such action shall have been called to the attention of the licensee in writing and the licensee shall have been accorded opportunity to demonstrate or achieve compliance with all lawful requirements.

(d) The Commission may terminate a specific license upon request submitted by the licensee to the Commission in writing.

ENFORCEMENT

§ 40.81 Violations.

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 willfully violates any provision of the Act 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.

§ 40.90 Schedule A.

Albania.
Bulgaria.
China, including Manchuria (and including Taiwan (Formosa)) (includes Inner Mongolia; the provinces of Tientsin and Shantung; Sinkiang; Tibet; the former Kwantung Leased Territory, the present Port Arthur Naval Base Area and Liaoning Province).
Communist-controlled area of Viet Nam.
Czechoslovakia.
East Germany (Soviet Zone of Germany and the Soviet Sector of Berlin).
Estonia.
Hungary.
Latvia.
Lithuania.
North Korea.
Poland (including Danzig).
Outer Mongolia.
Romania.
Union of Soviet Socialist Republics.

I. I at Germantown, Md., this 9th day of January 1961.

For the Atomic Energy Commission.

WOODFORD B. MCCOOL,
Secretary.

[P.R. Doc. 61-283; Filed, Jan. 18, 1961;
9:45 a.m.]

(Reprinted from 26 Federal Register, 7824, August 23, 1961)

Title 10—ATOMIC ENERGY**Chapter I—Atomic Energy
Commission****PART 30—LICENSING OF
BYPRODUCT MATERIAL****PART 40—LICENSING OF SOURCE
MATERIAL****Exports of Byproduct Material;
General Licenses to Export**

These amendments to 10 CFR Parts 30 and 40 are designed to bring the Commission's regulations for the export of byproduct and source materials into consonance with the export regulations of the U.S. Department of Commerce with respect to exports to Cuba.

Under the amended regulations export to Cuba of byproduct material having an atomic number from 3 to 83, contained in medicinals or pharmaceutical preparations or in devices, applicators or appliances designed for use in medical diagnosis or therapy, is authorized under a general license. Applications will have to be filed with the Commission for a specific license for export to Cuba of any other byproduct material or of source material. Applications for use of source material for medical diagnosis or therapy will ordinarily be granted. Individual applications will be reviewed in the light of the Agreement for Cooperation in the Peaceful Uses of Atomic Energy with Cuba which entered into force on October 10, 1957 (SUST1579; copies of this Agreement may be obtained from the Department of State).

Inasmuch as these amendments involve the foreign affairs functions of the United States, the Commission has found that general notice of proposed rule making and public procedure thereon are impracticable, unnecessary, and contrary to the public interest; and that good cause exists why these amendments should be made effective upon publication in the *Federal Register* without the customary 30-day period of notice.

Accordingly, pursuant to the Administrative Procedure Act, the following rules are published as documents subject to codification and are effective upon publication in the *Federal Register*:

§ 30.33 [Amendment]

1. Paragraphs (b) and (c) of § 30.33 are deleted and the following new paragraphs (b), (c) and (d) are added:

(b) Any licensee may export byproduct material covered by his license to any foreign country except Cuba or countries or areas now or hereafter listed as Subgroup A countries or destinations in § 371.3 of the Comprehensive Export Schedule of the United States Department of Commerce (15 CFR 371.3): *Provided*, That the authority conferred by this paragraph shall apply only to byproduct material having an atomic number from 3 to 83 inclusive.

(c) Any licensee may export byproduct material covered by his license to Cuba to the extent that the byproduct material is contained in medicinals or pharmaceutical preparations or in devices, applicators, or appliances designed for use in medical diagnosis or therapy: *Provided*, That the authority conferred by this paragraph shall apply only to byproduct material having an atomic number from 3 to 83, inclusive.

(d) The Commission may upon application by an interested person issue a license authorizing (1) the export of byproduct material to a country or area listed as a Subgroup A country or destination in § 371.3 of the Comprehensive Export Schedule of the United States Department of Commerce (15 CFR 371.3), or (2) the export of byproduct material not having an atomic number from 3 to 83, inclusive, or (3) the export to Cuba of byproduct material other than the byproduct material which may be exported under the general license established in paragraph (c) of this section: *Provided*, That the Commission will not issue a license authorizing such export if, in the opinion of the Commission, the proposed export would be inimical to the common defense and security.

2. Section 40.23 General Licenses to export is amended in the first sentence of paragraphs (a) and (b) to include "Cuba or" immediately after "to any foreign country or destination except". As so amended § 40.23 reads as follows:

§ 40.23 General Licenses to export.

(a) A general license, designated AEC-GRO-SMA, is hereby issued authorizing

the export at any one time of up to three (3) pounds of source material from the United States to any foreign country or destination except Cuba or countries or areas listed in § 40.90. Each person exporting source material pursuant to this general license shall file with the Collector of Customs or the Postmaster one copy, in addition to those otherwise required, of the Shipper's Export Declaration covering each export, and mark such copy for transmittal to the Division of Licensing and Regulation of the United States Atomic Energy Commission, Washington 25, D.C.

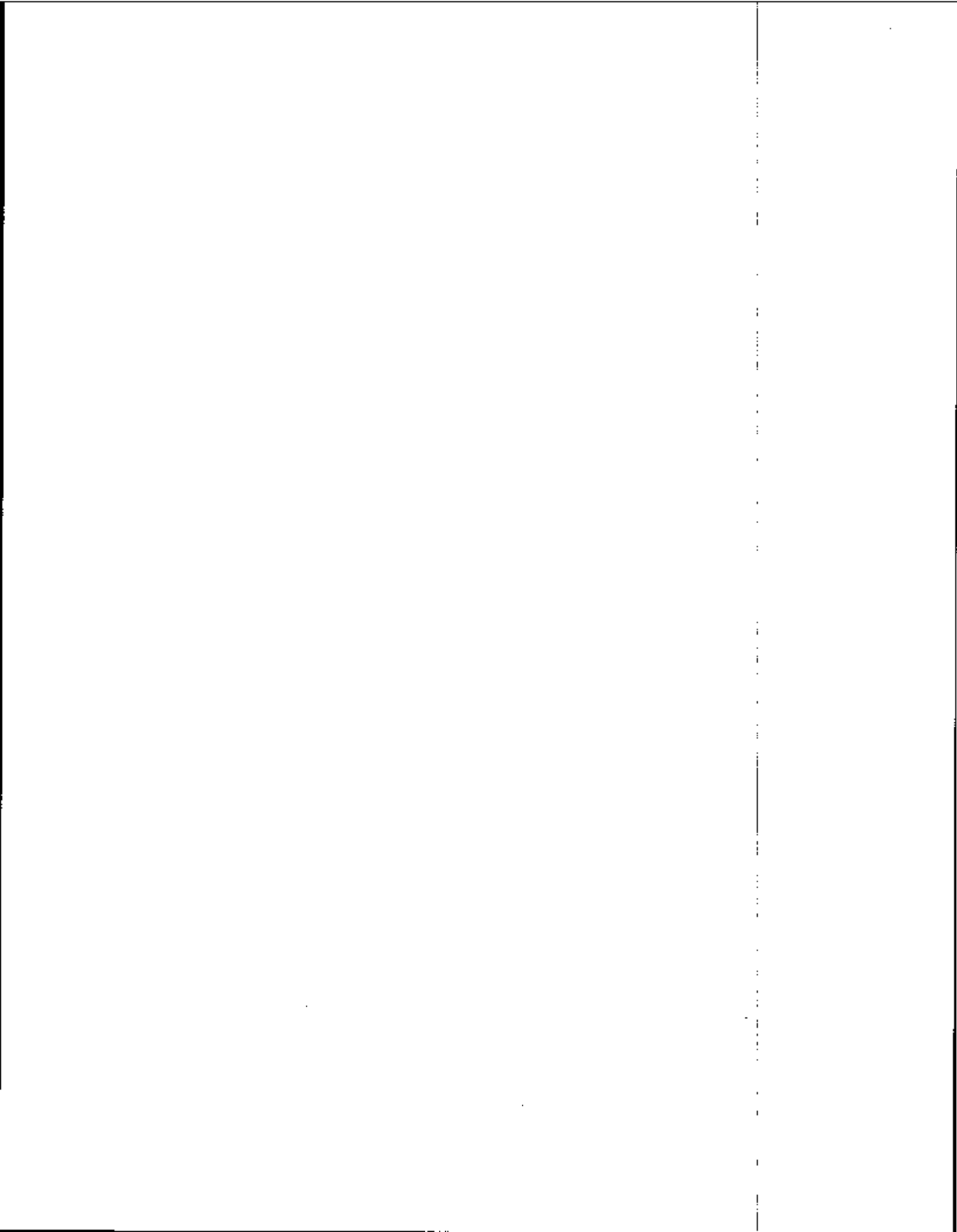
(b) A general license, designated AEC-GRO-SMB, is hereby issued authorizing the export of incandescent gas mantles containing thorium, without regard to quantity, from the United States to any foreign country or destination except Cuba or countries or destinations listed in § 40.90.

Dated at Germantown, Maryland this 14th day of August 1961.

For the Atomic Energy Commission,

HAROLD D. AMAROSA,
Acting Secretary.

[F.R. Doc. 61-3040; Filed, Aug. 23, 1961;
8:45 a.m.]



(Reprinted from 26 Federal Register, 7824, August 23, 1961)

Title 10—ATOMIC ENERGY**Chapter I—Atomic Energy
Commission****PART 30—LICENSING OF
BYPRODUCT MATERIAL****PART 40—LICENSING OF SOURCE
MATERIAL****Exports of Byproduct Material;
General Licenses to Export**

These amendments to 10 CFR Parts 30 and 40 are designed to bring the Commission's regulations for the export of byproduct and source materials into consonance with the export regulations of the U.S. Department of Commerce with respect to exports to Cuba.

Under the amended regulations export to Cuba of byproduct material having an atomic number from 3 to 83, contained in medicinals or pharmaceutical preparations or in devices, applicators or appliances designed for use in medical diagnosis or therapy, is authorized under a general license. Applications will have to be filed with the Commission for a specific license for export to Cuba of any other byproduct material or of source material. Applications for use of source material for medical diagnosis or therapy will ordinarily be granted. Individual applications will be reviewed in the light of the Agreement for Cooperation in the Peaceful Uses of Atomic Energy with Cuba which entered into force on October 10, 1957 (EUST1579; copies of this Agreement may be obtained from the Department of State).

Inasmuch as these amendments involve the foreign affairs functions of the United States, the Commission has found that general notice of proposed rule making and public procedure thereon are impracticable, unnecessary, and contrary to the public interest; and that good cause exists why these amendments should be made effective upon publication in the *FEDERAL REGISTER* without the customary 30-day period of notice.

Accordingly, pursuant to the Administrative Procedure Act, the following rules are published as documents subject to codification and are effective upon publication in the *FEDERAL REGISTER*:

§ 30.33 [Amendment]

1. Paragraphs (b) and (c) of § 30.33 are deleted and the following new paragraphs (b), (c) and (d) are added:

(b) Any licensee may export byproduct material covered by his license to any foreign country except Cuba or countries or areas now or hereafter listed as Subgroup A countries or destinations in § 371.3 of the Comprehensive Export Schedule of the United States Department of Commerce (15 CFR 371.3): *Provided*, That the authority conferred by this paragraph shall apply only to byproduct material having an atomic number from 3 to 83 inclusive.

(c) Any licensee may export byproduct material covered by his license to Cuba to the extent that the byproduct material is contained in medicinals or pharmaceutical preparations or in devices, applicators, or appliances designed for use in medical diagnosis or therapy: *Provided*, That the authority conferred by this paragraph shall apply only to byproduct material having an atomic number from 3 to 83, inclusive.

(d) The Commission may upon application by an interested person issue a license authorizing (1) the export of byproduct material to a country or area listed as a Subgroup A country or destination in § 371.3 of the Comprehensive Export Schedule of the United States Department of Commerce (15 CFR 371.3), or (2) the export of byproduct material not having an atomic number from 3 to 83, inclusive, or (3) the export to Cuba of byproduct material other than the byproduct material which may be exported under the general license established in paragraph (c) of this section: *Provided*, That the Commission will not issue a license authorizing such export if, in the opinion of the Commission, the proposed export would be inimical to the common defense and security.

2. Section 40.23 *General license to export* is amended in the first sentence of paragraphs (a) and (b) to include "Cuba or" immediately after "to any foreign country or destination except". As so amended § 40.23 reads as follows:

§ 40.23 General license to export.

(a) A general license, designated AEC-GRO-SMA, is hereby issued authorizing

the export at any one time of up to three (3) pounds of source material from the United States to any foreign country or destination except Cuba or countries or areas listed in § 40.90. Each person exporting source material pursuant to this general license shall file with the Collector of Customs or the Postmaster one copy, in addition to those otherwise required, of the Shipper's Export Declaration covering each export, and mark such copy for transmittal to the Division of Licensing and Regulation of the United States Atomic Energy Commission, Washington 25, D.C.

(b) A general license, designated AEC-GRO-SMB, is hereby issued authorizing the export of incandescent gas mantles containing thorium, without regard to quantity, from the United States to any foreign country or destination except Cuba or countries or destinations listed in § 40.90.

Dated at Germantown, Maryland this 16th day of August 1961.

For the Atomic Energy Commission.

HAROLD D. ANAMOSA,
Acting Secretary.

[F.R. Doc. 41-8040; Filed, Aug. 22, 1961;
6:45 a.m.]

(Published in 26 Federal Register on Tuesday, April 11, 1961)

Title 10—ATOMIC ENERGY

Chapter I—Atomic Energy Commission

PART 40—LICENSING OF SOURCE MATERIAL

Unimportant Quantities of Source Material

On January 14, 1961, the Atomic Energy Commission caused to be published in the *Federal Register* an over-all revision of its regulations 10 CFR Part 40, "Licensing of Source Material". These revised regulations became effective February 13, 1961. The regulations in 10 CFR 40 theretofore in effect contained therein an exemption from licensing with respect to rare earth metals and compounds, mixtures and products containing not more than 0.25% by weight thorium, uranium, or any combination of these. This exemption was not included in the revised regulations which became effective February 13, 1961.

On March 6, 1961, American Potash and Chemical Corporation filed a petition with the Commission requesting the re-establishment of this exemption. In its petition the Corporation described, among other things, the industrial processes and commercial products in which such rare earth chemicals are used and the absence of justification for licensing from the standpoint of the health and safety of the public.

The Commission has given careful consideration to the petition filed by American Potash and Chemical Corporation. Based on radioactivity exposure data furnished by the Corporation with respect to its rare earth material manufacturing operations since 1956, and on other data available to the Commission, the Commission has found that possession and use in the United States of source material in the materials and products for which the exemption is sought are not of significance to the com-

mon defense and security and that such activities can be conducted without any unreasonable hazard to life or property.

The Commission has also found that since the following amendment would relieve from rather than impose restrictions under regulations currently in effect and will not adversely affect the public health and safety, general notice of proposed rule making and public procedure thereon are unnecessary and good cause exists for making the amendment effective upon publication in the *Federal Register*.

The Commission will welcome suggestions and comments from interested persons regarding the following amendment. Such comments should be submitted within thirty days from the date of publication of this notice in the *Federal Register* and should be addressed to the Secretary, United States Atomic Energy Commission, Washington 25, D.C., Attention: Director, Division of Licensing and Regulation. The Commission will reconsider this amendment if comments received within the designated period should warrant such action.

Accordingly, pursuant to the Administrative Procedure Act, the following amendment is published as a document subject to codification and is effective upon publication in the *Federal Register*:

Section 40.13(c) (1) of 10 CFR Part 40 is amended to read:

(1) Any quantities of thorium contained in (i) incandescent gas mantles; (ii) vacuum tubes, (iii) welding rods; or (iv) rare earth metals and compounds, mixtures and products containing not more than 0.25% by weight thorium, uranium or any combination of these.

Dated at Germantown, Md., this 5th day of April 1961.

For the Atomic Energy Commission,

WOODWARD B. MCCOY,
Secretary.

[P.R. Doc. 61-6186; Filed, Apr. 18, 1961;
8:45 a.m.]

(AEC Reprint Containing Amendments Issued Through February 25, 1960)

TITLE 10—ATOMIC ENERGY

Chapter I—Atomic Energy Commission

PART 70—SPECIAL NUCLEAR MATERIAL

GENERAL PROVISIONS

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- 70.2 Scope.
- 70.3 License requirements.
- 70.4 Definitions.
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LICENSES

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- 70.51 Records.
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- 70.53 Inspections.
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MODIFICATION AND REVOCATION OF LICENSES

- 70.61 Modification and revocation of licenses.
- 70.62 Suspension and operation in war or national emergency.

ENFORCEMENT

- 70.71 Violations.

AUTHORITY: §§ 70.1 to 70.71 issued under sec. 161, 66 Stat. 948; 42 U. S. C. 2201. Interpret or apply secs. 51, 63, 182, 183, 66 Stat. 929, 930, 953, 954. 42 U. S. C. 2071, 2073, 2232, 2233. For the purpose of sec. 223, 66 Stat. 953; 42 U. S. C. 2273, §§ 70.32 (a) (5) and 70.31 (a) issued under sec. 161b, 66 Stat. 948; 42 U. S. C. 2201 (b) and §§ 70.31 to 70.54, inclusive, issued under sec. 161p, 66 Stat. 965, 42 U. S. C. 2201 (p).

SOURCE: §§ 70.1 to 70.71 appear at 21 F. R. 784, Feb. 3, 1956, except as otherwise noted.

GENERAL PROVISIONS

§ 70.1 Purpose. (a) The regulations in this part establish procedures and

criteria for the issuance of licenses to receive, possess, use and transfer special nuclear material and for the distribution by the Commission of special nuclear material to licensees; and establish and provide for the terms and conditions upon which the Commission will issue such licenses and distribute special nuclear material.

(b) The regulations contained in this part are issued pursuant to the Atomic Energy Act of 1954 (66 Stat. 919).

§ 70.2 Scope. Except as provided in §§ 70.11 to 70.13, inclusive, the regulations in this part apply to all persons in the United States.

§ 70.3 License requirements. No person subject to the regulations in this part shall receive, possess, use or transfer special nuclear material except as authorized in a license issued by the Commission pursuant to these regulations.

§ 70.4 Definitions. As used in this part,

(a) "Act" means the Atomic Energy Act of 1954 (66 Stat. 919), including any amendments thereto;

(b) "Atomic energy" means all forms of energy released in the course of nuclear fission or nuclear transformation.

(c) "Atomic weapon" means any device utilizing atomic energy, exclusive of the means for transporting or propelling the device (where such means is a separable and divisible part of the device), the principal purpose of which is for use as, or for development of, a weapon, a weapon prototype, or a weapon test device;

(d) "Commission" means the Atomic Energy Commission or its duly authorized representatives;

(e) "Common defense and security" means the common defense and security of the United States;

(f) "Government agency" means any executive department, commission, independent establishment, corporation, wholly or partly owned by the United States of America which is an instrumentality of the United States, or any board, bureau, division, service, office, officer, authority, administration, or other establishment in the executive branch of the Government;

(g) "Licensee", except where otherwise specified means a license issued pursuant to the regulations in this part;

(h) "Person" means (1) any individual, corporation, partnership, firm, association, trust, estate, public or private institution, group, Government agency other than the Commission, any State or any political subdivision of, or any political entity within a State, any foreign

government or nation or any political subdivision of any such government or nation, or other entity; and (2) any legal successor, representative, agent or agency of the foregoing;

(i) "Produce", when used in relation to special nuclear material, means (1) to manufacture, make, produce, or refine special nuclear material; (2) to separate special nuclear material from other substances in which such material may be contained; or (3) to make or to produce new special nuclear material;

(j) "Research and development" means (1) theoretical analysis, exploration, or experimentation; or (2) the extension of investigative findings and theories of a scientific or technical nature into practical application for experimental and demonstration purposes, including the experimental production and testing of models, devices, equipment, materials, and processes;

(k) "Restricted Data" means all data concerning (1) design, manufacture or utilization of atomic weapons; (2) the production of special nuclear material; or (3) the use of special nuclear material in the production of energy, but shall not include data declassified or removed from the Restricted Data category pursuant to section 142 of the act;

(l) "Source material" means source material as defined in section 11 c. of the act and in the regulations contained in Part 40 of this chapter;

(m) "Special nuclear material" means (1) plutonium, uranium 233, uranium enriched in the isotope 233 or in the isotope 235, and any other material which the Commission, pursuant to the provisions of section 51 of the act determines to be special nuclear material, but does not include source material; or (2) any material artificially enriched by any of the foregoing but does not include source material;

(n) "United States", when used in a geographical sense, includes all territories and possessions of the United States, the Canal Zone and Puerto Rico.

§ 70.5 Communications. All communications concerning the regulations in this part should be addressed to the Atomic Energy Commission, Washington 25, D. C. Attention: Division of Licensing and Regulations. Communications and reports may be delivered in person at the Commission's offices at 1717 H Street NW., Washington, D. C., or its offices at Germantown, Md.

[Amended]

CHANGE: § 70.5 amended by substituting "Division of Licensing and Regulation" for

"Division of Civilian Application" and adding last sentence at 23 F. R. 1122, Feb. 21, 1958.

§ 70.8 Interpretations. 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.

EXEMPTIONS

§ 70.11 Persons using special nuclear material under contract with and for the account of the Commission. The regulations in this part do not apply to any person to the extent that such person receives, possesses, uses or transfers special nuclear material under, and in accordance with, a contract with and for the account of the Commission. In any such case, such person's obligations with respect to the special nuclear material are governed by the applicable contract between such person and the Commission.

§ 70.12 Carriers. Common and contract carriers, warehousemen and the United States Post Office Department are exempt from the regulations in this part to the extent that they transport or store special nuclear material in the regular course of carriage for another or storage incident thereto.

§ 70.13 Department of Defense. The regulations in this part do not apply to the Department of Defense to the extent that the Department receives, possesses and uses special nuclear material in accordance with the direction of the President pursuant to section 91 of the act.

§ 70.14 Specific exemptions. The Commission may, upon application of any interested person, 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.

LICENSE APPLICATIONS

§ 70.21 Filing. (a) Applications for licenses should be filed in triplicate with the United States Atomic Energy Commission, Washington 25, D. C., Attention: Division of Licensing and Regulation. Papers may be filed in person at the Commission's offices at 1717 H Street NW., Washington, D. C., or its offices at Germantown, Md.

(b) An application for license, filed pursuant to the regulations in this part will be considered also as an application for licenses authorizing other activities for which licenses are required by the act, provided the application specifies the additional activities for which licenses are requested and complies with regulations of the Commission as to applications for such licenses.

(c) Any application which contains Restricted Data shall be prepared in such manner that all Restricted Data are separated from the unclassified information.

(d) Applications and documents submitted to the Commission in connection with applications may be made available for public inspection in accordance with the provisions of the regulations contained in Part 2 of this chapter.

(e) In his application, the applicant may incorporate by reference information contained in previous applications, statements or reports filed with the Commission: *Provided*, That such references are clear and specific.

[Amended]

CHANGE: § 70.21 (a) amended by deleting "1901 Constitution Avenue, NW", substituting "Division of Licensing and Regulation" for "Division of Civilian Application," and adding last sentence at 23 F. R. 1122, Feb. 21, 1958.

§ 70.22 Contents of applications. (a) Each application shall contain the following information:

(1) The full name, address, age (if an individual), and citizenship of the applicant and the names and addresses of three personal references. If the applicant is a corporation or other entity, it shall indicate the State where it was incorporated or organized, the location of the principal office, the names, addresses, and citizenship of its principal officers, and shall include information known to the applicant concerning the control or ownership, if any, exercised over the applicant by any alien, foreign corporation, or foreign government.

(2) The activity for which the special nuclear material is requested, or in which special nuclear material will be produced, the place at which the activity is to be performed and the general plan for carrying out the activity;

(3) The period of time for which the license is requested;

(4) The name, amount, and specifications (including the chemical and physical form and, where applicable, isotopic content) of the special nuclear material the applicant proposes to use or produce;

(5) To the extent applicable to his application,

(i) The estimated date on which the applicant desires to receive the first shipment of special nuclear material and an estimated schedule, by years, for subsequent receipts;

(ii) A schedule, by years, showing the estimated production, consumption and operating losses of special nuclear material, and

(iii) An estimated schedule, by years, for the transfer of special nuclear material to the Commission or to other licensees. Supporting data for such estimates shall be included.

(6) The technical qualifications, including training and experience of the applicant and members of his staff to engage in the proposed activities in accordance with the regulations in this chapter.

(7) A description of equipment and facilities which will be used by the applicant to protect health and minimize danger to life or property (such as handling devices, working areas, shields,

measuring and monitoring instruments, devices for the disposal of radioactive effluent and wastes, storage facilities, etc.).

(8) Proposed procedures to protect health and minimize danger to life or property, including procedures to avoid accidental conditions of critically and procedures for personnel monitoring and waste disposal.

NOTE: Where the quantity of material requested, or the nature of the proposed activities, is such as to require consideration of the following factors, the Commission will request the applicant to submit information with respect to his financial qualifications (1) to engage in the proposed activities in accordance with the regulations in this chapter, (2) to assume responsibility for the payment of Commission charges for use, consumption or loss of special nuclear material and (3) to undertake and carry out the proposed use of special nuclear material for a reasonable period of time. Consideration of such factors will normally not be involved in the consideration of applications for small quantities of special nuclear material for use in research and development.

(b) The Commission may at any time after the filing of the original application, and before the expiration of the license, require further statements in order to enable the Commission to determine whether the application should be granted or denied or whether a license should be modified or revoked. All applications and statements shall be signed by the applicant or licensee or a corporate officer thereof.

[Amended]

CHANGE: § 70.22 (b) amended by deleting the words "under oath or affirmation" at 23 F. R. 1875, March 11, 1958.

(c) Each application and statement shall contain complete and accurate disclosure as to all matters and things required to be disclosed.

§ 70.23 Requirements for the approval of applications. A license application will be approved if the Commission determines that:

(a) The special nuclear material is to be used for the conduct of research or development activities of a type specified in section 31 of the act, in activities licensed by the Commission under section 103 or 104 of the act, or for such other uses as the Commission determines to be

¹The types of research and development activities specified in section 31 are those relating to:

(1) Nuclear processes;
(2) The theory and production of atomic energy, including processes, materials, and devices related to such production;

(3) Utilization of special nuclear material and radioactive material for medical, biological, agricultural, health or military purposes;

(4) Utilization of special nuclear material, atomic energy, and radioactive material and processes entailed in the utilization or production of atomic energy or such material for all other purposes, including industrial use, the generation of usable energy, and the demonstration of the practical value of utilization or production facilities for industrial or commercial purposes; and

(5) The protection of health and the promotion of safety during research and production activities.

appropriate to carry out the purposes of the act;

[Amended]

CHANGE: § 70.23 (a) amended to read as set forth above. 23 F. R. 3956, Nov. 18, 1958.

(b) The applicant is qualified by reason of training and experience to use the material for the purpose requested in accordance with the regulations in this chapter; and

(c) The applicant's proposed equipment and facilities are adequate to protect health and minimize danger to life or property; and

(d) The applicant's proposed procedures to protect health and to minimize danger to life or property are adequate; and

(e) Where the quantity of material requested, or the nature of the proposed activities are such as to require consideration of these factors by the Commission, that the applicant appears to be financially qualified to assume responsibility for the payment of Commission charges for use, consumption or loss of special nuclear material and to engage in the proposed activities in accordance with the regulations in this part. If the allocation (pursuant to § 70.31 (b)) of a substantial quantity of special nuclear material is requested, the application should demonstrate that the applicant appears to be financially able to undertake and carry out the proposed use of special nuclear material for a reasonable period of time; and

(f) The special nuclear material can be made available to the applicant substantially in accordance with the estimated schedule, if any, in the application. In the event that applications for special nuclear material exceed the amount available for distribution, the Commission will give preference to those activities which are most likely, in the opinion of the Commission, to contribute to basic research, to the development of peacetime uses of atomic energy, or to the economic and military strength of the Nation. In the event that applications for special nuclear material for use in activities licensed by the Commission pursuant to section 304b of the act exceed the amount of special nuclear material available for such use, the Commission will give preference to such of said applications as will, in the opinion of the Commission, lead to major advances in the application of atomic energy for industrial or commercial purposes.

§ 70.24 *Additional requirements.* (a) In addition to any other requirements of these regulations, each licensee who under any license is authorized to possess in excess of 500 grams of contained U-235, 300 grams of plutonium, or 300 grams of U-233 shall in accordance with plans approved by the Commission:

(1) Maintain in each area in which special nuclear material subject to such license is handled, used, or stored, a monitoring system, including gamma or neutron-sensitive radiation devices, which will energize clearly audible alarm signals in the event a condition of ac-

cidental criticality occurs which generates radiation levels of 300 rem per hour one foot from the source of the condition. The monitoring devices in the system shall have a preset alarm point of not less than 5 millirem per hour (in order to avoid false alarms) nor more than 20 millirem per hour. In no event may any such device be farther than 120 feet from special nuclear material being handled, used, or stored; lesser distances may be necessary to meet the requirements of this subsection on account of intervening shielding or other pertinent factors.

(2) Maintain comprehensive emergency procedures in each area in which special nuclear material subject to such license is handled, used, or stored to assure that all personnel withdraw to an area of safety upon the sounding of the alarm. These procedures shall include the conduct of drills to familiarize all personnel with the evacuation plan; plans and designation of responsible individuals for determining the cause of the alarm; and placement radiation survey devices in accessible locations for use in such emergency.

(b) Each applicant for a license shall describe his plans for compliance with the requirements of this section as a part of his application for a license.

(c) Each licensee, who on the effective date of this section holds a license described in paragraph (a) of this section, shall file his plans for compliance with the requirements of this section in sextuplicate with the Commission for approval within 30 days after the date upon which this section becomes effective. This report shall include the date by which he proposes to complete the installation of the monitoring system. Information previously filed with the Commission in applications, statements or reports may be incorporated by reference, provided that such references are clear and specific. The requirements of this section shall be deemed to have been suspended with respect to any licensee filing a report pursuant to this paragraph pending further action by the Commission.

(d) Any licensee who believes that good cause exists why he should be granted an exemption in whole or in part from the requirements of this section may apply to the Commission for such exemption. Such application shall specify his reasons for the relief requested.

[Added]

Source: § 70.24 appears at 23 F. R. 3747, Nov. 11, 1958.

LICENSES

§ 70.31 *Issuance of licenses.* (a) Upon a determination that an application meets the requirements of the act, and of the regulations of the Commission, the Commission will issue a license in such form and containing such conditions and limitations as it deems appropriate or necessary to effectuate the purposes of the act.

(b) (1) The Commission will normally include in licenses issued pursuant to

section 53a (1)^a of the act provisions establishing the availability to the licensee, as needed, of the quantities of special nuclear material required for conduct of the activities authorized by the license. Such provisions usually will be in the form of a statement that the Commission has allocated to the licensee, for use in the conduct of such activities, a designated quantity (or quantities) of special nuclear material; and may include an estimated schedule for a reasonable period of time of special nuclear material transfers to the applicant and of special nuclear material returns to the Commission.

(2) Provisions allocating special nuclear material will not be included in a license where the special nuclear material involved is to be charged to a quantity allocated to another licensee. Unless other arrangements are made with the Commission, special nuclear material transferred to a licensee to be fabricated or processed for another licensee will be charged to the quantity allocated in the latter's license.

(c) Any license issued to a person for use of special nuclear material in activities in which special nuclear material will be produced shall (subject to the provisions of § 70.41 (b)) be deemed to authorize such person to possess, use, and transfer the special nuclear material produced in the course of such authorized activities.

(d) No license will be issued (1) to any person for a use which is not under the jurisdiction of the United States; or (2) to any person if the Commission finds that the distribution of special nuclear material to such person would be inimical to the common defense and security.

§ 70.32 *Conditions of licenses.* (a) Each license shall expire (except as provided in § 70.33 (b)), at the time specified in the license and shall contain and be subject to the following conditions:

(1) Title to all special nuclear material shall at all times be in the United States;

(2) No right to the special nuclear material shall be conferred by the license except as defined by the license;

(3) Neither the license nor any right under the license shall be assigned or otherwise transferred in violation of the provisions of the act;

(4) All special nuclear material shall be subject to the right of recapture or control reserved by section 103 and to all other provisions of the act;

(5) No special nuclear material may be used in any utilization or production facility except in accordance with the provisions of the act;

(6) The licensee shall not use the special nuclear material to construct an atomic weapon or any component of an atomic weapon;

(7) The licensee will hold the United States and the Commission harmless

^a The regulations in Part 50 of this chapter contain procedures for obtaining allocations of special nuclear material for use in the operation of facilities licensed by the Commission under section 103 or 104 of the act.

from any damages resulting from the use or possession of special nuclear material by the licensee;

(6) The licensee shall be subject to, and the licensee shall observe, all applicable rules, regulations and orders of the Commission.

(b) The Commission may incorporate in any license such additional conditions and requirements with respect to the licensee's receipt, possession, use and transfer of special nuclear material as it deems appropriate or necessary in order to:

(1) Promote the common defense and security;

(2) Protect health or to minimize danger to life or property;

(3) Protect Restricted Data;

(4) Guard against the loss or diversion of special nuclear material.

(5) Require such reports and the keeping of such records, and to provide for such inspections, of activities under the license as may be necessary or appropriate to effectuate the purposes of the act and regulations thereunder.

§ 70.33 *Renewal of license.* (a) Applications for renewal of a license should be filed in accordance with §§ 70.21 and 70.22. Information contained in previous applications, statements or reports filed with the Commission under the license may be incorporated by reference. Provided, That such references are clear and specific.

(b) In any case in which a licensee, not less than thirty (30) days prior to expiration of his existing license, has filed an application in proper form for renewal of a license, such existing license shall not expire until the application for a renewal has been finally determined by the Commission.

§ 70.34 *Amendment of license.* Applications for amendment of a license shall be filed in accordance with § 70.21 (a) and shall specify the respects in which the licensee desires his license to be amended and the grounds for such amendment.

§ 70.35 *Commission action on applications to renew or amend.* In considering an application by a licensee to renew or amend his license, the Commission will apply the criteria set forth in § 70.23.

§ 70.36 *Inalienability of license.* No license granted under the regulations in this part and no right to possess or utilize special nuclear material granted by any license issued pursuant to the regulations in this part shall be transferred, assigned or in any manner disposed of, either voluntarily or involuntarily, directly or indirectly, through transfer of control of any license to any person unless the Commission shall after securing full information, find that the transfer is in accordance with the provisions of the act, and shall give its consent in writing.

§ 70.37 *Disclaimer of warranties.* Neither the Government nor the Commission makes any warranty or other representation that special nuclear ma-

terial (a) will not result in injury or damage when used for purposes approved by the Commission, (b) will accomplish the results for which it is requested and approved by the Commission, or (c) is safe for any other use.

§ 70.38 *Reduction and termination of allocations.* (a) The Commission may, in accordance with the procedures provided in Part 2 of this chapter, reduce the quantities of special nuclear material allocated to any licensee pursuant to § 70.31, upon the ground that the quantities allocated exceed those reasonably required, or estimated to be required, for conduct of the activities authorized by the license.

(b) The expiration, revocation or other termination of a license shall terminate all special nuclear material allocations incorporated therein.

ACQUISITION, USE AND TRANSFER OF SPECIAL NUCLEAR MATERIAL

§ 70.41 *Authorized use of special nuclear material.* (a) Each licensee shall confine his possession and use of special nuclear material to the locations and purposes authorized in his license.

(b) The possession, use and transfer of any special nuclear material produced by a licensee, in connection with or as a result of use of special nuclear material received under his license, shall be subject to the provisions of the license and the regulations in this part.

(c) Nothing contained in the regulations in this part or in any license issued pursuant to the regulations in this part shall authorize or be deemed to authorize (1) the distribution of any special nuclear material to any person for a use which is not under the jurisdiction of the United States or (2) the export from or import into the United States of any special nuclear material.

§ 70.42 *Transfer of special nuclear material.* (a) No licensee shall transfer special nuclear material except as authorized pursuant to this section.

(b) Any licensee may transfer special nuclear material:

(1) To the Commission;

(2) To a licensee whose license authorizes him to receive such special nuclear material;

(3) As otherwise authorized by the Commission in writing.

§ 70.43 *Licensee's responsibility for special nuclear material.* (a) Any licensee who receives special nuclear material from the Commission shall be responsible and shall reimburse the Commission for any loss, consumption or contamination of, or damage to, such special nuclear material occurring from the time of delivery of such material to the licensee or to a carrier for delivery to the licensee and until such material has been returned to the Commission by delivery at the laboratory, plant or office designated for the return of the material in his license or other written instruction from the Commission.

(b) The transfer of special nuclear material by a licensee to another licensee shall not relieve the transferor of re-

sponsibility to the Commission for loss, consumption or contamination of, or damage to, such special nuclear material unless, upon receiving an agreement signed by the transferee assuming such responsibility, the Commission shall give its consent in writing. The Commission will not unreasonably withhold its consent. Such arrangements may be made with the Commission in advance for a series of anticipated transfers.

RECORDS, REPORTS AND INSPECTIONS

§ 70.51 *Records.* Each licensee shall keep records showing the receipt, inventory and transfer of special nuclear material.

§ 70.52 *Reports of accidental criticality or loss of special nuclear material.* Each licensee shall promptly report to the Commission any case of accidental criticality and any loss, other than normal operating loss, of special nuclear material.

§ 70.53 *Material Status Reports.* Each licensee shall submit to the Commission on Form AEC-578 reports concerning special nuclear material distributed by the Commission pursuant to section 58 of the Act and received, transferred or possessed by the licensee or for which the licensee is financially responsible. Such reports shall be made as of December 31 and June 30 of each year and shall be filed with the Commission within 30 days after the end of the period covered by the report, except that any licensee who during the six months preceding June 30 had losses or burnup of less than ten grams of special nuclear material and did not receive or transfer any special nuclear material, or financial responsibility therefor, is required to file only an annual report as of December 31. The Commission may permit a licensee to submit Material Status Reports at other times when good cause is shown.

[Added]

SOURCE: § 70.53 appears at 25 F.R. 1607, Feb. 25, 1960.

§ 70.54 *Material Transfer Reports.* Each licensee who transfers and each licensee who receives special nuclear material shall submit to the Commission on Form AEC-388, in accordance with the instructions set out therein, reports concerning each transfer of special nuclear material which has been distributed by the Commission pursuant to section 53 of the Act. Such reports shall be transmitted to the Commission promptly after the transfer takes place.

SOURCE: § 70.54 appears at 25 F.R. 17731, Dec. 18, 1960.

§ 70.55 *Inspections.* (a) Each licensee shall afford to the Commission at all reasonable times opportunity to inspect special nuclear material and the premises and facilities wherein special nuclear material is used, produced, or stored.

(b) Each licensee shall make available to the Commission for inspection, upon reasonable notice, records kept by the licensee pertaining to his receipt,

possession, use or transfer of special nuclear material.

§ 70.56 Tests. Each 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, including tests of (a) special nuclear material, (b) facilities wherein special nuclear material is utilized, produced or stored, (c) radiation detection and monitoring instruments, and (d) other equipment and devices used in connection with the production, utilization or storage of special nuclear material.

[Amended]

CHANGE: §§ 70.59 and 70.64 designated §§ 70.64 and 70.65 respectively at 25 F.R. 1607, Feb. 25, 1960. Subsequently §§ 70.64 and 70.65, redesignated §§ 70.58 and 70.56 respectively at 25 F.R. 12731, Dec. 13, 1960.

MODIFICATION AND REVOCATION OF LICENSES

§ 70.61 Modification and revocation of licenses. (a) The terms and conditions of all licenses shall be subject to amendment, revision, or modification by reason of amendments to the Atomic Energy Act of 1954, or by reason of rules, regulations or orders issued in accordance with the act or any amendments thereto;

(b) Any license may be revoked, suspended or modified for any material false statement in the application or any statement of fact required under section 122 of the act or because of conditions

revealed by such application or statement of fact or any report, record, or inspection or other means which would warrant the Commission to refuse to grant a license on an original application, or for failure to construct or operate a facility in accordance with the terms of the construction permit or license, the technical specifications in the application, or for violation of, or failure to observe any of the terms and conditions of the act, or of any regulation of the Commission.

(c) Upon revocation, suspension or modification of a license, the Commission may immediately retake possession of all special nuclear material held by the licensee. In cases found by the Commission to be of extreme importance to the national defense or security, or to the health and safety of the public, the Commission may recapture any special nuclear material held by the licensee prior to any of the procedures provided under the Administrative Procedure Act.

(d) Except in cases of willfulness or those in which the public health, interest or safety requires otherwise, no license shall be modified, suspended or revoked unless, prior to the institution of proceedings therefor, facts or conduct which may warrant such action shall have been called to the attention of the licensee in writing and the licensee shall have been accorded opportunity to demonstrate or achieve compliance with all lawful requirements.

§ 70.62 Suspension and operation in war or national emergency. Whenever

Congress declares that a state of war or national emergency exists, the Commission, if it finds it necessary to the common defense and security, may:

(a) Suspend any license it has issued.

(b) Order the recapture of special nuclear material distributed.

(c) Order the operation of any licensed facility.

(d) Order entry into any plant or facility in order to recapture special nuclear material or to operate the facility. Just compensation shall be paid for any damages caused by recapture of special nuclear material or by operation of any facility, pursuant to this section.

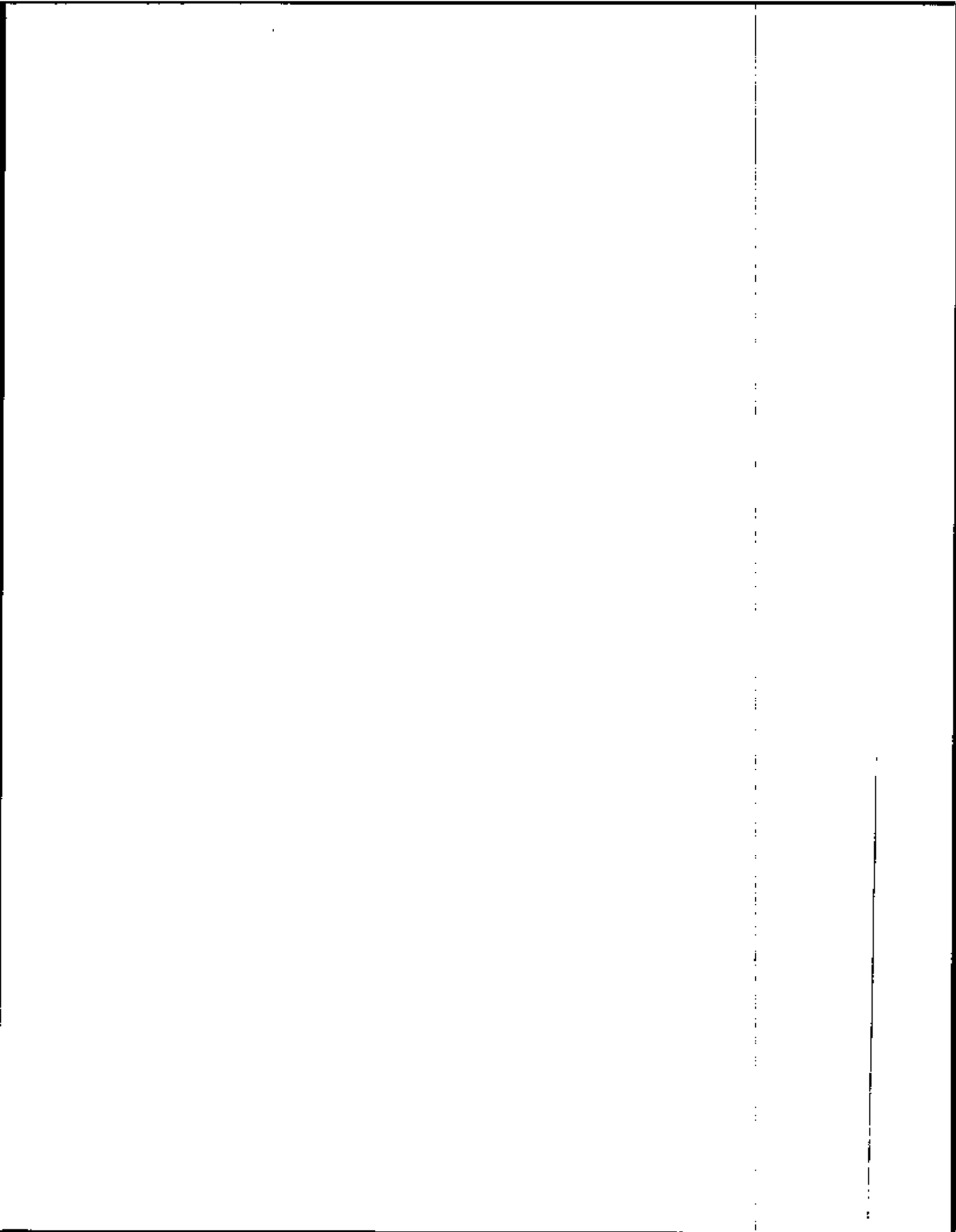
ENFORCEMENT

§ 70.71 Violations. 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 willfully violates any provision of the act 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.

NOTE: The record keeping and reporting requirements contained herein have been approved by the Bureau of the Budget in accordance with the Federal Reports Act of 1943.

[Prior History]

Notices of Proposed Rule Making appear at 20 F.R. 9481, Apr. 15, 1955, 34 F.R. 6817, Aug. 6, 1969, and 25 F.R. 7300, Aug. 17, 1960.



TITLE 10 - ATOMIC ENERGY

Chapter 1 - ATOMIC ENERGY COMMISSION

Part 72 -- Regulation to Protect Against Radiation in the Shipment of Irradiated Fuel Elements

NOTICE OF PROPOSED RULE MAKING

STATEMENT OF CONSIDERATIONS

The following proposed regulation is designed to assure that appropriate precautions are taken in connection with shipments of irradiated fuel elements to protect against accidental criticality, radiation exposure of individuals and release of fission products. Requirements to protect against hazards in the shipment of unirradiated special nuclear material and other requirements relevant to the shipment of special nuclear material are prescribed in other parts of the Commission's regulations and in regulations of other agencies having jurisdiction over means of transportation. This proposed regulation would govern persons subject to licensing under Part 70 of the Commission's regulations (10 CFR Part 70)

The increased number of both domestic and foreign reactors, and the fact that a number of licensed reactors will soon be due for refueling, have created a need for criteria for irradiated fuel element cask design and shipping procedures which will be acceptable from a radiological and nuclear safety standpoint. The proposed regulation has been written to provide cask manufacturers, reactor licensees and other persons interested in the transportation of irradiated fuel elements with criteria to meet this need.

In March, 1960, the Commission issued for public comment a proposed regulation to establish general criteria for the design of shipping containers, and to establish shipping requirements to protect against accidental criticality and radiation exposure in the shipment of irradiated fuel elements. Many comments and

suggestions have been received in response to the notice of proposed rule making. In addition, conferences were held with members of the industry concerned with the shipment of irradiated fuel elements and with a Task Group of the American Standards Association working on this problem. The comments received and information developed in the conferences have been taken into consideration in preparation of the proposed regulation set forth below. In formulating this proposed regulation, the AEC also had the assistance of AEC prime contractors and the Interagency Committee on the Transportation of Radioactive Materials, which consists of representatives of the Interstate Commerce Commission, Bureau of Explosives, Federal Aviation Agency, Coast Guard, Post Office Department and the AEC.

In accordance with this proposed regulation, a license may be issued under Part 30 and Part 70 to any person to carry out any of the three operations involved in the transportation of irradiated fuel elements: loading of the fuel elements into the cask, transportation of the loaded cask, and unloading of the fuel elements from the cask. The license may authorize these operations in connection with irradiated fuel elements used by the licensee or as a service to another licensee. Once approval of a cask design and procedures has been obtained, a licensee may make an unlimited number of shipments, using casks of the same design, subject to the provisions of the Commission's regulations and to the conditions and limitations of his license.

The proposed regulation specifies the information which an applicant must submit in an application for a license. This includes the applicant's evaluation of the adequacy of the cask to protect the public health and safety from hazards relating to criticality, heat transfer, radiation shielding, structural integrity, and control of contamination.

The criteria in the proposed regulation deal with the design of the cask and procedures for packaging and shipping of the irradiated fuel elements. The methods of mounting casks on vehicles or vessels and operation of those vehicles or vessels are not covered in this regulation.

Pursuant to the exemption in Part 70, Section 70.12 (10 CFR Part 70), carriers and warehousemen are exempt from special nuclear material licensing requirements, and hence from the requirements of 10 CFR Part 72, to the extent that they transport or store irradiated fuel elements in the regular course of carriage for another or storage incident thereto. Whether a special nuclear material licensee transports irradiated fuel elements in his own vehicle or delivers them to a carrier for shipment, he must meet the packaging requirements outlined.

The criteria specified in the proposed regulation involve complex technical considerations in such areas as criticality, heat transfer and structural integrity. In some areas, particularly structural integrity, adequate technical information is not available to provide completely satisfactory answers to many of the problems encountered. For example, reliable methods of predicting the extent of plastic deformation of some of the metals used in fabricating casks, as well as the forces developed as a function of angle of impact, are not at present available.

The proposed regulation is based on the assumption that there is reasonable assurance that a cask designed and constructed in accordance with the specifications in the regulation will withstand extreme conditions of transportation to which any shipment is likely to be exposed. The extreme conditions assumed are;

1. A 15 foot free fall on a large flat unyielding surface with the cask so oriented that it lands on any side. A force of 60 times the weight of the loaded cask applied for not less than 16 milliseconds is considered equivalent to that condition.
2. A puncture type of accident in which a force of 30 times the weight of the cask applied for not less than 16 milliseconds on a 6 inch diameter area of any side of the cask is followed by a fire.
3. Exposure to a standard 1-hour fire.
4. Submersion in water.

The crash shield (if one is used) must retain and protect the cask under a single impact of the magnitude assumed in Item (1) above. Subsequent impacts, such as from rolling down an embankment, are assumed to be of lesser magnitude. In either case, provision should be made to prevent the possibility of displacement of the lid.

Some of the principal differences between the proposed regulation set forth below and the original proposed regulation published in March, 1960, are summarized in the following paragraphs:

Section 72.3 - License Requirements. The proposed revision of Part 72 applies only to shipments of fuel elements containing 2000 curies or more of total radioactivity. The original proposed regulation would have been applicable to the shipment of any irradiated fuel element.

Section 72.20 - Definitions. Definitions already provided in Part 30 and Part 70 have not been restated, but are incorporated by reference. The definitions of "carrier" and "cask" have been revised, and definitions of "criticality", "decay heat", "neutron poison", and "primary coolant", added.

Section 72.21 - Contents of Applications. In support of an application, the applicant must submit his evaluation of the ability of the cask to provide safety from accidental criticality, heat transfer, loss of radioactive material radiation shielding and structural integrity under conditions likely to be encountered in transport.

Section 72.31 - Radiation Protection. This section is new and specifies general performance criteria to be met in packaging irradiated fuel elements.

Section 72.32 - Structural Integrity. The original proposed regulation specified that a cask be able to withstand a 30 foot drop onto a solid object and, assuming that the cask fell on a cover edge, that it contain the radioactive material and that the cask and cover remain intact. As a result of comments and further discussions with stress analysis experts, it has been determined that sufficient information is not available on plastic deformation of the various materials used in cask construction and the variation of the impact forces as a function of angle of impact under dynamic loading conditions to design a cask in such a way as to predict with confidence that it would meet the 30 foot drop test. It was also noted that the meaning of "a solid object" under such an impact was uncertain. The structural integrity requirements have been rewritten to specify forces, both static and dynamic, which a cask must be able to withstand. Within certain limitations, a cask may now be designed with the available technical

information on stress analysis to demonstrate theoretically that the specified conditions have been met. The objective of the structural integrity requirements is to provide reasonable assurance that a cask will retain the fuel elements in the event of a serious accident. The magnitude and duration of the impact force of 60 times the weight of the cask and contents is based on a 15 foot free fall with a three (3) inch deformation and an assumption of uniform yield. The deformation of the cask must be limited in such a manner that external radiation levels will not exceed 1 rem per hour. A liquid or gaseous coolant would in all probability be lost in the event of a severe accident. However, the amount of the shipment is limited so that in case of an accident causing loss of all liquid or gaseous coolant and failure of mechanical cooling devices, there would be only a limited release of radioactive material.

Information based on actual drop tests of containers is highly desirable in formulating structural integrity requirements, and the AEC is proceeding to obtain such data. The results of such tests may provide a basis for further revision of the proposed regulation.

Use of mechanical cooling devices, and shipment under pressure up to 50 pounds per square inch gauge, are permitted under this proposed regulation. These techniques provide additional carrying capacity as a result of improved heat transfer characteristics.

Section 72.33 - Internal Structural Components, is new and specifies structural requirements for fuel element holders and neutron poisons which are purposely built into the cask. The object is to prevent mechanical damage to fuel elements and release of radioactive material into the cask coolant and to assure

that, if essential to the control of criticality, the geometry of fuel elements does not change and neutron poisons do not lose efficiency because of damage or change of position

Section 72.34 - Exterior and Attachments, is new and specifies puncture resistance of the external surface of the cask. This surface provides protection of the cask from penetration by flying objects or impalement of the cask on a protruding object such as a bridge girder or railroad rail. The strength of this surface adds to the assurance that the cask will remain intact in the event of an accident. Requirements have been added with respect to exposure to a standard 1-hour fire to assure that the cask maintains its shielding efficiency, and with respect to the strength of hooks, handles, trunnions or other external appurtenances which might be used to handle a cask. It is also provided that a lifting device on the lid of the cask, which is intended only for lifting the lid, must be covered during transit in order to prevent its use for lifting the entire cask.

It is required that in the case of pressurized shipments, a cask must be equipped with a pressure relief device in order to prevent the pressure from exceeding 75% of the design pressure. The cask vent or the pressure relief device must be equipped with appropriate filters to prevent the loss of particulate radioactive material and, under certain conditions, the loss of radioiodine.

The cask must be provided with a flash arrester or appropriate measures taken to prevent an explosive mixture of gases from accumulating.

Section 72.35 - Shielding. The external radiation levels are the same as those originally published in the proposed rule. Requirements have been added

that the shielding be supported in the cask so that it cannot change position during normal transport and, in case of accident, will not cause an excessively high external radiation level. External pipes and attachments which might contain radioactivity during shipment must be shielded.

A new Section 72.36 - Materials and Methods of Cask Construction, specifies performance requirements for materials and techniques used in construction of the cask.

In Section 72.37 - Standards for Control of Criticality, an alternative criterion has been added which provides that the effective neutron multiplication constant (k_{eff}) shall not exceed 0.9 under specified conditions.

Neutron interaction between casks or shipments of special nuclear material must be taken into consideration in the design of the cask and in establishing the limits for the contents. The shipper will know the contents of other casks or the kind and amount of material at the point of origin of the shipment or which he will place on the same vehicle with any particular cask and, he can therefore evaluate possible interaction with that material. However, there may be other shipments at points of trans-shipment or on the same vehicle and shipments on other vehicles, the contents of which he cannot be expected to know. For other shipments at intermediate points or on the same vehicle, the applicant must consider possible effects of interaction with his shipment and in some cases take positive action to control the interaction between shipments or to insure that other shipments are maintained at a safe distance. Because of the factors of safety inherent in the assumptions on which the safety of a shipment of irradiated fuel elements is based in this regulation, the contribution due to neutron interaction between a shipment made under this regulation on one vehicle and any shipment of

Special nuclear material on a separate vehicle is considered to be insignificant and need not be further evaluated by the applicant.

Section 72.38 - Heat Removal, has been completely revised. The original proposed regulation required that the fuel elements should not reach a temperature greater than 180°F below the melting point in the event of loss of coolant. This original requirement did not adequately protect against the loss of fission products resulting from rupture of some types of fuel elements at temperatures below the melting points of the elements, nor did it provide appropriate criteria for ceramic-type fuel elements. The present proposed regulation meets these deficiencies.

The present requirements specify maximum temperatures which any fuel element may reach during normal and emergency shipping conditions in terms of the failure temperatures of the type of fuel element. The failure temperature may be determined by actual operating experience in a reactor or may be calculated from reliable experimental data. The intent of the requirements is to provide reasonable assurance that during normal transport, fission products are not released from the fuel elements into the cask in excessive quantities and that under emergency conditions which may cause loss of gaseous or liquid coolant and failure of mechanical cooling devices, the release of fission products as a result of elevated temperatures will be limited to specified quantities. In no case may the fuel elements reach a temperature as high as the melting point of the fuel or cladding.

To determine the maximum temperature of any fuel element in the fuel element holder, the temperature gradient across the fuel element holder must be established by calculation or experiment for both normal and emergency shipping

conditions. Wherever possible, a mockup of this arrangement should be used to justify the assumptions made in any design.

When the amount of decay heat generated in the fuel elements and the transfer of heat to the surface of the fuel element holder has been established, the transfer of heat to the inner cask wall and subsequent transfer and dissipation of that heat by the cask must be established. To verify the assumptions made in the design of the cask in regard to bonding of various components and the heat dissipating properties of the external surface of the cask, operating characteristics of the cask as they relate to the original design must be established prior to initial use of the cask. Wherever possible, it is preferable to verify the effectiveness of the over-all cask design with fuel element loading in place. Under Section 72.44, the calculated heat transfer characteristics of each cask must be verified by experiment or by a thorough check of the initial loading of the cask, both as to internal and external temperatures. After the temperature gradients across the cask are established, the internal temperature can usually be determined indirectly, under normal circumstances, by measuring the temperature of the outer wall. In addition, where it is possible during the initial loading of the cask to carry out such an experiment without serious risk, it is desirable to simulate emergency conditions by draining the primary coolant, if it is a liquid, and determining both internal and external temperatures of the cask. The temperature of any surface of the cask which may be in contact with any part of a vehicle in land transport must not exceed 350°F. This temperature, which is well below the self-ignition point for wood shavings, will prevent charring of wood structures of vehicles.

The original proposed regulation required that casks operate at atmospheric pressure. The present proposed regulation allows pressurization of casks to a maximum of 50 pounds per square inch gauge or 50% of the design pressure, whichever is lower. Each cask must be designed for 20 pounds per square inch gauge pressure and tested for leaktightness at no less than 5 pounds per square inch gauge pressure. As a result of this leaktightness gases released from casks should be released only through the filter required in the vent or pressure relief device. Shipping the cask under pressure with a pressure relief device will help prevent loss of the coolant should the cask be overturned and will also help in the retention of fission gases which may be released into the cask during transport. The advantages of pressurized casks include the ability to increase substantially the number of fuel elements which may be shipped in one cask because of the increased heat transfer efficiency of the cask at a slight pressure and somewhat elevated temperatures. The disadvantage of a pressurized cask is that, in the event of loss of pressure, some of the coolant may be lost from the cask by ejection and by evaporation if the cask reaches a temperature greater than the boiling point of the coolant. However, experience indicates that pressure systems can be fabricated with a high degree of reliability. Under the criteria specified in the proposed regulation, even if the cask loses all of its coolant the heat transfer characteristics must be such that there will not be a substantial release of fission products.

Other new Sections, 72.41 through 72.46, deal with the canning of ruptured fuel elements and specify tests to be carried out on each new cask, prior to each shipment, and in case of accident.

The labeling requirement in the original proposed regulation has been eliminated in view of the existing requirements for marking and labeling of the Interstate Commerce Commission.

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, U. S. Atomic Energy Commission, Washington 25, D. C. within 90 days after publication of this notice in the Federal Register. Pending adoption of the proposed regulation as an effective regulation the Commission will apply the criteria in the proposed rule in its review of applications for license to transport solid irradiated fuel elements.

GENERAL PROVISIONS

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- 72.2 Scope
- 72.3 Requirements for Shipment of Irradiated Fuel Elements
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- 72.5 Communications
- 72.6 Interpretations
- 72.7 Specific Exemptions
- 72.8 Additional Requirements
- 72.9 Casks Now in Use

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- 72.21 Contents of Applications
- 72.22 Elimination of Repetition

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- 72.33 Internal Structural Components
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- 72.37 Standards for Control of Criticality
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SHIPPING PROCEDURES

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- 72.43 Requirements for Tests
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NOTIFICATION, RECORDS AND INSPECTIONS

Section

72.51 Notification of AEC
72.52 Records
72.53 Inspections and Tests

ENFORCEMENT

72.71 Violations

Appendix "A" - Standard One-Hour Fire

AUTHORITY

Sections 72.1 - 72.71 issued under Sections 53 and 161; 68 Stat. 939 and 948, as amended; 42 U. S. C. 2073 and 2201.

GENERAL PROVISIONS

- 72.1 Purpose. Part 72 establishes procedures and criteria for obtaining Atomic Energy Commission approval of cask designs and procedures for the shipping of irradiated solid nuclear reactor fuels and certain requirements for such shipments. The criteria include safeguards against accidental conditions of criticality, overheating of the cask, meltdown of fuel elements, release of fission products or special nuclear material, and excessive exposure of individuals to radiation. Requirements to protect against hazards in the shipment of unirradiated special nuclear materials are prescribed by other parts of this chapter. 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.
- 72.2 Scope. This part applies to all persons licensed pursuant to Part 70 of this chapter to receive, possess, use or transfer special nuclear material in the form of solid irradiated fuel elements. Shipment of nuclear fuel in other than solid form is beyond the scope of this part. Shipment by air is not authorized by this part.

72.3 Requirements for Shipment of Irradiated Fuel Elements. No licensee shall receive, transport or deliver to a carrier for transportation any irradiated fuel element outside the confines of his plant or other authorized location if the total amount of radioactivity in a single cask is in excess of 2000 curies, unless the cask and procedures used have been approved by the Commission. Approval will be granted by the issuance of a license or an amendment to a license under Part 30 and Part 70 of this chapter.

72.4 Definitions. As used in this part

- (a) "Carrier" means a person who is exempted by Section 70.12 from the regulations in Part 70 of this chapter;
- (b) "Cask" means a container in which irradiated fuel elements are transported. A cask may consist of an inner container or receptacle immediately surrounding one or more fuel elements and an outer container which may include shielding, arrangements for cooling, and auxiliary equipment. An inner and outer container may constitute a single structural unit. An external structure may enclose or be attached to the cask for the purpose of absorbing mechanical shock, controlling access, or providing space for cooling;
- (c) "Commission" means the Atomic Energy Commission or its duly authorized representatives;
- (d) "Criticality" means the state in which the effective neutron multiplication constant (k_{eff}) of an array of

special nuclear material equals or exceeds unity, so that a nuclear chain reaction occurs;

(e) "Decay Heat" means heat caused by radioactive decay;

(f) "Neutron Poison" means a substance which effectively absorbs neutrons;

(g) "Primary Coolant" means a gas, liquid or solid, or combination of them, in contact with one or more fuel elements or the interior of a cask and used to dissipate heat.

Terms defined in Part 30 and Part 70 have the same meanings when used in this part.

72.5 Communications. All communications concerning the regulations in this part, and applications filed under them, should be addressed to the Atomic Energy Commission, Washington 25, D. C., Attention: Director, Division of Licensing and Regulation.

72.6 Interpretations. 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.

72.7 Specific Exemptions. The Commission may, upon application of any interested person, or upon 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.

72.8 Additional Requirements. 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.

72.9 Casks Now in Use. Any cask which has been approved by the Commission for transportation of irradiated fuel elements prior to the effective date of this part may be used for that purpose until the Commission shall have acted upon an application for a license authorizing its use pursuant to this part; provided that (a) an application is submitted to the Commission within 90 days of the effective date of this part, and (b) each shipment is made in compliance with all of the provisions of this part except Sections 72.31 to 72.36 inclusive and in substantial compliance with the provisions of Sections 72.37 and 72.38.

LICENSE APPLICATIONS

72.21 Contents of Applications. An application for a license or for amendment of 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 proposed methods of transporting irradiated fuel elements. The application shall be organized and presented in accordance with the requirements of this section and shall include:

(a) The applicant's evaluation of the adequacy of the cask and procedures to protect the public health and safety against ionizing radiation and the release of radioactive substances, including:

- (1) Structural integrity of the cask, including an analysis of the design in accordance with the applicable provisions of Sections 72.32, 72.33 and 72.34;
- (2) Resistance of the cask to fire, including an analysis in accordance with the provisions of Section 72.31 and paragraph 72.34(b);
- (3) Shielding against ionizing radiation, including an analysis in accordance with the provisions of Section 72.35;
- (4) Prevention of the occurrence of criticality, taking into account the possibility of accidents including flood, fire and change of configuration, in accordance with the provisions of Section 72.37;

(5) Removal of decay heat, in accordance with the provisions of Section 72.38;

(6) Adequacy of available equipment and facilities to handle the cask at all planned loading, transfer and unloading sites.

(b) Supporting information as to the design and construction of the cask, including:

(1) Information and engineering drawings describing the cask, a description of the fuel elements proposed to be transported in it, with experimental information, calculations and references to published information;

(2) Testing program to confirm the structural integrity of the cask and its leaktightness, and test results;

(3) Characteristics of fuel element holders, coolant, valves, sampling ports, handling devices, and other features of the cask;

(4) Shielding against the transmission of radiation from the cask, including the composition, structure, means of attachment, and other characteristics, with experimental information, calculations and references to published information;

(5) Devices designed to protect against accidental conditions of criticality during all loading, transport and unloading of the fuel elements and the cask;

(6) Structural, mechanical and other means of transfer, dissipation and removal of decay heat, with experimental information, calculations and reference to published information.

(c) Supporting information as to proposed handling and shipping procedures, including:

- (1) Type, maximum number, physical state, chemical composition, irradiation history and decay history of fuel elements to be transported, and maximum radiation levels and maximum decay heat anticipated at any time during loading, transport and unloading;
- (2) Procedures for loading fuel elements into the cask and unloading fuel elements from the cask, stating gross weights, methods for control of criticality, and methods of control of exposures of personnel to radiation, maximum anticipated coolant pressures in all portions of the cask cavity, and methods of measuring and relieving coolant pressures;
- (3) Mode of transport, general route, including destination and any transfer points, anticipated solar heat load, maximum predicted temperature of the fuel elements and the exterior surface of the cask during transport, and methods of handling the cask, including any special handling and emergency precautions;

- (4) In the event that any ruptured or damaged fuel element is to be shipped, a description and evaluation of the adequacy of the proposed method of interior containment, with supporting information as to methods of handling and special precautions;
- (5) Procedures for measuring:
 - (i) temperatures of the internal and external surfaces of the cask;
 - (ii) levels of radioactivity of the coolant and of the external surfaces of the cask;
 - (iii) radiation levels outside of the cask;
- (6) Procedures for testing the loaded cask for leaktightness;
- (7) Procedures for confirming the presence and effectiveness of neutron poisons.

72.22 Elimination of Repetition. An application may incorporate by clear and specific reference any information in previous applications, statements or reports filed with the Division of Licensing and Regulation of the Commission.

PACKAGING

General Packaging Requirements

72.31 Radiation Protection

- (a) Any irradiated fuel elements to be transported shall be contained in a cask which is leaktight within the limits prescribed by paragraph 72.45(c), and is securely closed by

a positive fastening device which cannot be opened unintentionally or by any predictable internal pressure.

(b) The cask shall constitute a shield, or shall be enclosed in a shield, adequate to reduce external radiation levels within the limits prescribed by paragraph 72.35(a).

(c) The cask and shield shall be adequate to prevent reduction of effectiveness of shielding which would permit radiation levels in excess of the limits prescribed by paragraph 72.35(b) or loss of radioactive materials, as a result of the action of the standard one-hour fire (see Appendix A), water, and the application to the cask of the forces described in Sections 72.32 and 72.34; corrosion of the cask and attached devices by the contents; changes in temperature and pressure; contamination of the surfaces of the cask and shield; and explosive or other effects of gases which may be generated by radiolytic, chemical or other processes.

(d) The construction of the cask, including internal fuel supporting structures and neutron poisons, shall be such that criticality cannot be attained under the normal conditions of transport or the conditions described in paragraph 72.31(c).

(e) The cask shall be so constructed that decay heat will not, under normal conditions, significantly impair its

effectiveness as a shield or container either through melting of the shielding or cracking of the cask, cause any internal fuel container to melt, or alter the form or nature of the fuel.

Construction Details of the Cask

72.32 Structural Integrity

(a) The cask, regarded as a simple beam supported at its ends along the major axis, shall be capable of withstanding a static load, normal to the major axis, uniformly distributed along the major axis, and equal to 10 times the weight of the cask when fully loaded, without exceeding the ultimate strength of the cask, considered as a whole.

(b) The cask, either alone or in combination with any shock absorbing structure securely fastened to it, shall be capable of withstanding an impact force in a direction normal to any side, including the top or bottom, caused by a free fall of the loaded cask through a distance of 15 feet upon an unyielding horizontal flat surface, without either:

- (1) Exceeding the ultimate strength of any structural portion of the cask, or
- (2) Deforming the cask to an extent which would permit the escape of fuel elements or portions of them or permit the level of external radiation to exceed 1 roentgen per hour at any point one meter from any accessible surface of the cask.

A force equal to 60 times the weight of the loaded cask and lasting not less than 16 milliseconds may be deemed equal to the impact force described in this paragraph.

(c) The lid and the lid closing mechanism, including bolts, clamps and other positive fastening devices, shall be capable of withstanding a force in any direction of at least 60 times the weight of the lid and the contents of the cask and, if the lid projects above the body of the cask, at least 15 times the weight of the loaded cask, without stress at any point exceeding the ultimate strength of the material. The duration of the applied force shall be assumed to be not less than 16 milliseconds.

(d) The cask shall be capable of withstanding a design pressure equal to an internal gauge pressure of not less than 20 pounds per square inch or twice the operating pressure, whichever is greater, with stresses which do not exceed the yield strength of the material of which the cask is composed.

72.33 Internal Structural Components

(a) Fuel element holders shall be adequate to protect fuel elements from mechanical damage under normal conditions of transport, and to avoid criticality when the cask is subjected to the forces described in Section 72.32 if preservation of the geometry of the fuel elements is necessary for that purpose.

(b) Neutron poisons shall be so constructed and installed that application to the cask of the forces described in Section 72.32 will not result in loss of efficiency and so that built in neutron poisons will remain present and effective at all times.

(c) Any internal container for one or more fuel elements shall be leaktight and shall be so constructed that the maximum stress in the material of the container will not exceed the yield strength under normal conditions of transport.

72.34 Exterior and Attachments

(a) Every exterior surface of the cask shall be capable of withstanding a force equal to 30 times the weight of the loaded cask, applied normal to that surface and over any circular area 6 inches in diameter, without exceeding the ultimate strength of the material of which the exterior surface is constructed. The duration of the applied force shall be assumed to be not less than 16 milliseconds. An exterior surface of steel with a total thickness equal to or greater than that indicated below satisfies the requirements of this paragraph.

<u>Loaded Cask Weight (in pounds)</u>	<u>Thickness of Steel (in inches)</u>
5,000 to 20,000	3/8
20,000 to 30,000	1/2
30,000 to 40,000	5/8
40,000 to 55,000	3/4
55,000 to 70,000	7/8
70,000 to 90,000	1
90,000 to 120,000	1-1/8
120,000 and above	To be determined on specific application

(b) Uranium or any substance having a melting point lower than 1000°F used as shielding shall be completely encased in welded mild steel or other material having a melting point higher than 1000°F, having all joints welded and having a minimum wall thickness of 1/8 inch for not more than 6 inches of shielding thickness or 1/4 inch for more than 6 inches of shielding thickness. If shielding material has a melting point lower than 1000°F, provision shall be made for assuring, by deformation of the container walls or controlled voids in the shell or similar means, that the welded shell will not rupture if the cask is exposed to a standard one-hour fire as defined in Appendix A to this part. The use of fusible plugs or discs or other types of vents in order to avoid rupture of the welded shell is prohibited if such use could result in loss of shielding to such an extent that the level of radiation could exceed 1 roentgen per hour at a distance of 1 meter from the accessible surface of the cask.

(c) The cask shall be provided with adequate hooks, handles, trunnions, skids, base plate, or other devices which will permit adequate tie down and support during transport and facilitate normal handling.

(d) Any device which is attached to the cask and which is designed or could be employed to tie the cask down during transport shall be sufficient to withstand a static force having a vertical component of 2 times the weight of the loaded cask and a horizontal component of 10 times the weight of the loaded cask without exceeding the yield strength of the materials in the device.

(e) Any device which is attached to the cask and which is designed to lift the cask shall be capable of lifting 6 times the weight of the loaded cask without exceeding the yield strength of the materials in the device.

(f) Any device which is attached to the cask and which is designed to lift the lid shall be capable of lifting 6 times the combined weights of the lid and contents of the cask without exceeding the yield strength of the materials in the device. If the device is attached to the lid during transport, it shall be securely covered during transport unless it complies with paragraph 72.34(e) above.

(g) The cask shall be capable of withstanding vibration incident to shipment without impairing the integrity of the closure or of the cask itself.

(h) Means shall be provided for applying a seal so that the lid cannot be opened without destroying the seal.

(i) Means shall be provided for measurement, either directly or indirectly, of the internal cask wall temperature at any time.

(j) Valves, piping, expansion tanks and other external functional parts of the cask shall be protected from mechanical damage to be anticipated during normal handling and transport. Any such part projecting beyond the contour of the body of the cask or the lid shall be so constructed or protected that mechanical damage will not cause loss of shielding which would permit the level of radiation to exceed 1 roentgen per hour at any point one meter from the accessible surface of the cask.

(k) Any valve, other than pressure relief devices, through which primary coolant could leak during transport to such an extent that the level of radiation could exceed 1 roentgen per hour at a distance of one meter shall be protected by a sealed, gasketed or welded closure adequate to retain leakage and shielding sufficient to reduce radiation to that level. A means shall be provided for detecting and safely removing coolant which may leak through any such valve.

(l) Any valve through which primary coolant can flow shall be provided with a lock, which shall be locked during transport.

(m) Any cask in which the operating pressure exceeds atmospheric pressure during transport shall be equipped with a pressure relief device which will prevent exceeding 75% of the design pressure prescribed by paragraph 72.32(d).

(n) Each cask vent or pressure relief device shall be equipped with a filter capable of removing at least 99.9% of particles greater than 0.3 micron in size, and of sufficient capacity for the maximum rate of discharge of the vent or device. The filter shall be protected against impairment of efficiency by mechanical shock or absorption of moisture.

(o) When the total amount of iodine 131 which will be released from the fuel element under the conditions specified in paragraph 72.38(b) exceeds 10 curies or the amount of iodine 129 which will be released under those conditions exceeds 1 curie, the pressure relief system shall be equipped with an iodine gas removal device having a removal efficiency and retention capacity in the anticipated temperature range adequate to reduce the total iodine which may be released from the cask to those quantities.

(p) In any case in which an explosive mixture of gases or of gas and vapor may accumulate within the cask, provision shall be made to prevent explosion by equipping the cask

with a flash arrester, pre-purging void spaces with inert gas, adding an appropriate catalytic re-combiner, or assuring that the maximum temperature of the fuel will remain under all circumstances, including loss of all liquid or gaseous coolant and with all mechanical cooling devices being inoperative, at least 200°F below the ignition temperature of the explosive mixture.

(q) Means shall be provided, either by a sampling port or pipe connection or otherwise, for obtaining samples of gas or liquid coolant in the cask while the lid is in place and the cask is in the vehicle or vessel.

(r) Means shall be provided for safely equalizing the internal pressure of the cask with the pressure of the atmosphere.

(s) The pressure relief system shall have sufficient capacity to avoid a pressure surge exceeding the design pressure of the cask in the event of steam generation resulting from the introduction of water after loss of gas or liquid coolant.

(t) Pipe connections shall be provided capable of removing substantially all liquid from the interior of the cask while the lid is in place.

(u) Any piping passing through lead shielding shall be so installed that damage will not result from settling or deformation of the lead during handling and transport.

(v) Provisions shall be made to prevent freezing in the cask or its attachments of any liquid normally present or resulting from condensation, unless freezing of the liquid will not impair the efficiency of the cask or damage the cask or its contents.

72.35 Shielding

(a) The external radiation level shall not exceed 200 milliroentgens per hour at the accessible surface of the cask or of the external structure, if used, or 10 milliroentgens per hour at a distance of 1 meter from the accessible surface of the cask or the external structure, except that when transport of a single cask has the exclusive use of a freight car or other vehicle the radiation level shall not exceed 200 milliroentgens per hour at the accessible surface of the cask or 10 milliroentgens per hour at a distance of 3 meters from such surface.

(b) The shield shall be so constructed that in the event of the escape of all substances which are liquid at ordinary temperatures, and in the event of loss of all external shielding which is not an integral part of the cask, radiation levels will not exceed 1 roentgen per hour at a distance of 1 meter from the accessible surface of the cask. Shielding provided by any solid coolant may be taken into account in determining compliance with

this paragraph only if that coolant will remain in the cask in the event of any accident.

(c) Shielding shall prevent beaming of radiation to the exterior of the cask, and shall be free of voids other than controlled voids designed to contain shielding in the event of melting.

(d) Shielding shall be supported in the cask so that it cannot change position or configuration under normal conditions of transport. The inner shell of the cask shall be supported so that it will not be displaced if the shielding should melt.

(e) Any pipes or other attachments which might contain radioactivity during shipment shall be shielded in accordance with paragraph (a) of this section, taking into account the possibility of flow of liquid primary coolant as a result of thermal expansion or the release of radioactive gas from fuel elements.

72.36 Materials and Methods of Cask Construction

(a) Materials of which the cask and any components or internal structures are constructed shall be such that there is no significant chemical, galvanic or other reaction between them or with fuel elements.

(b) There shall be no pockets or crevices on the external surface of the cask which will not drain free, or which are not easily accessible for decontamination.

(c) All external and internal exposed surfaces of the cask shall be free of pits, cracks or porosity from which contamination is not readily removable.

(d) All welding and brazing of the cask shall be performed in a workmanlike manner and free of significant defects, and shall provide a mechanical joint efficiency of not less than 85%. The melting point of any brazing material shall not be lower than 1000°F.

(e) Any hole drilled in the body of the cask and extending into low melting point shielding material shall terminate within a boss pad welded to the shell of the cask body through which the hole penetrates, unless loss of shielding material through the hole cannot occur.

Criticality and Heat Removal

72.37 Standards for Control of Criticality

(a) The transportation of irradiated fuel elements will be permitted only if either:

(1) The number of fuel elements in a single cask does not exceed 75% of the number required to attain criticality under the conditions specified in paragraph (b) of this section, or

(2) The effective neutron multiplication constant k_{eff} does not exceed 0.9 under the same conditions.

(b) In determining whether either of the conditions specified in paragraph (a) of this section exists, the following assumptions shall be made:

(1) Water is in and around the cask in such quantities and so distributed as to cause maximum reactivity. If more than trace quantities of beryllium, graphite or heavy water are present then further evaluation is required.

(2) If reactivity decreases with irradiation, the fuel elements are unirradiated. If reactivity increases with irradiation, the fuel elements are irradiated to the condition of maximum reactivity.

(3) Fuel elements are in the most reactive array, unless the proposed spacing will assure less than maximum reactivity and the fuel elements cannot be rearranged into a more reactive array.

(4) Structural materials, including spacers, cask components, and neutron poisons intentionally built into cask components or fuel elements may be considered if their effectiveness as neutron poisons cannot be reduced by application to the cask of the forces described in Section 72.32, by melting of the fuel or neutron poison, or by other cause under normal conditions of transport or in the event of accident.

(c) Each cask and each shipment, whether including one or more casks, shall be so constituted as to avoid criticality resulting from neutron interaction between

casks or other shipments of special nuclear material on the vehicle or at point of origin, trans-shipment or delivery. Bracing and dunnage shall be adequate to prevent relative movement of each cask under normal conditions of transport.

72.38 Heat Removal

(a) The cask shall be so constructed and loaded that under normal conditions of transport:

(1) The temperature of any easily accessible surface of the cask or of any external structure will not at any time exceed 180°F. The temperature of any surface which may be in contact with dunnage or any part of the vehicle or vessel shall not exceed 350°F in land transport or 180°F in water transport.

(2) Any coolant or cooling system meets the following conditions:

(i) Primary gaseous or liquid coolant is not circulated outside of the shielding of the cask.

(ii) Provision is made to prevent freezing of any liquid coolant under the most adverse weather conditions to be anticipated and with any proposed fuel loading. Any antifreeze is of a type which will not under such circumstances undergo chemical change which might impair the efficiency of the cooling system.

- (iii) The temperature of any liquid primary coolant will remain at all times at least 20°F below its boiling point at the anticipated operating pressure within the cask, under the conditions described in paragraph 72.38(b).
- (iv) Any primary coolant will not cause significant corrosion of the fuel element, fuel element cladding or any interior surface of the cask, or react with any components of fuel elements or cask with which it might come in contact.
- (v) The gauge pressure of the primary coolant will not exceed 50 pounds per square inch or 50% of the design pressure, whichever is lower.
- (vi) Each cask equipped with a mechanical cooling device is equipped with a standby cooling device of similar characteristics which operates automatically in the event of failure of performance of the first device, unless failure of performance of the first device will result neither in a rise in temperature exceeding 100°F nor an increase of pressure beyond 75% of the design pressure.

(3) The maximum surface temperature of any fuel element will be no higher than the highest of the following:

(i) 300°F;

(ii) The maximum temperature which the type of fuel element has maintained during at least 30 days of irradiation in an operating reactor, without failure of any portion of the fuel element, as measured directly or calculated from experimental data; or, if the type of fuel element has not been irradiated for at least 30 days, then the average temperature which the type of fuel element has maintained during the maximum period of irradiation and not less than two days;

(iii) 300°F below the failure temperature of the type of fuel element, with due consideration for the irradiation and decay history of the fuel elements to be shipped in the cask.

(4) For the purposes of paragraph 72.38(a), failure temperature shall be considered to be the minimum temperature at which initially sound fuel elements of the character and amount being considered as the cask load will, within 48 hours, release to the

primary coolant 100 curies of beta-gamma radioactivity or one curie of alpha radioactivity. In no case may failure temperature be taken as higher than the melting point of the fuel or cladding, whichever is lower.

(b) The cask shall be so constructed and loaded that, in the event all liquid or gaseous coolant should be lost, and mechanical cooling devices have become inoperative, but solid coolants including granular solids remain in the cask, the maximum surface temperature of any fuel element will not exceed a temperature of 100°F above the temperature specified in subdivision 72.38(a)(3)(iii). Fuel element surface temperatures may exceed the melting point of the cask shielding material if melting of the shielding material will not occur.

(c) Computation of the temperature within the cask shall in every case assume ambient air at 100°F without wind, with maximum solar heat load anticipated for the proposed route and conditions of shipments and, in the circumstances described in paragraph 72.38(b), loss of any sun shade or enclosure which would intercept solar radiation.

SHIPPING PROCEDURES

72.41 Ruptured Fuel Elements. Prior to the transport of any fuel element having any break or defect in its cladding, the licensee shall completely enclose the fuel element in an

internal container, unless the fuel element can be carried in the cask without significant reaction or contamination of the primary coolant in excess of 1/10 of the permissible limits prescribed in paragraph 72.45(d).

- 72.42 Defective Casks. The licensee shall not transport or cause to be transported irradiated fuel elements in any cask which the licensee knows or has reason to believe is defective in any respect having a potentially significant adverse effect on the efficiency of the cask.

Testing of Casks

72.43 Requirements for Tests

(a) No irradiated fuel elements shall be transported until the licensee has completed the tests described in Sections 72.44 and 72.45 and has determined that the loaded cask complies with the provisions of this part and the conditions of the license.

(b) No cask which has been involved in any accident or in which significant corrosion is suspected shall be employed for the transportation of irradiated fuel elements until the licensee has tested the cask and determined that it complies with the provisions of this part.

72.44 Preliminary Tests

(a) Prior to the first use of any cask, the licensee shall experimentally verify the calculated heat transfer

characteristics of the cask and any mechanical cooling device under normal conditions of transport.

(b) Prior to the first use of any cask, the licensee shall determine the effectiveness of the cask shielding and shall establish the absence of cracks, pinholes, uncontrolled voids or other defects.

72.45 Routine and Periodic Tests

(a) External Radiation Levels. Prior to each shipment of any cask, the licensee shall determine that the external radiation levels of the loaded cask comply with the provisions of paragraph 72.35(a).

(b) External Contamination. Prior to each shipment of any cask, the licensee shall survey representative parts of the surface of the loaded cask for external contamination by wiping an area of approximately 100 square centimeters with clean absorbent paper, applying moderate finger pressure, and measuring contamination on the paper through standard counting techniques for beta-gamma and alpha activity. Surface contamination so measured shall exceed neither 4000 disintegrations per minute per 100 square centimeters of beta-gamma activity nor 500 disintegrations per minute per 100 square centimeters of alpha activity.

(c) Pressure Test. Prior to each shipment, the licensee shall test the loaded cask with primary coolant in place for leaktightness using an internal pressure at least

50% higher than the maximum anticipated internal gauge pressure, and in any event not less than 3 pounds per square inch.

(d) Activity of Coolant. If all or any part of the primary coolant is liquid or gas, the licensee shall take a representative sample of the coolant prior to each shipment. The sample shall not be taken until at least 4 hours after the fuel elements and the primary coolant have been placed in the cask. The licensee shall measure the activity of the sample and the following limits of activity shall not be exceeded:

Liquid coolant:	10^{-5} curies of beta or gamma activity per milliliter
	10^{-7} curies of alpha activity per milliliter
Gas coolant:	10^{-7} curies of beta or gamma activity per milliliter
	10^{-10} curies of alpha activity per milliliter

(e) Neutron Poisons. The licensee shall perform periodic tests to establish that any built in neutron poisons are present and effective in accordance with the approved cask design.

72.46 Temperature and Pressure

(a) The licensee shall not transport or cause to be transported any cask containing irradiated fuel elements until the temperature of the cask and contents has reached

equilibrium or until it has been determined that equilibrium conditions will comply with Section 72.38.

(b) Prior to shipment, the licensee shall determine that the internal pressure of the cask will not exceed 50 pounds per square inch gauge or 50% of the design pressure, whichever is less, under normal conditions of transport.

NOTIFICATION, RECORDS AND INSPECTION

72.51 Notification of AEC. At least 20 days prior to the date each shipment is scheduled to be made, the licensee shall forward to the Director, Division of Licensing and Regulation, Washington 25, D. C., the following information concerning the intended shipment:

- (a) Date of the proposed shipment, the proposed route, mode of transport and destination.
- (b) Type of cask and AEC license number under which the shipment is authorized.
- (c) Description of the irradiated fuel to be carried, including the type of fuel element, irradiation history and cooling time, estimated maximum fission product content and estimated maximum heat output.
- (d) Any special conditions of shipment, such as any ruptured or leaking fuel elements, with special precautions to be taken.

72.52 Records. Each licensee shall keep the following records with respect to the irradiated fuel elements in the licensee's possession and shipments which the licensee has made:

- (a) Identification of each fuel element and the amount of special nuclear material contained in each fuel element prior to use in a reactor.
- (b) The irradiation history of each element.
- (c) The time during which each element has cooled since its removal from the reactor.
- (d) Details of any abnormal condition of any fuel element.
- (e) Details of each shipment, including list of fuel elements, type and quantity of coolant, gross weight, shipping date, mode and general route of transport.
- (f) Details and results of tests and observations made on each cask, including calculated and observed rates of heat generation and dissipation, coolant and cask temperatures and pressures, and radiation and contamination surveys.

72.53 Inspection and Tests

- (a) Each licensee shall afford to the Commission at all reasonable times opportunity to inspect irradiated fuel elements, casks, and the premises and facilities wherein irradiated fuel elements or casks are used, produced, tested, stored, or transported.

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

(c) Each 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

72.71 Violations. 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 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.

APPENDIX A

The "standard one-hour fire" mentioned in this part 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°F	after 5 minutes;
1300°F	after 10 minutes;
1550°F	after 30 minutes;
1700°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} ~~Association~~ for Testing Materials (ASTM, Design E 119-50). Details of methods for testing by means of the standard fire may be found in the cited references.

Dated at Germantown, Maryland, this _____ day of _____, 1961.

For the Atomic Energy Commission.

Secretary

SUBCONTRACT NO. 2070

THIS AGREEMENT, made and entered into this second day of February, 1961, by and between UNION CARBIDE NUCLEAR COMPANY, DIVISION OF UNION CARBIDE CORPORATION, a corporation organized and existing under the laws of the State of New York, with an office located at Charlotte Hall, Oak Ridge, Tennessee, (hereinafter referred to as the "Company"), and CAREY SALT COMPANY, a corporation duly organized and existing under the laws of the State of Kansas, with an office located at Hutchinson, Kansas, (hereinafter referred to as the "Seller").

WHEREAS the Company has heretofore entered into Contract No. W-7405-eng-26 (hereinafter referred to as the "Principal Contract"), with the United States of America (hereinafter referred to as the "Government"), as represented by the United States Atomic Energy Commission (hereinafter referred to as the "Commission"); and

WHEREAS in furtherance of the Principal Contract, the Company desires to procure from the Seller, for and on behalf of the Government, certain mine space and services in connection with such mine space, for conducting experiments to determine the feasibility of disposing of reactor fuel and reprocessing wastes in rock salt.

AND WHEREAS the Seller is willing to furnish the mine space and services upon the terms and conditions hereinafter set forth:

NOW THEREFORE, the parties hereto mutually agree as follows:

ARTICLE I - STATEMENT OF WORK

- A. 1 The Seller shall furnish required mine space in the Seller's mines near Hutchinson, Kansas and Lyons, Kansas necessary for the performance of Company's experiments in determining the feasibility of disposing of reactor fuel reprocessing wastes in rock salt. The mine space to be furnished will be at different locations throughout the mines but will not exceed 500,000 cubic feet of mine space in the mine near Hutchinson, Kansas and 500,000 cubic feet of mine space in the Seller's mine at Lyons, Kansas. The mine near Hutchinson is hereinafter referred to as the "Hutchinson Mine" and the mine at Lyons is hereinafter referred to as the "Lyons Mine".
- 2 The term "Mine Space" as used herein means space in the Seller's mines assigned to the Company for its exclusive use in conducting its experiments.
- B. The Company will from time to time during the term of this Agreement make requests in writing for the assignment of Mine Space required for conducting experiments and will set forth its space requirements in such requests. The Seller agrees to furnish the required Mine Space as and when requested by the Company, within the limitations set forth above, at suitable locations for the performance of the experiments.

Signed by Mr. 7.13-61

- C. The Seller further agrees to furnish such materials, equipment, and services necessary to permit ingress and egress to and from the Mine Space as may be necessary for the Company to obtain access to the Mine Space and for the transportation of personnel, materials, and equipment required by the Company in conducting its experiments. It is agreed and understood that if in the opinion of the Seller and the Company additional facilities or equipment is required to effect this transportation, not already installed in the mines, the Seller shall, with the approval of the Company, have such facilities installed and the reasonable cost of such additional facilities and equipment required solely for the Company's benefit as approved by the Company will be for the account of the Company. The Seller shall not install any additional equipment or facilities for the account of the Company unless authorized in writing by the Company. Failure to agree upon such cost shall be a dispute as to a question of fact which shall be resolved pursuant to the paragraph entitled "Disputes".
- D. A lift and shaft have been installed by the Seller in both the Hutchinson Mine and the Lyons Mine. The Seller agrees to maintain the lift and shaft in each mine in operating condition and operate the lift during the term of this Agreement for the transportation of Company equipment, personnel, and materials to the interior of the mines during normal working hours. If the Seller operates the lift for the sole benefit of the Company during other than normal working hours, the Seller shall be paid its direct labor cost for such lift operations.
- E. It is understood and agreed that in conducting its experiments the Company shall not introduce any radioactive waste material into the Hutchinson Mine. It is further understood and agreed that the Company shall have the right to use radioactive materials in conducting its experiments in the Lyons Mine. It is further understood and agreed that the Company shall have the right to introduce radioactive tracer material in the Hutchinson Mine subject to the approval of the Seller.
- F. The Seller agrees to maintain adequate ventilation in each of the mines at all times during the term of this Agreement when the Company is conducting its experiments therein. Seller further agrees to maintain the mine shaft and access corridors to the Mine Space being utilized by the Company in a safe condition.

ARTICLE II - TERM OF THIS AGREEMENT

- A. The parties hereto hereby agree that the initial term of this Agreement will be for the period beginning March 1, 1961 and ending February 28, 1962, provided however, that the Company may at its option and under the terms and conditions as herein contained by written notice to the Seller prior to February 28, 1962, and prior to February 28, of each calendar year thereafter cause the term of this Agreement to be extended for additional periods of one (1) year each.
- B. The parties further agree that with respect to any additional one (1) year period of this Agreement, beginning on March 1, 1962 to any March 1, thereafter, the Company may terminate all or any part of this Agreement upon a

sixty (60) day notice in writing to the Seller setting forth the extent of the termination.

- C. The parties further agree that at any time after January 1, 1970, but not before, the Seller may terminate all or any part of this Agreement upon a sixty (60) day notice in writing to the Company setting forth the extent of the termination.
- D. Upon expiration of this Agreement or prior termination under Paragraph B. or C. above, the Seller agrees to allow the Company or the Commission to enter upon the Seller's premises in order that the Company and/or Commission may remove therefrom all equipment, materials, and supplies that belong to or are otherwise subject to the control of the Government; providing, that nothing herein shall prevent the Company or the Commission, with the consent of the Seller, from abandoning any property owned or controlled by the Government at such time as the Company withdraws from the Seller's premises.

ARTICLE III - ACCESS TO MINE SPACE

The Seller agrees that authorized Company and/or Commission personnel will be afforded access to the Mine Space at any time during the term of this Agreement.

ARTICLE IV - CONSIDERATION /3/ 3.3.7. . . . 2,350.00

The Seller shall be paid \$1,250.00 per month for the duration of this Agreement, its direct labor cost for lift operation during other than normal working hours as provided in Article I Paragraph D. hereof, and such other costs under this Agreement as are approved by the Company, the total of which payments shall constitute full and complete consideration for the Seller's undertakings hereunder. In the event of the occurrence of a casualty or mishap which results in a termination of the Agreement as provided in Article VI hereof, the monthly payment to the Seller of \$1,250.00 shall cease effective at the end of the month in which the casualty or mishap occurs.

ARTICLE V - TERMS OF PAYMENT

The Seller shall submit invoices after the end of each calendar month and payment against proper invoices shall be made within thirty (30) days after the receipt of such invoices.

ARTICLE VI - CASUALTY OR MISHAP

Seller shall be responsible for normal maintenance of the equipment in the said salt mines, including the lifts and shafts of the said salt mines. In the event of any casualty or mishap rendering either mine or any equipment therein, including the lifts and shafts, unusable or only partially usable, Seller shall not be obliged to repair or replace the said equipment or the lifts or shafts. However, Company shall have the right to repair or replace or cause to be repaired or replaced the said equipment, lifts or shafts at the expense of the Company, or

Company may, in addition to any other right of termination herein contained, terminate in whole or in part this Agreement effective at the end of the month in which such casualty or mishap occurs.

ARTICLE VII - SAFETY, HEALTH AND FIRE PROTECTION

The Seller shall take all reasonable precautions in the performance of the work under this Agreement to protect the health and safety of employees and of members of the public and to minimize danger from all hazards to life and property, and shall comply with all health, safety, and fire protection regulations and requirements (including reporting requirements) of the Company and the Commission.

ARTICLE VIII - CESSATION OF MINE OPERATIONS

If, for any reason Seller shall determine at any time to cease the operation of either or both of its Hutchinson or Lyons Mines, it shall have complied with all of its obligations hereunder by continuing to make available to Company the salt mine or mines and equipment therein, and Company may operate all of Seller's equipment to accomplish Company's operations and experiments hereunder. In that event the maintenance and operation of such equipment and facilities shall be for the account of the Company, and Company and Seller shall negotiate in good faith for an adjustment of the consideration to be paid to Seller under the terms of this Agreement.

ARTICLE IX - EXAMINATION OF ACCOUNTS AND RECORDS

The Company and the Commission shall have the right to examine any directly pertinent books, documents, papers, and records of the Seller for the purpose of verification of any direct labor or other charges invoiced under the terms of this Agreement.

ARTICLE X - TERMS AND CONDITIONS

The provisions of "Terms and Conditions" designated as File No. 2-53 (9-60) attached hereto are hereby made a part of this Agreement except that Articles 9, 10, 16, and 17 are hereby deleted.

ARTICLE XI - APPROVAL REQUIRED

This Agreement shall have no force or effect until approved in writing by a duly authorized representative of the Commission.

IN WITNESS WHEREOF, the parties hereto have executed this Agreement as of the day, month and year first above written.

UNION CARBIDE NUCLEAR COMPANY
DIVISION OF UNION CARBIDE CORPORATION

General Purchasing Agent

CAREY SALT COMPANY

By _____

Title 100-442-1-1

APPROVED IN BEHALF OF THE UNITED STATES ATOMIC ENERGY COMMISSION

By _____

TERMS AND CONDITIONS

P. DEARMENTUS

1. 94. 1948. 10. 10. 1948.

[illegible]

b. The term "United States" means the United States of America and includes the Commission or Agent of the United States or the Governor, and

1. The term "discovery" means the first actual knowledge of the existence of the invention, whether or not the inventor is aware of it.

2. OFFICIALS NOT TO BENEFIT

No portion of the balance in (any) cash or residual compensation shall be admitted to any share or part of this contract nor to any benefit that may arise therefrom, but the person shall not be compensated in excess of their original 1. trade with a corporation for an original benefit.

3. CONVICT LABOR

In accordance with the requirements of work under this contract, the subject agrees not to employ any person in performing activities of espionage or sabotage at any time.

4. NONDISCRIMINATION IN EMPLOYMENT

in connection with the performance of work under this contract, the Seller agrees not to discriminate against any employee or applicant for employment because of race, religion, sex, or national origin. This nondiscrimination provision shall include, but not be limited to, no discrimination in hiring, upgrading, or transfer, or termination or nonrenewal of advertising contract or termination of any other form of contract. The Seller shall not discriminate in advertising contracts on the basis of sex, race or religion. In making decisions, including advertising contracts, the Seller agrees to make available to all employees and applicants for employment, notices in the provision by the Commission setting forth the provisions of the nondiscrimination statute. This provision shall not apply if this contract is for secondary commercial activities or raw materials.

1. If the Seller has not adequately protected against (from 2.0, 20-5-101-11 entitled "Economic Opportunity"), the Seller shall request and receive from the Company without delay:

3. ADMINISTRATION AND PAYMENT

[illegible]

4. ASSIGNMENT

Neither the contract, nor the interest therein nor this assignment, shall be assigned or encumbered by the seller to any party, in part or in whole, except in the name and in the presence of the Company.

7 SECURITY

2. Seller's Duty to Safeguard Restricted Data and Other Classified Information. In the performance of the work under this contract the Seller shall, in accordance with the Commission's security regulations and requirements, be responsible for safeguarding Restricted Data and other classified matter and protecting against espionage, espionage, loss and theft, the classified documents, materials, equipment, processes, etc., as well as such other material of high scientific or strategic value as may be in the Seller's possession in connection with performance of such studies and contracts. Proper safeguards already provided in the specifications the Seller shall upon completion or termination of the contract transmit to the Commission any classified matter in the possession of the Seller at any given date, the Seller's conduct in compliance with performance of this contract.

b. Regulations, The Seller agrees to comply, in all necessary regulations and requirements of the Commission.

c. Definition of Restricted Data. The term "Restricted Data," as used in this article, means all data concerning (1) design, nomenclature, or utilization of atomic weapons; (2) the production of special nuclear materials; or (3) the use of special nuclear materials in the production of energy, but shall not include data disclosed or connected therewith pursuant to data exchange programs, as defined in the Atomic Energy Act of 1954.

1. Security Clearance of Personnel. Except as the Commission may authorize, no employee within the Atomic Energy Act of 1954, the Geller shall use personnel who fail to have access to Restricted Data until the designated investigating agency shall have made an investigation and report to the Commission on the character, associations, and habits of such individual and the Commission shall have determined that personnel which person to have access to Restricted Data will not endanger the national defense and security. In case in this paragraph, the term "designated investigating agency" means the United States Civil Service Commission or the Federal Bureau of Investigation, as each, as determined pursuant to the provisions of the Atomic Energy Act of 1954. Access to classified information other than Restricted Information may be given to persons the recipient possesses appropriate security clearance.

4. Contract of Employment. It is understood that disclosure of information relating to a work or services ordered hereunder is to not be and not be entitled to receive in exchange for wages and benefits thereon or any Tax-Security, Pension, or Social Insurance benefits as would be the rights of any person under the Seller's contract in connection with work under this contract, may subject the Seller, and agents, employees, and subcontractors to criminal liability under the laws of the United States. (See Atomic Energy Act of 1954, 42 Stat. 2121. See also Executive Order 12065 of February 17, 1959, 24 U. S. C.

6. Supplements and Purchase Orders: Except as otherwise authorized in writing by the Company, the Seller shall amend, provisionally or otherwise, the foregoing order, supplements, and purchase orders, order lists, or contract.

8 DISCUSSION

[illegible]

1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12. 13. 14. 15. 16. 17. 18. 19. 20. 21. 22. 23. 24. 25. 26. 27. 28. 29. 30. 31. 32. 33. 34. 35. 36. 37. 38. 39. 40. 41. 42. 43. 44. 45. 46. 47. 48. 49. 50. 51. 52. 53. 54. 55. 56. 57. 58. 59. 60. 61. 62. 63. 64. 65. 66. 67. 68. 69. 70. 71. 72. 73. 74. 75. 76. 77. 78. 79. 80. 81. 82. 83. 84. 85. 86. 87. 88. 89. 90. 91. 92. 93. 94. 95. 96. 97. 98. 99. 100. 101. 102. 103. 104. 105. 106. 107. 108. 109. 110. 111. 112. 113. 114. 115. 116. 117. 118. 119. 120. 121. 122. 123. 124. 125. 126. 127. 128. 129. 130. 131. 132. 133. 134. 135. 136. 137. 138. 139. 140. 141. 142. 143. 144. 145. 146. 147. 148. 149. 150. 151. 152. 153. 154. 155. 156. 157. 158. 159. 160. 161. 162. 163. 164. 165. 166. 167. 168. 169. 170. 171. 172. 173. 174. 175. 176. 177. 178. 179. 180. 181. 182. 183. 184. 185. 186. 187. 188. 189. 190. 191. 192. 193. 194. 195. 196. 197. 198. 199. 200. 201. 202. 203. 204. 205. 206. 207. 208. 209. 210. 211. 212. 213. 214. 215. 216. 217. 218. 219. 220. 221. 222. 223. 224. 225. 226. 227. 228. 229. 230. 231. 232. 233. 234. 235. 236. 237. 238. 239. 240. 241. 242. 243. 244. 245. 246. 247. 248. 249. 250. 251. 252. 253. 254. 255. 256. 257. 258. 259. 260. 261. 262. 263. 264. 265. 266. 267. 268. 269. 270. 271. 272. 273. 274. 275. 276. 277. 278. 279. 280. 281. 282. 283. 284. 285. 286. 287. 288. 289. 290. 291. 292. 293. 294. 295. 296. 297. 298. 299. 300. 301. 302. 303. 304. 305. 306. 307. 308. 309. 310. 311. 312. 313. 314. 315. 316. 317. 318. 319. 320. 321. 322. 323. 324. 325. 326. 327. 328. 329. 330. 331. 332. 333. 334. 335. 336. 337. 338. 339. 340. 341. 342. 343. 344. 345. 346. 347. 348. 349. 350. 351. 352. 353. 354. 355. 356. 357. 358. 359. 360. 361. 362. 363. 364. 365. 366. 367. 368. 369. 370. 371. 372. 373. 374. 375. 376. 377. 378. 379. 380. 381. 382. 383. 384. 385. 386. 387. 388. 389. 390. 391. 392. 393. 394. 395. 396. 397. 398. 399. 400. 401. 402. 403. 404. 405. 406. 407. 408. 409. 410. 411. 412. 413. 414. 415. 416. 417. 418. 419. 420. 421. 422. 423. 424. 425. 426. 427. 428. 429. 430. 431. 432. 433. 434. 435. 436. 437. 438. 439. 440. 441. 442. 443. 444. 445. 446. 447. 448. 449. 450. 451. 452. 453. 454. 455. 456. 457. 458. 459. 460. 461. 462. 463. 464. 465. 466. 467. 468. 469. 470. 471. 472. 473. 474. 475. 476. 477. 478. 479. 480. 481. 482. 483. 484. 485. 486. 487. 488. 489. 490. 491. 492. 493. 494. 495. 496. 497. 498. 499. 500. 501. 502. 503. 504. 505. 506. 507. 508. 509. 510. 511. 512. 513. 514. 515. 516. 517. 518. 519. 520. 521. 522. 523. 524. 525. 526. 527. 528. 529. 530. 531. 532. 533. 534. 535. 536. 537. 538. 539. 540. 541. 542. 543. 544. 545. 546. 547. 548. 549. 550. 551. 552. 553. 554. 555. 556. 557. 558. 559. 560. 561. 562. 563. 564. 565. 566. 567. 568. 569. 570. 571. 572. 573. 574. 575. 576. 577. 578. 579. 580. 581. 582. 583. 584. 585. 586. 587. 588. 589. 590. 591. 592. 593. 594. 595. 596. 597. 598. 599. 600. 601. 602. 603. 604. 605. 606. 607. 608. 609. 610. 611. 612. 613. 614. 615. 616. 617. 618. 619. 620. 621. 622. 623. 624. 625. 626. 627. 628. 629. 630. 631. 632. 633. 634. 635. 636. 637. 638. 639. 640. 641. 642. 643. 644. 645. 646. 647. 648. 649. 650. 651. 652. 653. 654. 655. 656. 657. 658. 659. 660. 661. 662. 663. 664. 665. 666. 667. 668. 669. 670. 671. 672. 673. 674. 675. 676. 677. 678. 679. 680. 681. 682. 683. 684. 685. 686. 687. 688. 689. 690. 691. 692. 693. 694. 695. 696. 697. 698. 699. 700. 701. 702. 703. 704. 705. 706. 707. 708. 709. 710. 711. 712. 713. 714. 715. 716. 717. 718. 719. 720. 721. 722. 723. 724. 725. 726. 727. 728. 729. 730. 731. 732. 733. 734. 735. 736. 737. 738. 739. 740. 741. 742. 743. 744. 745. 746. 747. 748. 749. 750. 751. 752. 753. 754. 755. 756. 757. 758. 759. 760. 761. 762. 763. 764. 765. 766. 767. 768. 769. 770. 771. 772. 773. 774. 775. 776. 777. 778. 779. 780. 781. 782. 783. 784. 785. 786. 787. 788. 789. 790. 791. 792. 793. 794. 795. 796. 797. 798. 799. 800. 801. 802. 803. 804. 805. 806. 807. 808. 809. 810. 811. 812. 813. 814. 815. 816. 817. 818. 819. 820. 821. 822. 823. 824. 825. 826. 827. 828. 829. 830. 831. 832. 833. 834. 835. 836. 837. 838. 839. 840. 84

4. The "Lijerica" article does not require consideration of the question of consistency with decisions provided for in paragraph 11 above, provided that nothing in this context shall be construed as making void the decision of any administrative tribunal, representative, or figure of law.

1. In any dispute covered by this article, the procedures, provisions, and rules applicable to the resolution of disputes shall continue to apply to the Commission until they apply.

4. The term "Contracting Officer" as used in this article means the person exercising on behalf of the Government the Contractor's contract heretofore referred to and includes his successors or any duly authorized representatives of such persons.

9. PLATEMARKS

[illegible]

b. Seller further agrees that no claim or claims for pecuniary award or compensation under the provisions of the Atomic Energy Act of 1946 and 1946 shall be asserted by seller or his employees with respect to any investigations or disclosures made or conceived in the course of, or in connection with or under the terms of this contract.

* Except as otherwise indicated in writing by the Commission, the Author will retain patent responsibility for inventions disclosed in paragraph 1, and b, of this article from all persons who publish any part of it, even under this contract except clerical and managerial personnel who will not have access to the author's data.

J. Edgar Hoover authorized in writing to the Commission, the Siller will issue in all subsequent provisions making this act applicable to the sub-processor and his employees.

12. PLATE INDUSTRIES

4. The Seller agrees to indemnify the Company, and the consequences thereof, attorneys, accountants, consultants and other persons against liability of any kind for claims, costs and damages, threatened or incurred, arising out of or in connection with the performance of any future contract (not including liability arising pursuant to Section 486, Title 35, 49 USC) in the future, prior to the termination of the contract, except as carried on the performance of this contract or arising from the negligence of the Buyer or negligent in the performance of this contract or in the performance of the contract, and the Seller shall defend under this contract.

[illegible]

II. EXAMINATION OF RECORDS

11. The Seller agrees that the Copyrights owned by the Buyer in any or all of his fully copyrighted preproduction shall have Access to and the right to exercise any remedy provided in the, description, papers and records of the Seller's sole and exclusive business to him in full contract for a period of three years after final payment under this contract.

4. Nothing in this contract shall be construed to preclude an audit by the General Accounting Office of any transaction under this contract.

12. REPORTING OF ROYALTIES

These practices involve any regularly conducted use of the personal or non-royalty personal information of the donor of that computer, the donor agrees to comply with, subject to the following, during the performance of this contract and prior to the completion of final settlement: the amount of any donation or other license payment, past or to be paid; (b) directly to donors in connection with the performance of their contracts together with the names and addresses of the donor, for use in such performance, and enables the patent numbers involved in those other information, as well permit identification of the patents or other items in which the royalties are to be paid. The approval of the Commission of these individual payments may also allow the Commission to pay back from royalties the minor-ability, variety or amount of, or take in, any patent under which such royalty is paid or seek any other means to do so.

4. CONVENANT AGAINST CONTINGENT FEES

1. Selling weapons to any person or military unit may be carried out or arranged to be carried out only through the central agency or subagency or subagency of a government, government agency, organization, or institution having jurisdiction over the group of people for whom the government or selling agency is established by the seller in the process of selling weapons. But there is no violation of this subsection and, therefore, with the approval of the Commission, shall have the right to avoid this section's provisions if it is an individual or a religious group or a community or a corporation, or otherwise, and the full set of weapons, including, but not limited to, the following:

14. EIGHT-HOUR LAW OF 1937 - OVERTIME COMPENSATION

This document contains information which is classified as restricted under E.O. 12958, and its continuation, E.O. 13526, and is exempt from automatic downgrading and declassification pursuant to 25 U.S.C. 1621(a)(2). It is subject to the following provisions and exceptions: it is controlled by and to all other provisions of law relating to the protection of information.

We believe we are doing but part of the work contemplated by this contract, in the capital of the country, or any other place, for any part of said work contemplated, which is required, we are permitted to work more than eight hours in any one calendar day upon such work, except upon the condition that compensation shall be made in full for the labor in excess of the provisions of this article. The wages of every such worker and mechanic employed by the State or its subdivisions engaged in the performance of this contract shall be computed on a basis of eight hours per day and such excess of eight hours per day be permitted only upon the condition that there be no increase and no decrease shall be made in the rate of wages for the period of eight hours per day at work on this one and possibly more the majority of pay. For each violation of the requirement of this article a penalty of five dollars shall be imposed for each laborer or mechanic for every calendar day in which such violation is required or permitted to take place in the full time, and work without proper compensation shall be considered as a violation of this article and a violation of this article shall be a cause for the removal of the worker from employment.

15. GOVERNMENT PROPERTY

a. **Ownership of Government Property.** The Seller shall have the right to furnish any Government property or services required for the performance of the work under this contract.

b. **Title to Property.** Title to all property furnished by the Company shall remain in the Company except as otherwise provided in this contract. Except as otherwise provided by the Company and the Commission, title to all purchased materials, equipment, supplies, and tangible personal property of every kind and description, the cost of which is allocable as a direct cost of cost under this contract, shall pass directly from the Seller through to the Government. Title to other property, the cost of which is allocable under this contract, shall pass to and vest in the Government upon (1) payment for use of such property in the performance of this contract, or (2) completion or termination of use of such property in performance of this contract, or (3) delivery to the Seller of the cost thereof, at whatever time or times. Property furnished by the Company and purchased property or property furnished by the Seller, title to which vests in the Government under this paragraph, are hereafter referred to as Government property. Title to Government property shall not be affected by the incorporation of the property into, or the attachment of, a new property not owned by the Government, nor shall such Government property, in any part thereof, be or become a fixture or trade dress as personal property by reason of attachment to any realty.

c. **Identification.** To the extent directed by the Company, the Seller shall identify Government property coming into the Seller's possession or custody by marking or tagging of such property satisfactory to the Company, and shall indicate its ownership by the Government.

d. **Disposition.** The Seller shall make such disposition of Government property which has come into the possession or custody of the Seller under this contract as the Company, with the approval of the Commission, shall direct. When notified in writing by the Company during the progress of the work or upon completion or termination of this contract, the Seller may, upon such terms and conditions as the Commission may approve, sell or exchange such property, or acquire such property as a price agreed upon by the Company, with the approval of the Commission, and the Seller as the fair value thereof. The amount received by the Seller as the result of any disposition, or the amount of the agreed fair value of any such property acquired by the Seller, shall be applied in reduction of costs allocable under this contract, or shall be otherwise credited to the account of the Government, as the Company may direct. Upon completion of the work or the termination of this contract, or at such earlier time as may be required by the Company, the Seller shall render an accounting, as prescribed by the Company, of all Government property which has come into the possession or custody of the Seller under this contract.

e. **Protection of Government Property - Classified Materials.** The Seller shall take all reasonable precautions, as directed by the Company, or in the absence of such direction, in accordance with sound industrial practice, to safeguard and protect Government property in the Seller's possession or custody. Special measures shall be taken by the Seller in the protection of any classified or special materials involved in the performance of this contract in accordance with the regulations and requirements of the Government.

f. **Risk of Loss of Government Property.** The Seller shall not be liable for loss or destruction of or damage to Government property in the Seller's possession unless such loss, destruction or damage results from willful misconduct or lack of good faith on the part of the Seller's managerial personnel, or unless such loss, destruction or damage results from a failure on the part of the Seller's managerial personnel to take all reasonable steps to comply with any appropriate written directives of the Company to safeguard such property under paragraph (a) herein. The term "Seller's managerial personnel" as used herein means the Seller's directors, officers and any of its managers, superintendents, or other supervisory representatives who have supervisory or discretionary authority over all or substantially all of the Seller's business, or (2) all or substantially all of the Seller's operation at any one place or separate location at which this contract is being performed; or (3) a separate and complete major industrial operation in connection with the performance of this contract; or (4) a separate and complete major construction, alteration or repair operation in connection with performance of this contract.

g. **Steps to be Taken in Event of Loss.** Upon the happening of any loss or destruction of or damage to Government property in the possession or custody of the Seller, the Seller shall immediately inform the Company of the loss and extent thereof, shall take all reasonable steps to protect the property remaining, and shall repair or replace the lost, destroyed, or damaged property if and as directed by the Company, but shall have no action or claim for the right of the Government to recover therefor and shall furnish to the Company or the Government on request all reasonable assistance in locating recovery.

h. **Government Property for Government Use Only.** Except as otherwise authorized by the Company, with the approval of the Commission, Government property shall be used only for the performance of this contract.

~~16. GOVERNMENT PROPERTY - SPECIAL PROVISIONS~~

a. The Seller agrees to notify the Company, who in turn will notify the Commission, of any time or local tax, fee, or charge levied or imposed in or collected from the Seller with respect to the contract work or any transaction thereunder and constituting an allowable cost of cost if due and payable, but which, in the option of the Seller or under the position of the Commission as determined by the Seller is inapplicable or invalid, and the Seller further agrees to refrain from paying any such tax, fee, or charge unless authorized by the Company with the approval of the Commission. Any time or local tax, fee, or charge paid in the option of the Seller or under the position of the Commission as determined by the Seller is inapplicable or invalid, and which would otherwise be an allowable item of cost, shall not be disallowed as an item of cost by reason of any subsequent ruling or determination that such tax, fee, or charge was in fact inapplicable or invalid.

b. The Seller agrees to take such action as may be required or ordered by the Company with the concurrence of the Commission to cause any such tax, fee, or charge referred to above to be paid where payment and to take such action as may be required or approved by the Company with the concurrence of the Commission to seek recovery of any payment made, including assignment to the Government of the defense of all rights to an exemption or refund thereof, and granting permission for the Government to join with the Seller in any proceedings for the recovery thereof or to sue for recovery, in the name of the Seller. If the Commission directs the Seller to institute litigation for recovery of the tax, fee, or charge referred to above, or if a claim or suit is filed against the Seller for a tax, fee, or charge he has recovered from paying in accordance with this article, the Seller shall comply with procedures and requirements of the Commission, and the loss and expenses incurred by the Seller shall be allowable items of cost, as provided in this contract, together with the amount of any judgment rendered against the Seller.

c. The Company and the Commission shall have the Seller harmless from penalties and expenses incurred through compliance with this article.

17. ACCOUNTS, RECORDS AND INSPECTION

a. **Accounts.** The Seller shall maintain accounts, records, receipts and other evidence showing and supporting all allowable costs incurred, revenues or other applicable

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credits, used for or in the receipt, use, and disposition of all Government property coming into the possession of the Seller under this contract. The system of accounts employed by the Seller shall be satisfactory to the Company and in accordance with generally accepted accounting principles consistently applied.

b. **Inspection and Audit of Accounts and Records.** All books of account and records relating to this contract shall be subject to inspection and audit by the Company and/or the Commission at all reasonable times, before and during the period of execution provided for in 4. herein, and the Seller shall afford the Company and/or the Commission proper facilities for such inspection and audit.

c. **Audit of Subcontractors' Records.** The Seller also agrees, with respect to any subcontractors (including leasehold or master-subcontractors or purchase order) where, under the terms of the subcontract, costs incurred are a factor in determining the amount payable to the subcontractor of any kind, to conduct or audit of the costs of the subcontractors as a contract obligatorily to the Company, to have the audit conducted by the next higher tier subcontractor in a manner satisfactory to the Seller, the Company, and the Commission, except when the Company and the Commission elect to waive such audit or approve other arrangements for the conduct of the audit.

d. **Disposition of Records.** Except as required upon by the Company and the Seller, all financial and cost reports, books of account and supporting documents, and other data concerning costs allowable and revenues and other applicable credits under this contract in the possession of the Seller relating to this contract shall be preserved by the Seller for a period of six (6) years after termination of the contract or otherwise disposed of in such manner as may be agreed upon by the Company and the Seller.

e. **Reports.** The Seller shall furnish such progress reports and schedules, financial and cost reports, and other reports concerning the work under this contract as the Company may from time to time require.

f. **Inspections.** The Company and the Commission shall have the right to inspect the work and facilities of the Seller under this contract at such time and in such manner as they shall deem appropriate.

g. **Subcontractors.** The Seller further agrees to require the inclusion of provisions similar to those in paragraphs a through this paragraph g, of this article in all subcontracts (including purchase or purchase order) or purchase orders of any tier entered into hereunder where, under the terms of the subcontract, costs incurred are a factor in determining the amount payable to the subcontractor.

18. MISCELLANEOUS

a. **Whomsoever an actual or potential labor dispute is delaying or threatens to delay the performance of this contract, the Seller shall immediately notify the Company in writing.**

b. **Seller agrees that the work hereunder will be performed in accordance with the Fair Labor Standards Act of 1938, as amended.**

c. **To the extent that this contract is subject to the Walsh-Healey Public Contracts Act, as amended (41 U.S.C. 35-45), there are hereby incorporated by reference all representations and stipulations required by said Act and regulations issued thereunder by the Secretary of Labor, with representations and stipulations being subject to all applicable rulings and interpretations of the Secretary of Labor which are now or may hereafter be in effect.**

d. **If this contract is subject to the Renegotiation Act of 1951, as amended, the following provisions shall apply:**

(1) **This contract is subject to the Renegotiation Act of 1951, as amended (P.L. 9, 82d Cong., 44 Stat. 7, P.L. 764, 83d Cong., 46 Stat. 1114; P.L. 216, 84th Cong., 40 Stat. 447; P.L. 870, 84th Cong., 50 Stat. 761) and shall be deemed to comply with the provisions required by section 104 of said Act.**

(2) **The Seller agrees to submit the provision of this paragraph, including this subparagraph (2), in all subcontracts to the same extent as that term is defined in section 102g of the Renegotiation Act of 1951.**

19. ENTIRE CONTRACT

It is agreed and agreed by the parties hereto that this contract constitutes the entire and only present bargain. No parties hereto, past or future, are in agreement, understanding or consideration between the parties hereto of any kind, nature or description, express or implied, oral or otherwise, which have not been set forth herein.

20. BUY AMERICAN ACT

a. **In acquiring and producing, the Buy American Act (41 U.S.C. 101 and) provides that:** "Preference shall be given to domestic sources and products. For the purposes of this act:

(1) **"components" means those articles, materials, and supplies, which are directly incorporated in the end products;**

(2) **"end products" means those articles, materials, and supplies which are to be used under this contract for public use;**

(3) **"domestic source and product" means (a) an unmanufactured and product which has been mined or produced in the United States; and (b) an end product manufactured in the United States if the cost of the components thereof which are mined, produced, or manufactured in the United States exceeds 50 percent of the cost of all the components. For the purposes of this a. (3) (b), components of foreign origin of an same type or kind as the products referred to in (3) (a) or (3) (b) of this article shall be treated as components mined, produced, or manufactured in the United States.**

b. **The Seller agrees that there will be delivered under this contract only domestic source and products, except end products.**

(1) **which are for use outside the United States;**

(2) **which the Government determines are not mined, produced or manufactured in the United States in sufficient and reasonably available commercial quantities and of the satisfactory quality;**

(3) **as to which the Commission determines the domestic preference to be inconsistent with the public interest;**

(4) **as to which the Commission determines the preference to be inconsistent with the Government's interest.**

(The foregoing requirements are administered in accordance with Executive Order No. 9822 dated March 17, 1944.)

21. DATA AND INFORMATION

Unless otherwise agreed in writing by the Company, all data and information disclosed to or furnished by the Company in connection with this contract shall become the property of the Government and may be used by the Government for any purpose whatsoever without any claim on the part of the Seller for additional compensation.

PURCHASE ORDER SUBCONTRACT 96X-42124-C

THIS SUBCONTRACT, entered into this the 9th day of February, 1959, by and between UNION CARBIDE NUCLEAR COMPANY, DIVISION OF UNION CARBIDE CORPORATION (hereinafter referred to as the "Contractor" or the "Company") a corporation organized and existing under the laws of the State of New York with an office located at Charlotte Hall, Oak Ridge, Tennessee and THE CAREY SALT COMPANY (hereinafter referred to as the "Seller" or the Subcontractor"), a corporation organized and existing under the laws of the State of Kansas, with an office located in the City of Hutchinson, Kansas;

WITNESSETH THAT:

WHEREAS, the Company has heretofore entered into Contract No. W-7405-eng-26 (hereinafter referred to as the "Contract") with the UNITED STATES OF AMERICA (hereinafter referred to as the "Government") as represented by the UNITED STATES ATOMIC ENERGY COMMISSION (hereinafter referred to as the "Commission"), and

WHEREAS, in furtherance of the Contract, the Company desires that the Subcontractor furnish mine space and necessary utility services required to conduct a series of tests to determine the feasibility of the disposal of reactor fuel reprocessing waste in rock salt and

WHEREAS, the Subcontractor has signified its willingness to perform the work as required by the Company

NOW, THEREFORE, the parties hereto do mutually agree as follows:

ARTICLE I - STATEMENT OF THE WORK

The Subcontractor shall provide mine space and the necessary utility services required to conduct a series of tests which will help to determine the feasibility of the disposal of reactor fuel reprocessing waste in rock salt. The Subcontractor will further provide all necessary work, services, facilities, equipment and excavate the test cavities and install test equipment. Test equipment will be provided and operated by the Company. In general, the work will consist of the following

Phase I - Preparation of Selected Test Site. The Subcontractor will (1) scale any loose rock off the ceiling and white-wash the walls and ceiling of the selected test chamber, (2) provide adequate lighting and ventilation of said chamber, and (3) provide such power cables and outlets as may be required to operate the test equipment and associated control panels

Phase II - Installation of Test Facilities Unless otherwise directed by the Company, the Subcontractor shall (1) excavate two cavities, approximately 7-1/2' x 7-1/2' x 10' separated by a lineal distance of 100 feet,

(2) core drill 120 thermocouple wells in floor of chamber at locations designated by the Company; (3) transfer test equipment from the surface down to the test chamber; (4) assemble and install all test equipment in accordance with specifications designated by the Company; (5) assemble the segmented cavity-cover according to specifications designated by the Company; (6) conduct necessary tests to determine that all equipment and facilities are functioning properly; and (7) transfer approximately 7,000 gallons of Company furnished synthetic, non-radioactive, reactor fuel reprocessing waste from the surface to the test cavities in measured amounts for each cavity specified by the Company; and (8) perform all other work necessary or incident to the performance of the above work.

Phase III - Operation of Test Facilities. The Subcontractor shall provide the necessary services, labor, and equipment to permit continuous operation of the test equipment by Company personnel.

Phase IV - Clean Up of Test Chambers. At the conclusion of a test, the Subcontractor shall remove the wastes from the test cavities, and dispose of the wastes as directed by the Company. Prior to completion or termination of this Subcontract, the Subcontractor shall refill the test cavities only after notice from the Company that all test data have been accumulated.

Options for Additional Tests. In consideration of the award of this Subcontract to the Subcontractor, options are hereby given by the Subcontractor to the Company whereunder the Subcontractor will provide manpower, facilities, and services as outlined in Phases I, II, III, and IV above to enable the test program to continue beyond the present calendar year until such time as the Company has satisfactorily concluded its test program. Any option to be valid must be exercised in writing at least thirty (30) days prior to tentative commencement date associated with said option. The following is a list of additional tests covered by these options with tentative commencement and completion dates indicated:

| Option No. | Test No. | Tentative Commencement
and Completion Dates | No. Cavities |
|------------|----------|--|--------------|
| I | II | January 1, 1960 - June
30, 1960 | 2 |
| II | III | February 1, 1960 - July
31, 1960 | 1 |
| III | IV | July 1, 1960 - December
31, 1960 | 2 |

| Option No. | Test No. | Tentative Commencement
and Completion Dates | No. Cavities |
|------------|----------|--|--------------|
| IV | V | August 1, 1960 - January
31, 1961 | 1 |
| V | VI | August 1, 1960 - January
31, 1961 | 1 |
| VI | VII | January 1, 1961 - June
30, 1961 | 2 |

* * * * *

Dependent upon results of the test program, the Company may desire to introduce the use of radioactive tracers in the waste material. It is, however, specifically understood that the introduction of radioactive tracers in the waste will be permitted only upon Company's receipt of written authorization from the Subcontractor.

ARTICLE II - PERIOD OF PERFORMANCE

The period of performance of the work under this Subcontract, exclusive of options, shall begin on or before March 2, 1959 and shall continue until all test work is completed. It is presently estimated that the test will be completed on or before December 31, 1959

It is presently contemplated that work under options exercised by the Company shall be commenced and completed substantially in accordance with the tentative dates associated with each option under ARTICLE I of this Subcontract. It is specifically understood that the Subcontract work will not extend beyond June 30, 1962 unless said date is further extended by mutual agreement.

ARTICLE III - CONSIDERATION

Exclusive of any work performed by the Subcontractor under any option exercised by the Company, the Subcontractor shall receive a fixed fee in the amount of Five Thousand Dollars (\$5,000.00) and will be reimbursed for the allowable costs incurred in the performance of this Subcontract to the extent specified in Appendix A attached hereto and made a part hereof.

The Subcontractor will be reimbursed for allowable costs incurred in the performance of the work covered by any option exercised by the Company to the extent specified in the attached Appendix A, plus a fixed fee as indicated below:

| <u>Option No.</u> | <u>Fixed Fee</u> |
|-------------------|------------------|
| I | \$5,000.00 |
| II | 2,500.00 |
| III | 5,000.00 |
| IV | 2,500.00 |
| V | 2,500.00 |
| VI | 5,000.00 |

ARTICLE IV - TOTAL COST

It is estimated that the total cost to the Company for full performance of the work hereunder, exclusive of options, will not exceed the sum of Seventy-Two Thousand Dollars (\$72,000.00), exclusive of fixed fee, and the Subcontractor agrees to make every reasonable effort to keep said costs within said estimate. Neither the Company nor the Subcontractor guarantees the accuracy of said estimate. If the amount payable to the Subcontractor hereunder shall have equalled such total estimated cost, the Subcontractor shall not continue performance of the Subcontract unless and until the total estimated cost shall have been increased by the Company. The Subcontractor shall notify the Company of the date when, in the Subcontractor's estimation, the total estimated amount payable hereunder will equal such estimated cost; such notice shall be given at least fifteen (15) days prior to such date.

The maximum amount authorized by the Company for reimbursement for work performed and commitments made prior to June 30, 1959, including a fixed fee, is Forty-Five Thousand Dollars (\$45,000.00). Any expenditures or commitments in excess of this amount made by the Subcontractor prior to June 30, 1959, will be for the account of Subcontractor. Unless written authorization for additional funds is given by the Company to the Subcontractor prior to June 30, 1959, or such other date as the parties may mutually agree upon, the Subcontract will terminate, and the Subcontractor will be reimbursed for its expenditures and allowable fee in accordance with the termination article of this Subcontract relating to termination for the convenience of the Government, but not in excess of the amount authorized for work performed prior to June 30, 1959.

The estimated total cost designated in line three of paragraph one of this ARTICLE IV shall automatically be increased by the amounts set forth below for work performed by the Subcontractor under any option which is exercised by the Company:

| <u>Option No</u> | <u>Amount</u> |
|------------------|---------------|
| I | \$72,000.00 |
| II | 36,000.00 |
| III | 72,000.00 |
| IV | 36,000.00 |
| V | 36,000.00 |
| VI | 72,000.00 |

ARTICLE V - PAYMENTS

- A. Reimbursement for Allowable Costs. The Subcontractor will be reimbursed monthly within thirty (30) days after receipt of invoices for its allowable costs expended in accordance with ARTICLES III and IV hereof upon submission by the Subcontractor of duly certified vouchers or such other documents as the Company may require and in the form required by the Company.
- B. Provisional Overhead Rates. For the purpose of making payments in accordance with ARTICLE V A. of this Subcontract, the following provisional overhead rates shall apply:
- | | |
|-------------------------------|---|
| 1. Operating Overhead | 130 % of direct labor |
| 2. General and Administrative | 13 % of Subcontractor's allowable costs excluding G & A expenses. |
- C. Determination of Overhead Rates. Upon the determination of the revised rates for overhead allowance as provided in Appendix A, the Subcontractor shall pay to the Company the amount, if any, by which the overhead allowance paid under the provisional rate exceeds the amount payable under the revised rate, or the Company shall pay to the Subcontractor the amount, if any, by which the overhead allowance paid under the provisional rate is less than the amount payable under the revised rate.
- D. Fixed Fee. Ninety percent (90%) of the fixed fee shall be paid in monthly installments as follows:
1. The Subcontractor shall receive each month a sum bearing the same ratio to ninety percent (90%) of the fixed fee as the allowable costs reimbursed to the Subcontractor in accordance with paragraph A. of this ARTICLE V bears to the total estimated cost established under paragraph A. of ARTICLE IV.
 2. Upon completion and acceptance of the work hereunder and upon completion and submission by the Subcontractor of property accounting, patent disclosure, and assignment and final release in a form required by the Company and upon determination of the revised rate for overhead allowance and the payment of any amount due the Company by the Subcontractor under paragraph C. of this ARTICLE V, the Company shall pay the Subcontractor the remaining amount of the fixed fee.

ARTICLE VI - INDEMNIFICATION

- A. Subject to the availability of appropriated funds, the Subcontractor shall be indemnified and held harmless against all claims, losses and expenses on account of personal injury or property damage (including injury to the Subcontractor's employees or damage to the Subcontractor's property), not compensated by insurance or otherwise, based on or caused by the simulated radioactive wastes or radioactive tracer material furnished by the Company and used by the Subcontractor in the performance of the work under this Subcontract, unless such claim, loss or expense is caused directly by bad faith or willful misconduct on the part of the Corporate Officer of the Subcontractor or the supervising representative of the Subcontractor for the performance of the work under this Subcontract, and provided such claim, loss or expense is not specifically made an allowable cost elsewhere in this Subcontract.
- B. Subcontractor shall also be indemnified and held harmless against all claims by or on behalf of Company employees under Workmen's Compensation laws.

ARTICLE VII - SUB-SUBCONTRACTS AND PURCHASES

- A. While it is the intent of this Subcontract that the Subcontractor will perform the major portion of the work defined in ARTICLE I hereof, with its own forces, it may enter into sub-subcontracts for work and services which the Subcontractor is obliged to perform under ARTICLE I hereof subject to the limitations set forth in this ARTICLE VII.
- B. The Subcontractor shall reduce to writing all sub-subcontracts (except contracts with its employees) made pursuant to this Subcontract.
- C. The following prior written approvals are required for all sub-subcontracts entered into by the Subcontractor:
 - 1. All cost reimbursement type sub-subcontracts regardless of amount and all sub-subcontracts over \$100,000.00 are subject to the prior written approval of the Company and the Commission.
 - 2. All sub-subcontracts in excess of \$2,500 and less than \$100,000.00 are subject to prior written approval of the Company.

3. All lump sum and unit price sub-subcontracts in which the consideration is over \$500.00 and less than \$2,500. are subject to the prior written approval of the Company except sub-subcontracts awarded to the low bidder on the basis of proposals received in reply to inquiries sent to competitive suppliers.
- D. Record of Sub-Subcontracts. The Subcontractor agrees that the records of files for each transaction in which the consideration is more than \$500.00 shall contain information establishing the justification for the award.
- E. For the purpose of this ARTICLE, the term "sub-subcontract" shall include contracts, sub-subcontracts, purchase orders and commitments (except contracts with the Subcontractor's employees).
- F. The Company or the Government may furnish any equipment facilities or other items necessary for the performance of the work and if the Company notifies the Subcontractor that the Company or the Government will furnish any equipment, facilities, or other items, the Sub-contractor shall not purchase such equipment, facilities, or other items unless otherwise directed in writing by the Company. The Subcontractor shall obtain the approval of the Company of any building alterations and/or construction to be performed by the Subcontractor as well as that to be performed by any third party.
- G. The Subcontractor agrees to comply with requirements of the Company's subcontract purchasing procedure dated January 2, 1958, a copy of which has been furnished to the Subcontractor and which is incorporated herein and is made a part hereof by reference.

ARTICLE VIII - RELEASE OR PUBLICATION OF INFORMATION

The results of the work under this Subcontract may not be published by the Subcontractor except with the prior written approval of the Company.

ARTICLE IX - ADDITIONAL INSURANCE

Premiums paid by the Subcontractor for additional insurance to cover risks directly attributable to this Subcontract shall be reimbursed as a direct cost. Such insurance shall be specifically designated as applicable solely to this

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Subcontract. Payment thereof by the Company shall not exclude allowance of Subcontractor's general insurance cost as an overhead expense.

ARTICLE X - TERMS AND CONDITIONS

The provisions of "Terms and Conditions", designated as File No. 2-53 (1-58) pages 1, 2, and 3B are attached hereto and made a part hereof except Paragraph c of ARTICLE 21 is hereby deleted.

ARTICLE XI - APPROVAL REQUIRED

This Subcontract shall have no force or effect until approved in writing by a duly authorized representative of the Commission.

IN WITNESS WHEREOF, the parties hereto have executed this Subcontract as of the day, month and year first above written.

**UNION CARBIDE NUCLEAR COMPANY
DIVISION OF UNION CARBIDE CORPORATION**

By _____
General Purchasing Agent

THE CAREY SALT COMPANY

By _____

Title _____

**APPROVED IN BEHALF OF THE UNITED
STATES ATOMIC ENERGY COMMISSION**

By _____

2. DEFINITIONS

As used in this contract the terms "United States Atomic Energy Commission" and "Atomic Energy Commission" and "Commission" shall mean the United States Atomic Energy Commission or its duly authorized representative or representatives. The term "Seller" shall mean the subcontractor. The term "Company" shall mean Union Carbide Nuclear Company, Division of Union Carbide Corporation, acting under Contract No. W-405-ENG-26. The term "Government" shall mean the United States of America.

3. OFFICIALS NOT TO BENEFIT

No member of or delegate to Congress or resident commissioner shall be admitted to any share or part of this contract nor to any benefit that may arise therefrom, but this provision shall not be construed to extend to this contract if made with a corporation for its general benefit.

4. CONVICT LABOR

In connection with the performance of work under this contract, the Seller agrees not to employ any person undergoing sentence of imprisonment at hard labor.

5. NONDISCRIMINATION IN EMPLOYMENT

In connection with the performance of work under this contract, the Seller agrees not to discriminate against any employee or applicant for employment because of race, religion, color, or national origin. The aforesaid provision shall include, but not be limited to, the following: Employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The Seller agrees to post hereafter in conspicuous places, available for employees and applicants for employment, notices to be provided by the Company setting forth the provisions of the aforesaid provision. This provision shall not apply if this contract is for standard special supplies or raw materials.

6. ADMINISTRATION AND PAYMENT

It is understood and agreed that this contract is entered into by the Company for and on behalf of the Government, that the Company is authorized to and will make payments hereunder from Government funds allocated and agreed to be advanced to it by the Commission and not from its own assets, and acknowledges this contract is other than for the Commission unless otherwise specifically provided for herein, that administration of this contract may be transferred from the Company to the Commission or its designee, and in case of such transfer and notice thereof to the Seller the Company shall have no further responsibilities hereunder, and that nothing herein shall preclude liability of the Government for any payment properly due hereunder if for any reason such payment is not made by the Company from such Government funds.

7. ASSIGNMENT

Neither this contract nor any interest therein nor claims thereunder, shall be assigned or transferred by the Seller to any party or parties, except on the prior written approval of the Commission.

8. SECURITY

a. In the performance of the work under this contract, the Seller shall, in accordance with the Commission's security regulations and requirements, safeguard Restricted Data and other class for matter and protect against sabotage, espionage, loss and theft the "classified" or "secret" materials, equipment, processes, etc., as well as such other material of high intrinsic or statistical value as may be in the Seller's possession in connection with performance of work under this contract.

b. Seller agrees to conform to all security regulations and requirements of the Commission.

The term "Restricted Data" means all data concerning (1) design, manufacture, utilization of atomic weapons; (2) the production of special nuclear material or (3) the use of special nuclear material in the production of energy, but shall not include data declassified or removed from the Restricted Data category pursuant to section 142 of the Atomic Energy Act of 1946.

d. Except as the Commission may authorize, in accordance with the Atomic Energy Act of 1946, the Seller shall not permit any individual to have access to Restricted Data until the designated investigating agency shall have made an investigation and report to the Commission or the designated investigating agency, and copies of such report and the Commission shall have determined that permitting such person to have access to Restricted Data will not endanger the common defense and security. As used in this paragraph the term "designated investigating agency" means the United States Civil Service Commission or the Federal Bureau of Investigation or both, as determined pursuant to the provisions of the Atomic Energy Act of 1946.

e. It is understood that disclosure of information relating to the work is necessary and authorized for use by any person not entitled to receive it, or failure to disclose any Restricted Data or any top secret or confidential matter that may come to the Seller or any person under the Seller's control in connection with work under this contract may subject the Seller to criminal liability under the laws of the United States. (See the Atomic Energy Act of 1946, 60 Stat. 619. See also Executive Order 11652 of February 1, 1950, 15 F. R. 597.)

9. DISPUTES

In case of a difference of opinion between the Seller and the Commission, the dispute shall be referred to the question of fact arising under this contract, the dispute shall be submitted for arbitration and determination to the Manager, Oak Ridge Operations, Office of the Atomic Energy Commission, whose decision, or that of his designated representative, if he is duly authorized to decide such matters, shall be final and conclusive upon the parties hereto, unless such decision is determined by a court of competent jurisdiction to have been fraudulent or capricious or the result of a grossly erroneous application of law and in such case it may be subject to review by a court of law. Pending final decision of a dispute hereunder, the performance of the contract shall not be interrupted by the Seller's instructions.

10. PATENTS

It is understood and agreed that where, in the performance of the contract, the

Seller determines that an invention or discovery has been made or conceived in the course of, in connection with, or under the terms of this contract, Seller shall furnish the Company with complete information thereon and shall render such assistance as is requested in the course of the investigation of such invention or discovery, and the Commission shall have the sole power to determine whether or not and where a patent application shall be filed, and to determine the disposition of the title to and the rights under any application or patent that may result. It is further understood and agreed that the judgment of the Commission on such matters shall be accepted as final, and Seller for himself and his employees agrees that the inventor or inventors will execute all documents and do all things necessary or proper to carry out the judgment of the Commission.

b. Seller further agrees that no claim or claims for pecuniary award or compensation under the provisions of the Atomic Energy Act of 1946 and 1954 shall be asserted by Seller or his employees with respect to any inventions or discoveries made or conceived in the course of, in connection with, or under the terms of this contract.

c. Except as otherwise authorized in writing by the Commission the Seller will obtain patent agreements to effectuate the purposes of paragraphs a. and b. of this article from all persons who perform any part of the work under this contract except clerical and manual labor personnel who will not have access to technical data.

d. Except as otherwise authorized in writing by the Commission, the Seller will insert in all sub-subcontract provisions making this article applicable to the sub-subcontractor and its employees.

11. PATENT INDEMNITY

a. The Seller agrees to indemnify the Company and the Government, their officers, agents, servants and employees against liability of any kind (including costs and expenses incurred) for the use of any invention or discovery and for the infringement of any Letters Patent (not including liability arising pursuant to Section 163, Title 35, (1952) U. S. Code, prior to the issuance of Letters Patent) occurring in the performance of this contract or arising by reason of the use or disposal by or for the account of the Company and of the Government of items manufactured or supplied under this contract.

b. In case the use of any article or material is enjoined, Seller within a reasonable time will either secure for the Company and Government at Seller's expense the right to use such article or material or will, at Seller's expense and at the Company or Government's election, replace such article or material with non-infringing article or material, or modify it so that it becomes non-infringing, or remove it and refund the purchase price if paid.

12. EXAMINATION OF RECORDS

a. The Seller agrees that the Comptroller General of the United States or any of his duly authorized representatives shall have at any time and the right to examine any directly pertinent to this contract, papers and records of the Seller involving transactions relating to this contract for a period of three years after final payment under this contract.

b. Nothing in this contract shall be deemed to preclude an audit by the General Accounting Office of any transaction under this contract.

13. REPORTING OF ROYALTIES

If this contract involves any royalties or other license payments or if the amount of any royalty or other license payments is reflected in the price of this contract, the Seller agrees to report in writing to the Company during the performance of this contract and prior to its completion or final settlement the amount of any royalties or other license payments paid or to be paid by a line item to others in connection with the performance of this contract together with the names and addresses of licensors to whom such payments are made and either the patent numbers involved or such other information as will permit identification of the patents or other basis on which the royalties are to be paid. The approval by the Commission of any individual payments or royalties so reported shall not exempt the Government at any time from conducting the customary, voluntary or compulsory, or title to, any patent under which such royalties or other license payments are made.

14. COVENANT AGAINST CONTINGENT FEES

The Seller warrants that no person or selling agency has been employed or retained to solicit or secure this contract upon an agreement or understanding for a commission, percentage, brokerage, or contingent fee, excepting bona fide employees or bona fide agents of the Seller or selling agency maintained by the Seller for the purpose of securing business. For breach or violation of this warranty the Company, with the approval of the Commission, shall have the right to cancel this contract without liability on its part to deduct from the contract price or consideration the full amount of such commission, percentage, brokerage, or contingent fee.

15. EIGHT HOUR LAW OF 1912

This contract, to the extent that it is of a character specified in the Eight-Hour Law of 1912 as amended (40 U. S. C. 324-326) and is not covered by the Walsh-Healey Public Contract Act (40 U. S. C. 334-335) is subject to the following provisions and exceptions of said Eight-Hour Law of 1912 as amended and to all other provisions and exceptions of said law.

No laborer or mechanic doing any part of the work contemplated by this contract, in the employ of the Seller or any subcontractor, contracting for any part of the said work, shall be required or permitted to work more than eight hours in any one calendar day upon such work, except upon the condition that compensation be paid to such laborer or mechanic in accordance with the provisions of this clause. The wages of every such laborer and mechanic employed by the Seller or any subcontractor engaged in the performance of this contract shall be computed on a basis of eight hours per day, and work in excess of eight hours per day is permitted only on the condition that every such laborer and mechanic shall be compensated for all hours worked in excess of eight hours per day at not less than one and one-half times the basic rate of pay. For each violation of the requirements of this clause a penalty of five dollars shall be imposed upon the Seller or such laborer or mechanic for every calendar day in which such employee is required or permitted to labor more than eight hours upon said work without the using of compensatory computed in accordance with this clause, and all penalties so imposed shall be withheld for the use and benefit of the Government or

13. GOVERNMENT PROPERTY

a. **Furnishing of Government Property.** The Company reserves the right to furnish any Government property or services required for the performance of the work under this contract.

b. **Title to Property.** Title to all property furnished by the Company shall remain in the Government except as otherwise provided in this article. Except as otherwise approved by the Company and the Commission, title to all purchased materials, equipment, supplies, and tangible personal property of every kind and description, the cost of which is allowable as a direct item of cost under this contract, shall pass directly from the Seller thereof to the Government. Title to other property, the cost of which is allowable under this contract, shall pass to and vest in the Government upon (1) issuance for use of such property in the performance of this contract, or (2) commencement or resumption of use of such property in performance of this contract, or (3) payment to the Seller of the cost thereof, whichever first occurs. Property furnished by the Company and purchased property or property furnished by the Seller, title to which vests in the Government under this paragraph, are hereinafter referred to as Government property. Title to Government property shall not be affected by the incorporation of the property into or the attachment of it to any property not owned by the Government, nor shall such Government property, or any part thereof, be or become a fixture or lose its identity as personally by reason of affixation to any realty.

c. **Identification.** To the extent directed by the Company, the Seller shall identify Government property coming into the Seller's possession or custody by marking or segregation in such a way, satisfactory to the Company, as shall indicate its ownership by the Government.

d. **Disposition.** The Seller shall make such disposition of Government property with it has come into the possession or custody of the Seller under this contract as the Company, with the approval of the Commission, shall direct. When authorized in writing by the Company during the progress of the work or upon completion or termination of this contract, the Seller may, upon such terms and conditions as the Commission may approve, sell or exchange such property, or acquire such property at a price agreed upon by the Company, with the approval of the Commission, and the Seller as the fair value thereof. The amount received by the Seller as the result of any disposition, or the amount of the agreed fair value of any such property acquired by the Seller, shall be applied in reduction of costs allowable under this contract, or shall be otherwise credited to the account of the Government, as the Company may direct. Upon completion of the work or the termination of this contract, or at such earlier time as may be requested by the Company, the Seller shall render an accounting, as prescribed by the Company, of all Government property which has come into the possession or custody of the Seller under this contract.

e. **Protection of Government Property - Classified Materials.** The Seller shall take all reasonable precautions, as directed by the Company, or in the absence of such instructions in accordance with sound industrial practice, to safeguard and protect Government property in the Seller's possession or custody. Special measures shall be taken by the Seller in the protection of any accounting for any classified or special materials involved in the performance of this contract, in accordance with the regulations and requirements of the Commission.

f. **Risk of Loss of Government Property.** The Seller shall not be liable for loss, destruction or damage to Government property in the Seller's possession unless such loss, destruction or damage results from willful misconduct or lack of good faith on the part of the Seller's managerial personnel, or unless such loss, destruction or damage results from a failure on the part of the Seller's managerial personnel to take all reasonable steps to comply with any appropriate written directives. The Company to safeguard such property under paragraph (e) hereof. The term "Seller's managerial personnel" as used herein means the Seller's directors, officers and any of its management-independents, or other equivalent representatives who have major responsibility for all or substantially all of the Seller's business, or (2) all or substantially all of the Seller's operations at any one plant or separate location at which this contract is being performed or (3) a separate or complete major industrial operation in connection with the performance of this contract, or (4) a separate and complete department, division, or repair operation in connection with performance of this contract.

g. **Steps to be Taken in Event of Loss.** In the happening of any loss, destruction or damage to Government property in the possession or custody of the Seller, the Seller shall immediately inform the Company of the occasion and extent thereof, and shall take all reasonable steps to protect the property remaining, and shall cause or direct the same to be restored, or deemed repaired, and as directed by the Company, but shall take no action prejudicial to the right of the Government to recover therefor and shall furnish to the Company or the Government on request all reasonable assistance in obtaining recovery.

h. **Government Property for Government Use Only.** Except as otherwise authorized by the Company, with the approval of the Commission, Government property shall be used only for the performance of this contract.

14. STATE AND LOCAL GOVERNMENT TAXES, FEES AND CHARGES

a. The Seller agrees to notify the Company, who in turn will notify the State or local authorities, of any tax, fee or charge levied or assessed upon the Seller or from the Seller with respect to the contract work or to the property thereunder, and to secure an allowable item of cost if due and payable by the Seller. The Company shall be the Seller or under the position of the Seller in such matters as to the applicability or payment of such tax, fee or charge, and the Seller shall be responsible for payment of such tax, fee or charge unless authorized by the Company with the approval of the Commission. Any State or local tax, fee or charge assessed on the Seller, with the approval of the Commission, or in the absence of such approval, with the concurrence of the Commission that such tax, fee or charge is applicable and valid, and which would otherwise be an allowable item of cost shall be itemized on an itemized basis by reason of any statute relating to such itemization that such tax, fee or charge was in fact applicable and paid.

b. The Seller agrees to take such action as may be required or approved by the Company, with the concurrence of the Commission in making any such tax, fee or charge referred to above to be paid under protest, and to take such actions as may be required or approved by the Company with the concurrence of the Commission

to seek recovery of any payment made, including assignment to the Government or the assignment of all rights to an abatement or refund thereof, and granting permission for the Government to join with the Seller in any proceedings for the recovery thereof or to sue for recovery in the name of the Seller. If the Commission directs the Seller to institute litigation to obtain the collection of or to recover payment of any such tax, fee, or charge referred to above, or if a claim or suit is filed against the Seller for a tax, fee, or charge he has refrained from paying in accordance with this article, the Seller shall comply with procedures and requirements of the Commission, and the costs and expenses incurred by the Seller shall be allowable items of cost, as provided in this contract, together with the amount of any judgment rendered against the Seller.

c. The Company and the Government shall leave the Seller harmless from penalties and interest incurred through compliance with this article.

17. ACCOUNTS, RECORDS AND INSPECTION

a. **Accounts.** The Seller shall maintain accounts showing and supporting all allowable costs incurred, revenues earned, fixed fee accruals, and the receipt, use, and disposition of all Government Property coming into the possession of the Seller under this contract. The system of accounts employed by the Seller shall be satisfactory to the Company and in accordance with generally accepted accounting principles.

b. **Inspection and Audit of Accounts and Records.** All books of account and records relating to this contract shall be subject to inspection and audit by the Company and/or the Commission at all reasonable times, and the Seller shall afford the Company and/or the Commission proper facilities for such inspection and audit.

c. **Audit of Subcontractor's Records.** The Seller also agrees, with respect to any subcontractors (including lump-sum or unit-price subcontractors) where, under the terms of the subcontract, costs incurred are a factor in determining the amount payable to the subcontractor for any time to conduct an audit of the costs of the subcontract in a manner satisfactory to the Company or to have the audit conducted by the next higher tier subcontractor in a manner satisfactory to the Seller and the Company except where the Company upon the recommendation of the Seller elects to have such audit or to approve other arrangements for the conduct of the audit.

d. **Disposition of Records.** Except as otherwise directed by the Company or agreed upon by the Company and the Seller, all financial and cost reports, books of account and supporting documents, and time data showing costs allowable and revenues earned under this contract in the possession of the Seller relating to this contract shall be preserved by the Seller for a period of six (6) years after final settlement of the contract or otherwise as directed in such manner as may be agreed upon by the Company and the Seller.

e. **Reports.** The Seller shall furnish such progress reports and schedules, financial and cost reports, and other reports concerning the work under this contract as the Company may from time to time require.

f. **Inspections.** The Company shall have the right to inspect the work and activities of the Seller under this contract at such time and in such manner as it shall deem appropriate.

g. **Subcontractors.** The Seller further agrees to require the inclusion of provisions similar to those in paragraphs a, b, c, d, e, f, g, h, i, j, k, l, m, n, o, p, q, r, s, t, u, v, w, x, y, z of this article in all subcontracts of any tier negotiated hereunder, including lump-sum or unit-price subcontracts where, under the terms of the subcontracts, costs incurred are a factor in determining the amount payable to the subcontractor.

18. MISCELLANEOUS

a. Whenever an actual or potential labor dispute is delaying or threatens to delay the performance of this contract, the Seller shall immediately notify the Company in writing.

b. Seller agrees that the work hereunder will be performed in accordance with the Fair Labor Standards Act of 1938 as amended.

c. In the event that the Government, pursuant to the Defense Production Act of 1950 or other applicable legislation or its valid rules or regulations issued thereunder, shall establish a maximum price for any of the supplies purchased under this contract which is lower than the price payable in accordance with the provisions hereof, the price to be paid hereunder for such supplies shall be such maximum price in effect as of the date of delivery of such supplies. The stated amount of any such maximum price of all and otherwise after the date of the purchase hereunder nor shall it constitute a cause for termination or annulment of this contract by any of the parties hereto.

d. In the event that this contract is subject to the Walsh-Healey Public Contract Act as amended (41 U.S.C. 51-55), there are hereby incorporated by reference all representations and stipulations required by said Act and regulations issued thereunder by the Secretary of Labor, such representations and stipulations being subject to all applicable laws and interpretations of the Secretary of Labor which are now or may hereafter be in effect.

e. If this contract is subject to the Negotiations Act of 1941, as amended, the following provisions shall apply:

(1) This contract is subject to the Negotiations Act of 1941, as amended (40 U.S.C. 2951-2956), and shall be deemed to contain all the provisions required by sections 2951-2956 of said Act.

(2) The Seller agrees to insert the provisions of this paragraph, including this subparagraph (2), in all subcontracts specified in Section 103(a) of the Negotiations Act of 1941 provided that the Seller shall not be required to insert the provisions of this paragraph in any subcontract exempted by or pursuant to Section 103 of the Negotiations Act of 1941, as amended.

19. ENTIRE CONTRACT

It is expressly agreed by the parties hereto that this contract constitutes the entire and sole contract between the parties hereto, that there are no agreements, understandings, or covenants between the parties hereto of any kind, nature or description, express or implied, or in writing or otherwise, which vary or supplement the terms hereof.

DRAWINGS, DESIGNS, SPECIFICATIONS

All drawings, sketches, designs, design data, specifications, notebooks, technical and scientific data, and all photographs, negatives, reports, findings, recommendations, data and memoranda of every description relating thereto, as well as all copies of the foregoing relating to the work or any part thereof, shall be subject to inspection by the Company and the Commission at all reasonable times, and the Seller and his subcontractors shall afford the Company and the Commission proper facilities for such inspection and, further, shall be the property of the Government and shall be delivered to the Government, or otherwise disposed of by the Seller either as the Company or the Commission may from time to time direct during the progress of the work or in any event as the Company or the Commission shall direct upon completion or termination of this contract. It is understood and agreed that, at any or all time or times, in its discretion, the Government shall have the right to use all or any part of said material for any purpose whatsoever, including but not limited to the right to reproduce said material and to disseminate it to the public.

TERMINATION

a. **Notice of Termination for Default or Convenience.** The Company may at any time terminate performance of the work under this contract in whole or in part for the default of the Seller, or in whole or from time to time in part for the convenience of the Government, by written notice to the Seller stating the ground for termination. Such termination shall be effective in the manner and upon the date specified in said notice and shall be without prejudice to any claims which the Company and/or the Government may have against the Seller. Upon receipt of such notice, the Seller shall, unless the notice directs otherwise, immediately discontinue all work and the placing of all orders for materials, facilities, and supplies in connection with performance of this contract and shall proceed to cancel promptly all existing orders and terminate all subcontracts insofar as such orders or subcontracts are chargeable to this contract.

b. **Termination for Default.** The performance of the work may be terminated for default if the Seller refuses or fails to prosecute the work, or any separable part thereof, with such diligence as will insure its completion within a reasonable time; *Provided* That the performance of the work shall not be terminated for default because of any delays in the completion of work due to unforeseeable causes beyond the control and without the fault or negligence of the Seller, including, but not restricted to, acts of God, or of the public enemy, acts of the Government in either its sovereign or contractual capacity, fires, floods, epidemics, quarantine restrictions, strikes, freight embargoes, and unusually severe weather or delays of subcontractors due to such causes. If the Seller shall within ten (10) days from the beginning of any such delay (unless the Company shall grant a further period of time prior to the date of final settlement of the contract) notify the Company in writing of the causes of delay, who shall ascertain the facts and the extent of the delay and extend the time for completing the work when in its judgment the findings of fact justify such an extension, and its findings of fact thereon shall be final and conclusive on the parties hereto, subject only to appeal by the Seller to the Commission in accordance with the article entitled "Disputes."

~~c. **Right to Company-Owned Property.** If performance of the work under this contract is terminated for the default of the Seller, the Company may enter upon the premises and take possession of all materials, tools, machinery, equipment, and appliances which may be owned by or in the possession of the Seller and of all options, privileges, and rights, may complete or employ any other person or persons to complete the work and the Seller shall be liable to the Company and/or the Government for compensation the Company and the Government pay the Seller. Rental shall be paid to the Seller for Seller-owned equipment so retained by the Company at rates established pursuant to the article entitled "Costs and Expenses."~~

d. **Terms of Settlement.** Upon the termination of performance of work under this contract, full and complete settlement of all claims of the Seller with respect to this terminated work shall be made as follows:

(1) **Assumption of Seller's Obligations.** The Company may, at its discretion, assume and become liable for all obligations, commitments and claims that the Seller may have theretofore in good faith undertaken or incurred in connection with the terminated work, the cost of which would be allowable in accordance with the provisions of this contract; and the Seller shall, as a condition of receiving the payments mentioned in this article, execute and deliver all such papers and take all such steps as the Company may require for the purpose of fully vesting in the Company all the rights and benefits of the Seller under such obligations or commitments.

(2) **Payment for Allowable Costs.** The Company shall reimburse the Seller or allow credit for all allowable costs incurred in the performance of the terminated work and not previously reimbursed or otherwise discharged.

(3) **Payment for Termination Expenses.** If performance of work under the contract is terminated for the convenience of the Government, the Company shall reimburse the Seller for such further expenditures made after the date of termination for the production of Government property and for such legal and accounting services in connection with settlement as are required or approved by the Company.

(4) **Payments on Account of Fixed Fee.** If performance of work under the contract is terminated for the convenience of the Government, the Seller shall be paid that portion of the fixed fee which the work actually completed, as determined by the Company, bears to the entire work under this contract less payments previously made on account of the fee. If performance of the work under the contract is terminated for the default of the Seller, no further payments on account of the fixed fee shall accrue.

(5) **Computation of Amounts Due.** In arriving at the amount due the Seller under this article, there shall be deducted (1) all unliquidated advance or other unliquidated payments on account theretofore made to the Seller, (2) any claims which

the Company and/or the Government may have against the Seller in connection with this contract, and (3) deductions under the terms of this contract, and not otherwise recovered by or credited to the Company. Nothing contained in this paragraph shall be construed to limit or affect any other remedies which the Company may have as a result of a default by the Seller.

(6) **Disposition of Advances.** If performance of the work under the contract is terminated for the default of the Seller, the Seller shall forthwith remit to the Company the unliquidated balance of any advance under the contract. If performance of work under the contract is terminated for the convenience of the Government, the unliquidated balance of any advance shall be deducted from any payment otherwise due the Seller, and if the sum due the Seller is insufficient to cover such balance, the excess thereof shall be remitted by the Seller to the Company after demand and final audit of all accounts hereunder.

(7) **Property Accounting and Release.** The Seller shall furnish an accounting for Government-owned Property as required by the article entitled "Accounts, Records and Inspection."

22. BUY AMERICAN ACT

The Seller agrees that in the performance of the work under this contract the Seller, subcontractors, material men and suppliers shall use only such manufactured articles, materials and supplies (which term "articles, materials and supplies" is hereinafter referred to in this clause as "supplies") as have been mined or produced in the United States, and only such manufactured supplies as have been manufactured in the United States substantially all from supplies mined, produced, or manufactured, as the case may be, in the United States. The foregoing provisions shall not apply (1) with respect to supplies excepted by the Commission from the application of the Buy American Act (41 U. S. C. 101-104), (2) with respect to supplies for use outside the United States, or (3) with respect to the supplies to be used in the performance of work under this contract which are of a class or kind determined by the Commission not to be mined, produced, or manufactured, as the case may be, in the United States in sufficient and reasonably available commercial quantities and of a satisfactory quality, or (4) with respect to such supplies, from which the supplies to be used in the performance of work under this contract are manufactured, as are of a class or kind determined by the Commission not to be mined, produced, or manufactured, as the case may be, in the United States in sufficient and reasonably available commercial quantities and of a satisfactory quality, provided that this exception (4) shall not permit the use in the performance of work under this contract of supplies manufactured outside the United States if such supplies are manufactured in the United States in sufficient and reasonably available commercial quantities and of a satisfactory quality.

23. CHANGES

a. **Changes and Adjustment of Fee.** The Company may at any time and without notice to the Seller, if any, issue written directions requiring additional work within the general scope of this contract or directing the omission of or variation in work covered by this contract. If any such direction results in a material change in the amount or character of the work described in the article entitled "Statement of Work," an equitable adjustment of the fixed fee shall be made in accordance with the agreement of the parties and the contract shall be modified in writing accordingly. Any claim by the Seller for an adjustment under this article must be asserted in writing within thirty days from the date of receipt by the Seller of the notification of change unless the Company grants a further period of time. A failure to agree on an equitable adjustment under this article shall be deemed to be a dispute within the meaning of the article entitled "Disputes."

b. **Work to Continue.** Nothing contained in this article shall excuse the Seller from proceeding with the prosecution of the work in accordance with the requirements of any direction hereunder.

24. LITIGATION AND CLAIMS

a. **Initiation of Litigation.** If the Company, with the approval of the Commission, requires the Seller to initiate litigation, including proceedings before administrative agencies, in connection with this contract, the Seller shall proceed with the litigation in good faith as directed from time to time by the Company with the approval of the Commission.

b. **Defense and Settlement of Claims.** The Seller shall give the Company immediate notice in writing (1) of any action, including any proceeding before an administrative agency, filed against the Seller arising out of the performance of this contract, and (2) of any claim against the Seller the cost and expense of which is allowable or reimbursable under this contract. Except as otherwise directed by the Company in writing, with the approval of the Commission, the Seller shall furnish immediately to the Company copies of all pertinent papers received by the Seller with respect to such action or claim. To the extent not in conflict with any applicable policy of insurance, the Seller may, with the approval of the Company and the Commission, settle any such action or claim, shall assert at the Commission's request an assignment and subrogation in favor of the Government of all of the Seller's rights and claims (except those against the Company or the Government) arising out of any such action or claim against the Seller, and, if required by the Commission, shall authorize representatives of the Government to settle or defend any such action or claim and to represent the Seller in, or take charge of, any such action. If the settlement or defense of an action or claim against the Seller is undertaken by the Government, the Seller shall furnish all reasonable assistance in effecting a settlement or winning a defense. Where an action against the Seller is not covered by a policy of insurance the Seller shall, with the approval of the Company and the Commission, proceed with the defense of the action in good faith, and in such event the defense of the action shall be reimbursed to the Seller; providing, however, that the Company and the Government shall not be liable for such expense to the extent that it would have been compensated for by insurance which was required by law or by the written direction of the Company, with the approval of the Commission, but which the Seller failed to secure through its own fault or negligence.

APPENDIX A

The Carey Salt Company

Subcontract 96X-42124- C

STATEMENT OF ALLOWABLE AND UNALLOWABLE COSTS

I - ACCOUNTING PROCEDURE

The Subcontractor represents that it has, and has had throughout its current and next preceding fiscal years, an established accounting procedure which will accurately reflect all of the costs allowable hereunder; that such established accounting procedure is in accordance with generally accepted accounting principles, consistently applied; that such established accounting procedure is fully reflected in its books of account; that it will maintain its books of account in accordance with such established accounting procedure for the period of this Subcontract unless otherwise approved in writing by the Company, and that it will maintain its books of account in a manner conducive to verification by audit.

II - ALLOWABLE COSTS

A. Basis for Determination of Allowable Costs The allowable costs to be reimbursed to the Subcontractor under this Subcontract shall be all costs and expenses necessarily incurred by the Subcontractor in the proper performance of this Subcontract; provided, however allowable costs shall not include, directly or indirectly, (i) any costs or expenses designated in this Subcontract, or this Appendix as unallowable, and (ii) any costs or expenses for overhead and other indirect costs except to the extent provided in paragraph B. (2) of this Article II.

B. Examples of Allowable Costs. The following are examples of items of cost which are allowable under this Subcontract to the extent indicated.

1. Direct Costs.

(a) Direct Labor. Direct labor costs consisting of salaries and wages including premium pay actually paid by the Subcontractor and properly chargeable to the performance of this Subcontract in accordance with the established accounting procedure of the Subcontractor, consistently applied. In the event the full time of an employee of the Subcontractor is not applied on the work hereunder, his salary shall be prorated on the basis of the actual time worked in the performance of this Subcontract.

(b) Engineering Labor. Engineering labor costs consisting of salaries and wages actually paid by the Subcontractor and properly chargeable to the performances of this Subcontract in accordance with the established accounting procedure of the Subcontractor, consistently applied. In the event the full time of an employee of the Subcontractor is not applied on the work hereunder, his salary shall be prorated on the basis of the actual time worked in the performance of this Subcontract.

(c) Materials. The cost of purchased materials, tools, supplies, apparatus, equipment, and other articles (including processing and testing thereof and rentals of apparatus and equipment) and services (all of which are collectively referred to in this paragraph as "Materials"), including transportation charges thereon as are consumed during or necessarily acquired by the Subcontractor solely for, the performance of its undertakings hereunder. If such Materials are furnished from the Subcontractor's common inventory, such Materials shall be charged at the Subcontractor's inventory cost thereof in accordance with the Subcontractor's established accounting procedure, consistently applied. In calculating the cost of Materials, there shall be deducted all cash discounts, trade discounts, rebates and other allowances and credits available to the Subcontractor, including credit for any Materials returned to stock or to vendors. The Subcontractor shall physically inventory Materials left over after the performance of this Subcontract and shall furnish the Company with a certified copy of such inventory.

(d) Cost of Travel. Cost of travel for the Subcontractor's engineering and operating employees in connection with matters directly related and pertinent to the performance of the work under this Subcontract. Cost of travel for employees in other than engineering and operating classifications shall be charged to overhead accounts. Reimbursement shall be limited to the actual cost of transportation, communications and lodging plus an allowance of Seven Dollars (\$7.00) for each full calendar day each employee is in travel status in lieu of subsistence and all other expenses for travel performed. One-fourth (1/4) of the daily allowance is payable for each 6-hour period, or less, of travel status time. Transportation and lodging receipts shall be retained with report of travel expenses, to the extent that obtaining and retention of such receipts is consistent with the Seller's practice. Cost of travel in private automobiles shall be reimbursed at the rate of 7 cents per mile based upon mileage distances set forth in the Rand-McNally Road Atlas.

(e) Other Direct Costs. The cost of such other direct expenditures by the Subcontractor as may be approved or ratified by the Company as properly allocable to the performance of the work hereunder and which are specifically certified by the Company in writing to constitute an allowable item of cost.

2. Indirect Costs.

(a) Operating Overhead. An allowance to cover all of the Subcontractor's overhead and indirect expenses (except G & A expenses set forth below) properly allocable to the performance of the work under this Subcontract other than the unallowable costs set forth in Article III of this Appendix A shall be paid to the Subcontractor. Such an allowance shall be the sum that bears the same ratio of the direct labor cost exclusive of engineering labor allowable under this Subcontract as the total overhead and indirect expenses of the Subcontractor bears to the total direct labor exclusive of engineering labor in the fiscal year or years covered by this Subcontract.

(b) General and Administrative Expense. An allowance to cover all general and administrative costs of Subcontractor, other than the unallowable costs set forth in Article III of this Appendix, shall be paid to the Subcontractor. Such

allowance shall be the sum which bears the same ratio to the total allowable costs under this Subcontract, exclusive of the costs allowable under this item (b), as the total general and administrative expenses of the Subcontractor bears to the total cost of the Subcontractor's sales in the fiscal year or years covered by this Subcontract.

(c) Determination of Overhead Rates. Upon the completion or termination of this Subcontract, the Company, in consultation with the Subcontractor, shall determine the actual rates of operating overhead and general and administrative expense allowances applicable to this Subcontract in accordance with items (a) and (b) above, and the parties shall execute and appropriate amendment to this Subcontract setting forth the rate agreed upon which shall apply to the entire period of the Subcontract. In determining Subcontractor's total operating overhead and total general and administrative expenses under items (a) and (b) above, there shall be excluded from such totals (i) all costs and expenses which are similar to or of the same class as costs and expenses which are unallowable or are allowable as direct costs under this Subcontract or this Appendix and (ii) all costs and expenses which, in accordance with Subcontractor's established accounting procedure, are charged on Subcontractor's books of account as direct costs of another job or contract. If the Company and the Subcontractor fail to agree upon such revised overhead and general and administrative rates within ninety (90) days (or extended period to which the parties may agree) after expiration or termination of this Subcontract, the failure to agree shall be deemed to be a dispute within the intent and meaning of Article 8. DISPUTES, of the attached "Terms and Conditions".

III - UNALLOWABLE COSTS

A. Examples of Items of Unallowable Cost. Irrespective of whether they are treated as direct costs or as indirect costs, the following items are considered unallowable except as indicated. Failure to mention any item of cost specifically does not imply that it is allowable.

1. Advertising, except "help wanted" advertising and other advertising clearly necessary for the performance of the Subcontract.

2. Bad debts (including expenses of collection) and provisions of reserves for such debts.
3. Bonuses, and similar compensation under any other name, which are not consistent with a practice so established as to constitute a condition of employment.
4. Compensation pursuant to any agreement or understanding for payment of a commission, percentage, brokerage, or contingent fee to any person or selling agency employed or retained to solicit or secure a Government contract.
5. Contingency reserve provisions (except provisions for self-insurance reserves).
6. Contributions and donations.
7. Depreciation in excess of that calculated by application of the straight-line method, on the basis of expected useful life, to the cost of acquisition of the related fixed assets less estimated salvage or residual value at the end of the expected useful life. Any amount for depreciation in excess of that computed in accordance with the foregoing is not allowable, regardless of whether such excess is included in tax amortization certificates or is acceptable for income tax purposes under liberalized depreciation methods permitted by the Internal Revenue Code and Regulation. Amortization or depreciation of unrealized appreciation of values of assets or of assets fully amortized or depreciated on the Subcontractor's books of account is unallowable.
8. Dividends provisions or payments.
9. Entertainment expenses.
10. Federal, state and local taxes on income and excess profits.
11. Interest on borrowings, however represented, bond discount and expenses, and financing charges.
12. Legal, accounting, and consulting services, and related expenses incurred in connection with organization or reorganization, prosecution of patent infringement litigation, prosecution or defense of anti-trust suits, or the prosecution of claims against the United States.

13. Losses from sale, exchange, or abandonment of capital assets, including investments

14. Losses on other contracts.

15. Maintenance, depreciation and other costs incidental to the Subcontractor's excess facilities (including machinery and equipment) other than reasonable standby facilities.

16. Premiums for insurance on the lives of any persons where the Subcontractor is the beneficiary directly or indirectly.

17. Selling and distribution activities and related expenses not applicable to this Subcontract products or services

18. Taxes and expenses in connection with financing, refinancing, or refunding operations, including the listing of securities on exchanges

19. Employee compensation and benefit plans, including pension, vacation, sick leave, hospitalization, termination pay, retirement, bonus, group health, accident, life insurance, etc., employee relation programs, including awards, recreation, house organ, operation of dispensaries, etc., except those currently in effect as of the date of this Subcontract as a condition of employment.

20. Fines and penalties, except as provided for elsewhere in this Subcontract.

21. Except as otherwise provided in this Subcontract, losses and expenses (not compensated by insurance or otherwise) sustained in the performance of this Subcontract.

22. Moving expenses of employees and their families except as specifically provided in this Subcontract.

23. Any profits in connection with intra-company transactions and transactions with subsidiaries and affiliates of the Subcontractor.

Appendix A

Page 6

B. Examples of Unallowable Costs Unless Specifically
Approved by the Company.

1. Rearrangement or relocation of facilities or plant sites.
2. Repair and replacement of Government-owned property.
3. Security measures of a special nature.

PURCHASE ORDER SUBCONTRACT 96X-42124-C

SUPPLEMENTAL AGREEMENT NO. 1

THIS SUPPLEMENTAL AGREEMENT, made and entered into this the 10th day of March, 1959, by and between UNION CARBIDE NUCLEAR COMPANY, DIVISION OF UNION CARBIDE CORPORATION (hereinafter referred to as the "Contractor" or the "Company") acting under Contract No. W-7401-eng-26 with the UNITED STATES OF AMERICA (hereinafter referred to as the "Government") as represented by the UNITED STATES ATOMIC ENERGY COMMISSION (hereinafter referred to as the "Commission") and THE CAREY SALT COMPANY (hereinafter referred to as the "Seller" or the "Subcontractor")

WITNESSETH THAT:

WHEREAS the Company and the Subcontractor have heretofore as of the 9th day of February, 1959 entered into Purchase Order Subcontract 96X-42124-C (hereinafter referred to as the "Subcontract"), and

WHEREAS, it is found advantageous and in the best interests of the Contractor and Government to modify said Subcontract as hereinafter set forth,

NOW, THEREFORE, in consideration of the premises and the mutual agreements hereinafter set forth, the Subcontract is hereby modified in the following particulars only.

1. In Article VI - INDEMNIFICATION, Paragraph A, line 14, the word "allowable" is hereby deleted, and the word "unallowable" substituted in lieu thereof
2. In Article IX - ADDITIONAL INSURANCE, the words "Subject to the approval of the Company" shall be inserted preceding the first sentence of the first subparagraph, beginning with the word "Premiums."
3. In Appendix "A" - STATEMENT OF ALLOWABLE AND UNALLOWABLE COSTS, under subparagraph III B, add the following:
"4. Overtime work and related compensation of direct and indirect labor".

All other provisions, terms and conditions of the Subcontract shall remain unchanged and in full force and effect.

IN WITNESS WHEREOF, the parties hereto have executed this Supplemental Agreement as of the 10th day of March and year first above written.

UNION CARBIDE NUCLEAR COMPANY

THE CAREY SALT COMPANY

DIVISION OF UNION CARBIDE CORPORATION

By W. B. Farrell

By

G. J. Jenkins
Purchasing Agent

Title Director of Operations

Figure 1. A schematic diagram of the experimental setup. The subject is seated in a chair, viewing a screen displaying a target (a red dot) and a starting point (a green dot). The subject's hand is positioned at the starting point, and the target is located at a distance of 10 cm from the starting point. The subject is instructed to move the hand to the target as quickly and accurately as possible. The screen is positioned at a distance of 40 cm from the subject's eyes. The starting point and target are marked on the screen. The subject's hand is positioned at the starting point, and the target is located at a distance of 10 cm from the starting point. The subject is instructed to move the hand to the target as quickly and accurately as possible. The screen is positioned at a distance of 40 cm from the subject's eyes. The starting point and target are marked on the screen.

ATTACHED 3-24-44

and Government to address the situation. The Government is committed to ensuring the safety and security of its citizens and to maintaining the integrity of its institutions.

"CW, TIGER" 9/11 - 10/11/1964. It is a press release from the American
 Red Cross, dated 10/11/1964, which is a copy of the original document.
 Particulars are:

- [illegible]

all other public and private and additional information shall remain
in perpetuity full, true and correct

[illegible]

1990 17 10 10

LIVE DONOR ALLO-TRANSPLANTATION

1970

W. L. Line
- Pres. Purchasing Agent

U.S. DEPARTMENT OF JUSTICE

WASHINGTON, D.C. 20535

TO: DIRECTOR, FBI (100-443888)
FROM: SAC, NEW YORK (100-123456)
SUBJECT: [REDACTED]
RE: [REDACTED]

NY 100-123456

On 10/10/78, [REDACTED] advised that [REDACTED] had been contacted by [REDACTED] who stated that [REDACTED] was currently in the New York area.

[REDACTED] advised that [REDACTED] was currently in the New York area and was being monitored by [REDACTED].

[REDACTED] advised that [REDACTED] was currently in the New York area and was being monitored by [REDACTED].

[REDACTED] advised that [REDACTED] was currently in the New York area and was being monitored by [REDACTED].

[REDACTED] advised that [REDACTED] was currently in the New York area and was being monitored by [REDACTED].

[REDACTED] advised that [REDACTED] was currently in the New York area and was being monitored by [REDACTED].

[REDACTED] advised that [REDACTED] was currently in the New York area and was being monitored by [REDACTED].

NY 100-123456

NY 100-123456

NY 100-123456

PURCHASE ORDER SUBCONTRACT NO. 96X-42124-C

SUPPLEMENTAL AGREEMENT NO. 5

THIS SUPPLEMENTAL AGREEMENT, made and entered into this the 9th day of March, 1961, by and between UNION CARBIDE NUCLEAR COMPANY, DIVISION OF UNION CARBIDE CORPORATION (hereinafter referred to as the "Company") acting under Contract No. W-7401-eng-26 with THE UNITED STATES OF AMERICA (hereinafter referred to as the "Government") as represented by THE UNITED STATES ATOMIC ENERGY COMMISSION (hereinafter referred to as the "Commission") and THE CAREY SALT COMPANY (hereinafter referred to as the "Seller")

WITNESSETH THAT:

WHEREAS the Company and the Seller have heretofore as of the 9th day of February, 1959 entered into Purchase Order Subcontract 96X-42124-C (hereinafter referred to as the "Agreement"), and

WHEREAS the Agreement has heretofore been modified by Supplemental Agreement Numbers 1, 2, 3, and 4, and

WHEREAS it is found advantageous and in the best interests of the Company and Government to modify said Agreement as hereinafter set forth,

NOW, THEREFORE, in consideration of the premises and the mutual agreements hereinafter set forth, the Agreement is hereby modified in the following particulars only:

1. In Article IV - MAXIMUM AMOUNT AND INCENTIVES, delete Paragraphs A and B in their entirety and insert the following in lieu thereof.

"A It is estimated that the total cost to the Company for performance of this Agreement for the period March 2, 1959 through June 30, 1961 will not exceed a maximum amount of \$90,000.00, which amount consists of \$85,000.00 estimated cost and \$5,000.00 fee.

2. In Article VI - INSURIFICATION, Paragraph A, line 13, the word "allowable" is hereby deleted and the word "unallowable" substituted in lieu thereof.

All other provisions, terms and conditions of the Agreement shall remain unchanged and in full force and effect.

IN WITNESS WHEREOF, the parties hereto have executed this Supplemental Agreement as of the day, month and year first above written.

THE CAREY SALT COMPANY

UNION CARBIDE NUCLEAR COMPANY

DIVISION OF UNION CARBIDE CORPORATION

By W. H. H. H. H.

Secretary & Treasurer

By J. A. E. E. E.

General Purchasing Agent

PURCHASE ORDER SUBCONTRACT NO. 96X-42124-C

SUPPLEMENTAL AGREEMENT NO. 4

THIS SUPPLEMENTAL AGREEMENT entered into the 2nd day of February, 1961 and effective the 1st day of March, 1961, by and between UNION CARBIDE NUCLEAR COMPANY, DIVISION OF UNION CARBIDE CORPORATION (hereinafter referred to as the "Contractor" or the "Company"), acting under Contract No. W-7405-eng-26 with THE UNITED STATES OF AMERICA (hereinafter referred to as the "Government"), as represented by THE UNITED STATES ATOMIC ENERGY COMMISSION (hereinafter referred to as the "Commission"), and THE CAREY SALT COMPANY (hereinafter referred to as the "Seller"),

WITNESSETH THAT:

WHEREAS, the Company and the Seller have heretofore as of the ninth day of February, 1959, entered into Purchase Order Subcontract No. 96X-42124-C (hereinafter referred to as the "Agreement"), and

WHEREAS the Subcontract has heretofore been modified by Supplemental Agreement Numbers 1, 2 and 3, and

WHEREAS the parties hereto have entered into Subcontract No. 2070 whereby the Seller has agreed to furnish the Company certain mine space and services in salt mines of the Seller located near Hutchinson and Lyons, Kansas for the purpose of conducting certain experiments to determine the feasibility of disposing of reactor fuel reprocessing wastes in rock salt, and

WHEREAS the Company is desirous of securing additional supporting services from the Seller in conducting the said experiments and the Seller is willing to furnish such services as hereinafter provided

NOW, THEREFORE, in consideration of the premises and mutual agreements hereinafter set forth, the Subcontract is hereby modified in the following particulars only:

1. Articles I, II, III, IV, V and VI are hereby deleted in their entirety and the following Articles I, II, III, IV, V and VI are substituted in lieu thereof.

"ARTICLE I - STATEMENT OF WORK

"A. In support of the Company's experiments to determine the feasibility of disposing of reactor fuel reprocessing wastes in rock salt (hereinafter referred to as the "Work"), the Seller shall render service and furnish facilities as set forth below for the periods shown. Test equipment will be provided and operated by the Company.

"During the Period March 2, 1959 through February 28, 1961:

- "1. The Seller shall provide space in its Hutchinson, Kansas mine and provide the following supporting services for the Work:

- a. (1) Scale any loose rock off the ceiling and whitewash the walls and ceiling of the selected test chamber; (2) provide adequate lighting and ventilation of said chamber; and (3) provide such power cables and outlets as may be required to operate the test equipment and associated control panels.
 - b. (1) Excavate two cavities, approximately 7-1/2' x 7-1/2' x 10', separated by a lineal distance of 100 feet; (2) core drill 120 thermocouple wells in floor of chamber at locations designated by the Company; (3) transfer test equipment from the surface down to the test chamber; (4) assemble and install all test equipment in accordance with specifications designated by the Company; (5) assemble the segmented cavity cover according to specifications designated by the Company; (6) conduct necessary tests to determine that all equipment and facilities are functioning properly; (7) transfer approximately 7,000 gallons of Company furnished synthetic, non-radioactive, reactor fuel reprocessing waste from the surface to the test cavities in measured amounts for each cavity specified by the Company; and (8) perform all other work necessary or incident to the performance of the above work.
 - c. Fill the two cavities 7-1/2' x 7-1/2' x 10' with brine solution. Excavate two experimental test chambers in the wall of the large test room. The bottom plane of each chamber is to be located 3' above and parallel to the floor of the test room; each being 10' wide x 6' high x 7' deep; each to have one 19" square x 24" deep excavated hole located in accordance with the sketch "Suggested Location for Experiments 1 and 2", dated May 11, 1959. Each chamber is to have approximately 12 thermocouple holes located at the direction of the Company. Excavate one cavity 19" square x 24" deep on the floor of the mine in the area adjacent to the large test room.
- "2. The Seller shall provide mine space, supporting labor, material and utility services to enable Company personnel to conduct the following experiments in the Seller's Hutchinson mine:
- a. Study of Cavity Alteration for Synthetic Hanford Type Purex Waste in Rock Salt. An experiment consisting of two 3" diameter cylinders 3' long containing synthetic waste. The cylinders will be sealed with salt blocks and heated over a period of time. The change in shape of the cavities will then be studied in detail.

- b. Determination of Effect of Temperature Variation of Thermal Properties of Salt on Applicability of Superposition Principle. This experiment will consist of the measurement of temperatures around an array of buried heaters and around a single heater.
- c. Field Measurement of Heat Flow Patterns from Cylindrical Radio-active Sources Stored in Natural Salt Formations. A long cylindrical heater (84" active length) will be buried in the floor with 41 thermocouples installed at various distances and various depths in eight holes around this heater. A second cylindrical heater will be buried in the wall of the large pillar adjacent to the Company's previous experiments, and will also have 41 thermocouples in eight similar holes. Dial type strain gauges will be installed to measure floor to ceiling movement and "Reid" type gauges to measure floor to ceiling and wall to wall movement.
- d. "Room and Riddle" Test. A small (12" x 12" x 24" cavity cut into the face of a pillar and having a recessed floor will be used to evaluate the concept of disposal in shallow layers on the floor of a cavity in salt.

- "2. The Seller shall furnish without charge except for labor and transportation, six (6) blocks of salt, total estimated weight 750 pounds, and shall ship via prepaid motor freight to the following address:

Eugene C. Robertson
U. S. Geological Survey
Admin. Building
B-Street Avenue and Federal Street
Silver Spring, Maryland

- "3. The Seller will core drill at approximately four (4) locations in the Lyons mine. There will be two (2) core holes at each location. One (1) core hole will be in the floor, 30 to 40 feet deep. The other to be in the roof, as near vertically as possible, 30 to 40 feet deep. Two of the four core hole locations are fixed as follows:

(1) At the extreme south end of the "Mc Lad" entry.

(2) At the extreme west end of Entry No. 5 off the "Mc Lad" entry.

Locations of the two additional core drill holes will be determined after the work begins.

"During the Period March 1, 1961 through June 30, 1961:

- "5. In addition to the continuation of the Statement of Work outlined

in Article I A above, the Seller shall provide supporting labor, water and electricity service to enable the Company or Company authorized personnel to conduct the following described studies related to plastic flow and creep rate, in space in the Seller's Hutchinson and Lyons, Kansas mines provided for under space agreement Subcontract No. 17 between the Company and the Seller.

- a. Approximately three (3) rooms (approximately 10' x 10' x 10') will be excavated and heated to various temperatures. The plastic flow (creep rate) will be measured in these small rooms at ambient temperatures and at the elevated temperatures. By locating the rooms in areas of different stress the effect of initial stress will also be studied.
- b. Measurements at ambient temperature in various portions of the Seller's Hutchinson and Lyons, Kansas mines will be made to determine the effects of depth, room size, and pillar size on plastic flow. The data from these measurements will be used to determine empirical relationships between depth and stress, plastic flow, and the resulting structural integrity of areas used for storage of radioactive wastes.
- c. The removal and use of waste and equipment is directed by the Company.

"During the Period July 1, 1968 thru June 30, 1969:

The Seller shall furnish the following services supporting the design and use of the Seller's Hutchinson and Lyons, Kansas mines provided for under space agreement Subcontract No. 17 between the Company and the Seller. The Seller shall be responsible for the design and schedule of the work, by written direction from the Company's resident engineer to the Seller, and the Seller shall furnish the same cost form therein.

- a. Furnish labor, material and equipment necessary to perform the test program in the Seller's Hutchinson and Lyons, Kansas mines continuously throughout the period.

Perform minor maintenance tasks in connection with the work.

- c. After removal of the waste and equipment by the Company for transport to an off-site disposal site, certain and material, some of which may be radioactive.
- d. Provide handling and storage of samples, some of which may be radioactive.

- e. Remove and dispose of wastes and equipment as directed by the Company.
- f. Provide the privilege of and facilities for ingress and egress to the work areas of the Company and its contracted personnel and equipment deemed necessary by the Company to maintain progress in the Work.

"7. It is understood and agreed that radioactive tracer materials may be used in the Hutchinson mine subject to the prior approval by the Seller. It is further understood and agreed that the Company shall have the right to use radioactive reactor fuel reprocessing wastes and other radioactive materials in conducting its experiments in the Lyons' mine.

"ARTICLE II - PERIOD OF PERFORMANCE

"A. The period of performance of this Agreement shall commence March 2, 1959 and continue until June 30, 1964. The work shall be in three stages. The periods of performance of each stage are as follows:

1. March 2, 1959 through February 28, 1961.
2. March 1, 1961 through June 30, 1961.
3. July 1, 1961 through June 30, 1964.

"ARTICLE III - CONSIDERATION

"A. Payment for allowable costs to the extent specified in Appendix "A" attached hereto and made a part hereof and fees as set forth in this Article shall constitute complete compensation for the Seller's services including profit and all items and kinds of expenses not allowable under the terms of this Agreement.

1. Fixed fee for performance set forth in Paragraphs A-1, A-2, A-3 and A-4, Article I of this Agreement - \$5,600.00.
2. Fixed fee for performance set forth in Paragraph A-5, Article I of this Agreement - \$250.00.
3. A fixed fee will be negotiated annually for the performance described in Paragraphs A-6 and A-7 of Article I of this Agreement. Prior to July 1st of each year (beginning year 1961) the Company will present to the Seller the scope of the work to be performed during the succeeding twelve-month July-through-June period, and the parties agree to negotiate in good faith the reasonable estimated cost of such work. The fixed fee for that twelve-month period shall be five percent (5%) of the agreed estimated cost. Failure of the parties to agree upon such

estimated cost shall constitute a breach of this Agreement. In the event of a breach of this Agreement, the Seller shall be entitled to recover its costs and expenses, including reasonable attorneys' fees, incurred in connection with the enforcement of this Agreement.

estimated cost shall be deemed to be a dispute within the intent and meaning of Paragraph 3, DISPUTES, of the Terms and Conditions of the Agreement.

"ARTICLE IV - MAXIMUM AMOUNT AND LIMITATIONS

- "A. It is estimated that the total cost to the Company for performance of this Agreement for the period March 2, 1959 through February 28, 1961 will not exceed \$85,500.00, which amount consists of \$80,000.00 estimated cost and \$5,500.00 fee.
- "B. It is estimated that the total cost to the Company for performance of this Agreement for the period March 1, 1961 through June 30, 1961 will not exceed a maximum amount of \$5,250.00, which amount consists of \$5,000.00 estimated cost and \$250.00 fee.
- "C. The estimated total cost to the Company for performance of this Agreement during the period July 1, 1961 through June 30, 1962 and the fixed fee included shall be determined in accordance with Article III A.3 hereof.
- "D. The Seller agrees to use his best effort to complete performance of this Agreement within said estimated costs, but neither the Company nor the Seller guarantees the accuracy of the estimated costs.
- "E. The Seller shall keep the Company currently advised of expenditures and commitments and shall not expend and/or commit any amounts in excess of the estimated costs as set out in Article IV A and IV B, and as shall be determined in accordance with Article III C, hereof. The Company shall not be required to make payments to the Seller in excess of the maximum amounts hereinafter stated, as such maximum amounts may be subsequently revised in writing by the Company, and the Seller shall not incur costs for performance of this Agreement in excess of the estimated costs hereinafter stated, unless and until the Company shall advise the Seller in writing of increasing the estimated cost, and stating the revised estimated cost and all thereupon constitute the estimated cost of performance for the period of this Agreement. Upon receipt by the Company of any such revised estimated cost, the Company shall have the right to specify the portion of the work and other obligations under this Agreement the Seller shall continue to perform.
- "F. No adjustment shall be made in the amount of the fixed fee in the event that the actual cost of the work varies from the estimated cost thereof, in the event the estimated cost is revised as hereinafter provided, except as provided for in the paragraph hereinafter provided.

attached "Terms and Conditions" entitled "Changes". No claim for any adjustment of fixed fee shall be made or entertained because of error or omission in computing the estimated cost of the work.

- "G. The giving of any notice by either party under this Article shall not be construed to waive or impair any right of the Company to terminate the Agreement under the provisions of the Article entitled "Termination."

"ARTICLE V - PAYMENTS

- "A. Payment for Allowable Costs. The Seller will be paid monthly within thirty (30) days after receipt of invoices for its allowable costs expended in accordance with Articles III and IV hereof upon submission by the Seller of duly certified vouchers or such other documents as the Company may require and in the form required by the Company.
- "B. Provisional Overhead Rates. For the purpose of making payments in accordance with Article V A. of this Agreement, the following provisional overhead rates shall apply:
1. Operating Overhead - 104% of direct labor
 2. General and Administrative - 8% of Seller's allowable costs excluding G & A expenses
- "C. Determination of Overhead Rates. Upon determination of the actual rates for overhead allowance and general and administrative expense as provided in Appendix "A", the Seller shall pay to the Company the amount, if any, by which the overhead allowance and general and administrative expense paid under the provisional rates exceed the amount payable under the actual rates; or the Seller shall be paid the amount, if any, by which the overhead allowance and general and administrative expense paid under the provisional rates is less than the amount payable under the actual rates.
- "D. Fixed Fee. Ninety percent (90%) of the fixed fee shall be paid in monthly installments as follows: The Seller shall be paid each month a sum bearing the same ratio to ninety percent (90%) of the fixed fee as the allowable costs reimbursed to the Seller in such month in accordance with Paragraph A. of this Article V bears respectively to the total estimated cost established under Paragraphs A., B. and C. of Article IV. Upon completion and acceptance of the work hereunder and upon completion and submission by the Seller of property accounting, patent disclosure, assignment and final release in the form required by the Company, and upon determination of the actual rates for overhead allowance and general and administrative expense and the payment of any amount due from the Seller under Paragraph C. of this Article V, the Seller shall be paid the remaining amount of the fixed fee."

Abstract

1. The value of the property shall be the fair market value of the property at the time of the loss, less any depreciation or other loss sustained by the property prior to the loss. The value of the property shall be determined by the appraiser or the court, as the case may be.

[illegible]

2. Add the following sentence to p. 109:

"In view of the provisions of the article entitled 'Home-made Property', the Seller shall not procure or maintain for its own protection any insurance - including self-insurance or reserves - covering loss or destruction of, or damage to Government-owned property."

3. The following article is added to the literature:

14-00000 14-00000 14-00000

It is understood and agreed, if, for any reason, Seller shall cease operation of either or both of the International and Lyons mines, it shall be complied with all of its obligations hereunder by continuing to make available to Company the said mine or mines and equipment thereof and Company shall have the right to operate any of Seller's or its subsidiary company's operations and experiments hereunder. In that event, the maintenance and operation of such equipment and facilities shall be for the account of the Company and Company and Seller shall negotiate in good faith for an assignment of the fee or fees to be received hereunder.

4. In April 1966, the following information was received as follows:

"Spec. A. 3101. In charge of the telephone company for installation of the experimental laboratory's listed telephone, which is a lease of the telephone as an item of direct cost."

Supplemental Agreement No. 4
Purchase Order Subcontract 95A-12124-3
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5. The Company's letters of June 12, 1959, November 17, 1960 and July 27, 1960 are merged with and superseded by this Supplemental Agreement.

All other provisions, terms and conditions of the Subcontract shall remain unchanged and in full force and effect.

This Supplemental Agreement shall have no force or effect until approved in writing by a duly authorized representative of the Commission.

IN WITNESS WHEREOF, the parties hereto have executed this Supplemental Agreement as of the day, month and year first above written.

UNION CARBIDE NUCLEAR COMPANY

DIVISION OF UNION CARBIDE CORPORATION

By _____
General Purchasing Agent

THE CAREY SALT COMPANY

By _____

Title _____

APPROVED IN BEHALF OF THE UNITED
STATES ATOMIC ENERGY COMMISSION

By _____

Chronological Summary of AEC Contact with
Petroleum Research Corp. and Atomic Storage Co.

January, 1960 - A. I. Levorson, consulting petroleum geologist, acting on behalf of PRC, wrote Director, U. S. Geological Survey, for help in arranging a meeting with AEC staff for presentation of PRC ideas on waste disposal.

February 24, 1960 - Meeting with Gilman Hill, President PRC, J. A. Lieberman, RDT, and representatives of USGS.

June 17, 1960 - Letter from Lieberman to Hill requesting an informal indication of "the nature and scope, including estimated cost, of laboratory and field investigations... to demonstrate and prove the concepts..." Stated that budget limitations precluded commitments for new projects.

June 24, 1960 - Letter from W. A. Colburn, Vice President PRC, to Lieberman transmitting and elaborating on an outline of research (total cost - \$248,000).

August, 1961 - PRC negotiated with Blackfeet Indian Tribe on a joint venture to drill test wells on the Indian reservation and to develop a facility for subsurface disposal of Hanford high-level wastes. AEC was not approached on this proposal and was not a party to the discussions between PRC and the Blackfeet Tribe. See staff papers 180/17, August 17, 1961; 180/18, October 30, 1961; 180/19, November 13, 1961; and 180/20, November 9, 1961. Voluminous correspondence and much discussion involving Senators Mansfield and Matcalf, Governor Nutter, and numerous private citizens. Blackfeet rejected the proposal.

Forwarded by memo: 9-9-65

January, 1963 - Ex-governor McNichols of Colorado approached JCAE staff on behalf of PRC for information on the status of a proposal to AEC by PRC to dispose of radioactive wastes. A proposal of this nature had not been made at the time. Review of contacts with PRC sent to JCAE staff.

January, 1964 - *Joint proposal from Stearns Roger Manufacturing Co., E. A. Columbus, Jr. and Associates, and Atomic Storage Co. submitted to RDT. Detailed discussion of the proposal between R. W. Akerlow, Stearns Roger W. A. Colburn, and RDT and Production staffs. Copies of proposal sent by Colburn to Senators Mansfield and Metcalf.

February 12, 1964 - *Proposal rejected by letter from Pittman to Colburn on the basis of unacceptable problems in safety and economics of the concept after technical review by RDT and Production.

April 8, 1964 - *Rebuttal attempt by Colburn, submitting a series of "questions, answers, and discussion".

June 8, 1964 - *Detailed response to questions posed by Colburn in letter from Vander Weyden.

May 1, 1965 - Letter from Colburn to Senator Jackson requesting information on incidence of cancer and leukemia in Washington. Expresses concern that radioactive waste is escaping from Hanford. Letter referred to AEC by Senator Jackson.

May 20, 1965 - Response to Senator Jackson by General Manager.

*Copy Attached.

RESUME

Atomic-waste disposal will play a vital role in the development of the civilian nuclear industry as well as in the continuation of the United States Atomic Energy Commission plants.

A "fail-safe", economically competitive method for storing atomic waste was developed by the Petroleum Research Corporation and is presently owned and being promoted by the Atomic Storage Company.

In a limited number of locations, the pressure of the water in deeply buried geologic formations is lower than the pressure elsewhere in the same formation and also lower than the pressure in other permeable formations above and below it. When toxic fluids, such as atomic waste, are injected into the formation by conventional petroleum-industry techniques, the fluids will remain perpetually in storage. These low-pressure zones, therefore, constitute "fail-safe" storage zones for toxic fluids because the existence of faults, fractures, etc., will result only in the further dilution of the waste by fluids from the outside.

The sites where these storage zones exist can be utilized effectively both as industrial centers for new fuel-element-processing and isotope-production plants and as storage sites for waste from existing plants. The latter application will require that the atomic waste be removed from the temporary storage tanks, be treated in preparation for shipment, and be transported to the storage site.

Extensive work has already been done by many organizations on each of these operations, but a coordinated feasibility study of the entire program has not yet been carried out.

It is hereby proposed, therefore, that a detailed feasibility study, as described below, be conducted by the following team under the auspices of the United States Atomic Energy Commission:

Stearns-Roger Corporation (Prime Contractor)

E. A. Polumbus, Jr. and Associates

Atomic Storage Company

.. INTRODUCTION

The role that atomic-waste disposal will play in the overall development of a dynamic nuclear industry will be, by necessity, a vital one. Literally every phase of the nuclear industry, from the mining of the ore to the reprocessing of the fuel elements, produces atomic waste that must be stored for from hundreds to thousands of years.

Although the cost of atomic-waste storage is not the principle expense of the nuclear industry, the danger to man's environment posed by the waste is a principle problem for the industry.

Numerous storage methods have been proposed and many more will be forthcoming. Many of these methods involve some form of deep burial, such as in salt mines, in low-permeability shales, in isolated sandstone lenses, and in depleted oil fields. The method advocated in this proposal also involves deep geologic burial but in a very advanced form.

Many factors must be considered for any permanent storage methods, but three of them are paramount --- (1) the absolute protection of man's environment, (2) conservation of natural resources, and (3) the economics.

Undoubtedly, the most important feature of waste storage must be absolute safety. Not only must the method be "fail-safe" under normal conditions, but also, it must remain "fail-safe" even in the event of such natural or man-made catastrophes as devastating earthquakes or thermonuclear explosions.

The conservation of our natural resources must also be a major consideration. Many very valuable radionuclides are present in atomic waste, and therefore, the strategic need for them must be evaluated. Fortunately, the projected generation of valuable radionuclides (from civilian applications alone) exceeds the projected production capabilities of even the proposed isotope-production plants. Therefore, such plants can be fully supplied by fresh waste from other facilities and, consequently, the requirement for saving the existing waste is eliminated. In the interest of safety, it is very desirable to keep the amount of waste in temporary tank storage to the barest minimum. The very presence of large quantities of high-level atomic waste in the vicinity of prime military targets may pose a major threat to international safety. Although an attack on such an installation is highly improbable, every eventuality must be anticipated.

Safety, conservation, and economics can all be realized by building reprocessing plants and isotope-production plants at sites where the waste can be stored by a "fail-safe" method. Such a method is

proposed by the Atomic Storage Company. This method involves the injection of the waste into very selective deeply buried geologic formations that are under very low geologic-fluid pressure because of the natural conditions of salinity, electrical potential, and temperature that exist in the geologic formation at the storage site. When atomic waste is injected into such a geologic formation, the waste will not be able to move from the storage site and will remain perpetually in storage. Such a storage facility is literally "fail-safe" because the existence of faults, fractures, etc. will result only in the further dilution of the waste by fluids from the outside.

These storage sites can be efficiently utilized in two very general ways --- (1) by building new fuel-element processing and isotope-production plants at the storage sites so that the surplus waste can be permanently and safely stored immediately after it is generated, and (2) by transporting existing waste (and new waste from existing plants) to the nearest storage sites. Of course, each site can be used for both applications.

Detailed theoretical, laboratory, and field investigations of this storage method have been performed. However, because of the critical nature of the atomic waste, it will be necessary for similar technical and economic feasibility studies to be carried out under the auspices of the United States Atomic Energy Commission before the storage method can be utilized for atomic waste.

Such feasibility studies will require the combined efforts of engineers, geologists, and scientists who are familiar with handling radioactive materials, with chemical plants, with petroleum drilling, completion, and injection practices, and with the detailed knowledge of the low-pressure storage method. Therefore, Stearns-Roger Corporation, E. A. Polumbus, Jr. and Associates, and the Atomic Storage Company have formed a team to carry out such feasibility studies.

Stearns-Roger Corporation will provide all architectural and structural, electrical and mechanical engineering, and chemical processing for the processing plants, transportation systems, and special radioactive-material handling equipment. Stearns-Roger Corporation will also provide all project-management personnel and be responsible for coordination and planning of the entire project. E. A. Polumbus, Jr. and Associates will provide drilling, completion, and reservoir engineering services similar to those provided by them for the deep disposal well drilled at the Rocky Mountain Arsenal near Denver, Colorado. The Atomic Storage Company will furnish the detailed knowledge of the storage method, the hydrodynamic evaluation of the storage sites, and the geologic interpretation of the storage sites.

Because each site can be used both as a location for new reprocessing plants and as a storage site for waste from existing facilities, a detailed feasibility study of one site will serve a dual purpose. The largest single quantity of existing waste is at the Hanford Plant at Richland, Washington, and the nearest safe storage site to the Hanford Plant is in northern Montana.

It is proposed, therefore, that detailed feasibility studies of (1) the storage method, (2) the storage site in northern Montana, (3) the transportation of waste from the Hanford Plant, and (4) the techniques for handling the waste be conducted by this team under the auspices and supervision of the United States Atomic Energy Commission.

HISTORY

Since 1951, the Petroleum Research Corporation has devoted most of its efforts to the study of ground-water flow and its effects on petroleum trapping, production, secondary recovery, etc.

Through this extensive research and evaluation program, a number of sites were discovered in the continental United States where the ground water is flowing toward each site from all directions: north, east, south, west, above and below. These flow patterns have been fully documented and verified by large volumes of reliable pressure data obtained from the petroleum industry.

To explain these apparently paradoxical conditions, extensive research programs were carried out both with staff members and with numerous consultants from universities, research institutes, and industry. The cause of these closed-low-pressure conditions has now been established to be electro-chemical osmosis --- the same phenomenon which brings water to the leaves of trees and which causes many physiological and biological processes to take place. Laboratory and field investigations have verified quantitatively that the pressure conditions in such "closed-low-pressure" sites are consistent with the electro-chemical and geologic conditions which exist at such sites.

A very complete disclosure of the theory and practice of utilizing these closed-low-pressure areas for atomic waste storage was prepared and submitted to the United States Atomic Energy Commission (on a company-confidential basis) in February, 1960. However, a complete proposal was never submitted to USAEC, nor was USAEC requested to evaluate the method.

Soon after the closed-low-pressure-zone method of storage was disclosed to the USAEC, the ground-water hydrodynamics of the States of Washington and Oregon were investigated in search of storage sites, but no satisfactory sites could be found. At the request of USAEC, the results of the study were sent to USAEC and to members of the AAPG Subcommittee on Atomic Waste Disposal.

As a result of the extension of the study of the States of Washington and Oregon, two storage sites were discovered in northern Montana. One was under the Blackfeet Reservation. Therefore, in June, 1961, a proposal was presented to the Blackfeet Indians at Browning, Montana, whereby the storage site under the Reservation would be developed. Ultimately, the Blackfeet Tribe rejected the proposal with the expressed fear that the U. S. Government would condemn the Reservation if the atomic-waste material were injected under the Reservation.

In June, 1963, Gilman A. Hill and William A. Colburn applied for a patent on this toxic-fluid storage method, and assigned all rights to the Petroleum Research Corporation.

Stearns-Roger

On February 16, 1963, the Atomic Storage Company was formed to promote this waste disposal project; and, subsequently, all rights to the project were purchased by the Atomic Storage Company.

Subsequently, a study team has been organized that is capable of carrying out all areas of the investigation.

This unsolicited proposal constitutes the next step in the verification of this method as a practical solution to the storage of atomic waste.

DESCRIPTION OF THE PROJECT

The proposed feasibility study will consist of four separate, but closely interrelated divisions of study. Division I will be devoted to a detailed study of the storage method. Division II will involve the evaluation of the geologic conditions and pressure systems in the storage site. Division III will consist of technical and economic evaluations of transportation-container designs and transportation systems. Division IV will consist of investigating waste-handling systems and facilities.

Division I --- The Storage Method

The practice of injecting salt water into permeable aquifers is routine and accepted practice in the petroleum industry. Because of the need for salt-water disposal, pressure maintenance, water flooding, etc., the petroleum industry has extensively developed the science, engineering, and art of such injection practices.

In October, 1958, the Subcommittee on Disposal of Radioactive Waste of the American Petroleum Institute submitted a report on the deep-well disposal of liquid-radioactive waste entitled, "Problems in the Disposal of Radioactive Waste in Deep Wells." This report was very optimistic in its evaluation of the deep-well disposal system and indicated no insurmountable obstacles. The addition of the closed-low-pressure storage method to conventional petroleum-industry operations provides an economically competitive "fail-safe" storage system.

This "fail-safe" method of storing radioactive waste involves injecting the waste into deeply buried geologic formations that are under abnormally low pressure because of the natural conditions of salinity, electrical potential, and temperature that exist in the geologic formation at the storage site. The very fine pore spaces between the individual platelets of a shale mineral have properties similar to those of a membrane. Whenever a membrane-like material separates two waters of different salinity, of different electrical (redox) potential, or of different temperature, osmotic "pumping" of water across the membrane results. However, only water molecules are "pumped" across the membrane because the membrane filters out the salt ions. Because of osmotic "pumping", water will be removed (1) from the permeable formation with the fresher water, across the shale, to the formation with the more saline water, (2) from the permeable formation with the more positive electrical potential, across the shale, to the formation with the less positive electrical potential, or (3) from the permeable formation that is at a higher temperature, across the shale, to the formation that is at a lower temperature.

Under certain combination of natural osmotic and geologic conditions, closed-low-pressured and/or closed-high-pressured zones are maintained. In a closed-low-pressured zone, water is flowing toward the zone from all directions: north, south, east, west, above and below. Consequently, once atomic waste is placed in the closed-low pressured zone (storage zone) it will not be able to escape. Even if an earthquake should occur and cause a major fault to open up through the storage zone, the only effect would be that water from the outside would enter the storage zone and merely further dilute the waste. No radioactive ions could escape.

Furthermore, with the procedures proposed for the utilization of this storage method, even after the injection of atomic waste, all of the chemical, electrical, and thermal conditions will continue to be such as to naturally maintain the zone as a closed-low-pressured storage site.

The results of the theoretical, laboratory, and field verifications of geologic osmotic pumping are immediately available for the feasibility study. Therefore, the division of the feasibility study that will pertain to the storage method will involve reviewing, challenging, evaluating, and presenting current data, procedures, and results.

Division II --- The Storage Site

The proposed storage site in northern Montana was discovered as an extension of the investigation of the States of Washington and Oregon for possible sites. In the storage zone, the Cut Bank sandstone dips to the west and is from 3800 to 5200 feet deep. Pressure in the Cut Bank sandstone at the storage site is approximately 500 pounds per square inch lower than it would have been if hydrostatic conditions had existed.

Although the storage zone in the Cut Bank sandstone is at the lowest datum pressure in the area, water-withdrawal (or bleed) wells will be used (1) to lower the pressure further in order to improve the efficiency of injection, (2) to insure that the pressure near the injection wells will not become excessive due to the injection rate, (3) to furnish water to elutriate the radioactive ions from the containers, (4) to furnish water to dilute the waste, (5) to control the distribution of the waste in the storage aquifer, etc.

The evaluation of the storage site will be carried out in two phases. In the first phase, one test well will be drilled, cored, logged, and thoroughly tested; and detailed geologic, reservoir engineering, and hydrodynamic studies of the greater storage area will be made. An appreciable amount of data are already available from the petroleum industry. However, because most of the petroleum exploration wells in the area were drilled prior to the acceptance of hydrodynamics by the petroleum industry, insufficient pressure data are available to delineate the exact extent of the storage zone. Data from the first well, when compared with existing data, will (1) establish that the storage site does exist, (2) provide water samples for use in Division IV, (3) indicate the probably storage capacity of the site, and (4) provide geologic, pressure, and chemical data which will be necessary for the design of the injection system.

Subsequent wells to be drilled in the second phase of Division II will delineate the areal extent of the storage site and also will provide data necessary to locate the "eye" of the closed-low-pressure zone. A review of existing data indicates that from four to six wells probably will be needed to complete the second phase of Division II.

Division III --- Transportation

Unfortunately, the geologic and pressure conditions at the Hanford Plant site are not favorable for the storage of waste in salt beds, or in fractures in low-permeability shales, or an "isolated" porous stratum, or in closed-low-pressure zones. Therefore, the transportation division of this project will add materially to the serious consideration of any of these storage systems for the Hanford waste.

It would be very difficult, and perhaps even impossible, to overestimate the importance of a detailed, comprehensive, and unbiased study of the transportation division of this project. The operation of the other divisions of the project will be carried on within the confines of restricted areas populated by trained personnel. However, for the transportation division, the waste will be in the public realm even though it is being handled by experts. The absolute security and safety of the public are paramount, but perhaps of equal importance is the conviction of the populace that every precaution is being taken and that the new storage site will alleviate potential hazards of the present storage systems.

The feasibility study of the transportation system will also involve two phases. The first phase will involve the selection of the proper transportation-container for the waste and the selection of the optimum means of transportation of the containers. The second phase will involve the preparation of preliminary engineering designs and cost estimates for the container and the transportation system.

While negotiations with the Blackfeet Indians were being carried out, preliminary studies were made of the optimum container for transporting the waste. Considering the methods of loading, heat dissipation, ease of coupling the container to the injection well, ease of handling the containers, the availability of handling equipment, ease of maintenance of the containers, etc., it was suggested that metal containers 2 to 6 inches in diameter and 10 to 60 feet long would be applicable. Depending upon the method of waste handling that is adopted and depending upon the physical state in which the waste is placed in the capsules, additional concentric cylinders may be required as insurance against accidental spillage. Of course, the method of transportation that is ultimately selected may suggest another shape of container.

Five forms of transportation have been suggested for evaluation by the feasibility study --- transportation by railroad, by truck, by propulsion of the sealed containers through pipelines, by aircraft, and by aerial tramway.

The use of cask cars on the railroads for transporting radioactive materials is already an accepted practice, and Stearns-Roger Corporation has designed and built such rail cask cars.

The use of trucks has similarly been accepted for the transportation of radioactive materials in casks.

The propulsion of the sealed containers through pipelines is not an obvious transportation system, so some elaboration is necessary. In the recent past, department stores used pneumatic tubes to carry metal capsules from one part of the store to another. Similarly, but on a much more technical scale, the pipeline industry "pumps" very large solid "pigs" through the pipeline in order to separate different materials or to clean out the pipeline. The "pigs" used for cleaning the pipeline are equipped with wire brushes, weigh on the order of 500 pounds, and are capable of passing through 37-degree bends. Consequently, the technology of moving the containers through the pipeline is routine and operational, but many other considerations are still to be evaluated.

Transportation of containers by aircraft was studied to a moderate extent. Technically, the method is feasible, but public apprehension is anticipated.

The use of aerial trams to transport shielded casks is feasible and apparently economically competitive. However, only a cursory evaluation of this system was made.

Division IV --- Waste Handling

A vast amount of research and development work has already been done on the handling of atomic waste as part of the routine operation of the USABC plants, as part of the Waste Management Program, as part of the isotope-production programs, and as part of the study of waste disposal.

However, the particular flow sheet for handling the waste that is to be injected into permeable geologic formations must be designed to meet the requirements of the injection and transportation systems.

The first phase of Division IV of this study will involve (1) a review of current waste-handling methods, (2) an investigation into the possible need for modifying such methods, (3) an investigation of the availability of facilities at Hanford, and (4) a preliminary design of a flow sheet for processing and handling the waste.

The second phase of Division IV will involve (1) a detailed study of the chemical flow sheet, (2) a detailed study of systems for loading the waste into the containers, (3) a detailed study of systems for elutriating the waste from the containers, (4) a study of the compatibility of the reservoir water and the waste, (5) a preliminary design of the waste-handling facilities at the storage site, and (6) a preliminary design of the water-treatment plant at the storage site.

Through many years of experience in salt-water disposal and water flooding, the petroleum industry has developed highly the technology of injecting fluids into permeable geologic formations. Of the many factors to be considered, the two most important are (1) that the waste must be in liquid form, and (2) that the waste must be compatible with the water that is in the geologic formation.

With respect to the transportation of large volumes of high-level atomic waste, no formal criteria have been established. However, to insure maximum safety, it is suggested that the waste should be in coarse granular form.

All of these requirements can be met by the use of solvent extraction and ion-exchange techniques. The containers can be filled with coarse granular ion-exchange material and then the aqueous solution of waste can be passed through the containers. After the exchange material is properly loaded, air can be blown through the container to dry the exchanger and then the containers can be sealed.

At the storage site, treated formation water can be used to elutriate the waste from the ion-exchange material. By this system, even though the waste is transported to the storage site in solid form, it is injected into the storage formation in liquid form as a compatible salt solution.

RESUME OF CAPABILITY TO PERFORM DATA

The particular abilities and experience of each member of the team as they pertain to the feasibility study are as follows:

Stearns-Roger Corporation (Contractor)

The Special Projects Division of Stearns-Roger Corporation is a widely diversified group which was organized to handle projects such as nuclear engineering, cryogenics, missile launch complexes, and test facilities.

This division is supported by a centralized engineering department that coordinates the needs for designers and draftsmen for all divisions of Stearns-Roger Corporation.

The portions of this project assigned to Stearns-Roger Corporation are normal functional products and services. The chemical portions, the designing of "cask" cars, the design and construction of pipelines, the design and construction of remote-handling-equipment, etc., are conventional projects for Stearns-Roger Corporation.

E. A. Polumbus, Jr. and Associates

The functions assigned to E. A. Polumbus involve operations for which they are specialists. Their abilities were demonstrated specifically by their performance on the waste disposal well at the Rocky Mountain Arsenal near Denver, Colorado.

E. A. Polumbus and Associates are internationally recognized for their abilities in petroleum engineering, reservoir evaluation, secondary recovery programming, water flooding, drilling-testing-logging supervision, and petroleum property evaluations.

Atomic Storage Company

The functions assigned to Atomic Storage Company for this project involve the theories, data, and techniques developed by the Petroleum Research Corporation and purchased by William A. Colburn doing business as the Atomic Storage Company.

As Vice President for Research for the Petroleum Research Corporation during the entire period of research and development on the study of causes and effects of groundwater flow (1954 to 1963), William A. Colburn was involved directly in all phases of the theoretical, laboratory, field, instrumentation, and testing work of Petroleum Research Corporation. Furthermore, William A. Colburn is co-inventor of this method of toxic-fluid storage and, through contractual agreements with Petroleum Research Corporation, possesses the rights to all of Petroleum Research Corporation's theoretical, laboratory, and field data which may be needed to verify, explain, or defend the Atomic Storage Company's method.

Petroleum Research Corporation's activities were devoted mainly to:

1. The study of the causes and effects of geologic pressure systems. The causes of pressure systems include gravitational forces, differences in salinity, differences in temperature, differences in oxidation and reduction conditions, geologic compaction, and man-made fluid withdrawals and injection.
2. The reduction to practice of the results of these studies in fields both related to and unrelated to the petroleum industry.
3. The collection, evaluation, extrapolation, and interpretation of over 30,000 geologic fluid pressures which were measured by the petroleum industry. These pressure data have been made available to the petroleum industry through Petroleum Research Corporation's Data Centers.
4. The invention of instrumentation and equipment for geologic-information evaluation and production.

RD:DNS:AC

Dr. William A. Colburn
Noble Storage Company
1525 South Josephine Street
Denver 5, Colorado

Dear Dr. Colburn:

Reference is made to a proposal of the Burns-Roger Corporation to develop a system of injecting liquid wastes into formations having lower formation-fluid pressures than adjacent zones, which was submitted to this Division of January 27, 1953. A subsequent discussion of this proposal and related matters was held at the Air Force Energy Conference on January 17, 1954, and involved yourself and Mr. W. H. Brown of Burns-Roger, Mr. J. H. Brown of our Division of Petroleum, and Messrs. Holter, Hagin and Sheer, members of my staff. I understand that our response to the proposal was forwarded to you, with a copy to Burns-Roger.

Although the Burns-Roger proposal is directed in larger part at the transportation of high-boiling hydrocarbon wastes from the Hanford site to a location in the desert where they would be injected into a subsurface formation, as mentioned in the course of the discussion that even though I am not personally interested in your proposal to dispose of Hanford's liquid wastes, you wished to have an evaluation of the concept of injection of liquid wastes into subsurface formations having low fluid pressures.

My staff has further reviewed the material which you left during your visit, and the following paragraphs summarize our thoughts on your proposal, as well as the issues which were discussed with you and Mr. Maxwell during your January 17 visit.

With reference to the Hanford wastes which you would propose to transport to a site in Nevada and inject into wells, the Hanford long-range waste management plan for treatment, handling and storage of these wastes does not, and will not, include transporting them in gross quantities off the reservation. The Hanford waste-management plan is based on a careful consideration of numerous safety, economic, engineering, and other factors that affect waste management and the

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plan is considered to be entirely adequate.

As you know, this Division has for a number of years considered that deep-well injection of radioactive waste may hold promise for the disposal of certain types of waste, provided the subsurface geologic and hydrologic conditions are favorable at the site of the plant generating the wastes. It is quite obvious that an anomalously high fluid pressure in a potential disposal reservoir would be an unfavorable condition, but beyond this, the relative importance of fluid pressures to other factors, such as permeability, stability of the mineral assemblage in the presence of waste, salinity of the native water, etc., has not been completely determined.

In discussing your proposal, it was pointed out that during the past three years the research and development effort has been redirected from consideration of high activity wastes toward application of the method for low and intermediate activity wastes. Although this thinking has been evolutionary in nature and is in part a product of favorable developments in methods and techniques for converting high activity wastes to solid, relatively inert form in which they can be more safely and conveniently transported and stored, it has also developed as a result of the very definite and important limitations of deep-well disposal methods for high level wastes, e.g., 1) the high degree of pretreatment required, 2) the site-dependence, and 3) estimated costs.

This is not to say that the concept of deep-well injection of high activity wastes has been irrevocably discarded, but that low and intermediate-activity wastes are being explored. Because of their lower toxic content and generally simpler chemistry such wastes will require much less pre-injection treatment and are less likely to create problems in handling, injection, and formation plugging. They are, however, just as dependent on favorable subsurface conditions at the site. On the other hand, the requirement that the wastes are confined to that part of the disposal reservoir in the immediate vicinity of the injection well is much less strict in the case of low and intermediate-activity wastes so long as we are able to predict reliably the rate and direction of movement of hazardous radionuclides. Current research and work planned for the future is directed at improving these predictive techniques. Insofar as our current appraisal of the role of formation-fluid pressure distribution in deep-well injection of wastes is concerned: it is only one of many important factors to consider at any plant site where deep-well injection appears to offer a solution to a specific waste disposal problem and low pressure anomalies would not necessarily be required for low and intermediate level wastes.

Dr. William A. Colburn

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In summary, the proposal as containing, site and economic limitations, high level waste disposal system development. We therefore do not believe your proposal is warranted.

... have certain engineering... when compared with... advanced state of... support of your

We thank you and the Stearns-Roger Corporation for your interest in our program and for the effort that went into the preparation of your joint proposal.

Yours,

Robert K. Pittman, Director
Division of Reactor Development

cc. Stearns-Roger Corp.

bcc. Director, Division of Production
Attention: Mr. B. Schwartz

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RD:DM3:AC

Dr. William A. Colburn
Atomic Storage Company
1525 Josephine Street
Denver 6, Colorado

Dear Dr. Colburn:

This is in response to your letter of April 8, 1964, with the list of six questions, answers, and discussions your Company has prepared on the transportation and storage of atomic waste.

Your letter implies that the Stearns-Roger proposal may have been rejected because it was too brief, or lacked essential details that might have influenced our evaluation. My staff has assured me that the proposal and the Petroleum Research Corporation reports, augmented by the long discussion with you and Mr. Merlow of Stearns-Roger, and Mr. Schwartz of our Division of Production, provided a sufficiently detailed description of the concepts and plans for us to reach a firm decision not to support the proposal. There were no unresolved issues.

Although the proposal contained no information on cost of the work you wished to undertake nor did it locate the site for the proposed injection wells, these points would have been important only if the proposed work had warranted support.

As you may know, one of the AEC objectives in the long term storage and/or disposal of the highly radioactive wastes from its chemical processing operations is to provide a plan as economically as possible commensurate with the safety requirements for the long term. Any plan which we have examined for transporting large quantities of radioactive wastes off-site for disposal is so unattractive as to be completely unattractive. Our reluctance to support off-site operations for off-site disposal of radioactive wastes is strengthened by our general consensus that the sites where the AEC radioactive wastes now are being held in tank storage also can be suitable for long term storage provided certain precautionary measures are taken. This is true particularly of

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the Hanford site. Insofar as we have been able to ascertain, disposing of the Hanford radioactive wastes in Montana would be a great deal more expensive than taking the necessary precautions to safely contain these wastes at their present locations.

Several points brought out in the questions, answers, and discussion are erroneous, or indicate a lack of understanding of waste handling and treatment technology as well as of the Commission's policy on high-level waste management. We have reviewed the question-and-answer material and have the following comments:

1. Is there an economically feasible, safe, transportation system for atomic waste?

In the context of the Stearns-Roger proposal, this question refers to high-level liquid radioactive wastes. The cost of transporting high-level liquid wastes 300 miles or more would have to be added to the costs of present waste storage methods, because transportation, per se, would not eliminate the need for present treatment and storage. In fact, additional treatment would be required for several of the transportation methods proposed. This might be "feasible" in the sense of being possible, but it would not be economically competitive with existing and projected waste-management methods.

Because of the mobility of liquid wastes and their extremely high hazard potential, accidental release during transport could not be tolerated. The cost of any system for shipping the large volume of waste under consideration, which is designed to maintain its integrity under credible accident conditions, would be prohibitively high.

The matter of the feasibility of shipping solid containers of strontium and cesium on an ion-exchange medium through pipelines is not pertinent; strontium and cesium are separated from the wastes and stored for possible future use in small nuclear power devices and other radiation sources. Furthermore, the recovery of these useful fission products to the extent contemplated (95 to 99%) does not eliminate the waste problem. Several hundred years of storage will be required before the residual radioisotopes in the waste have decayed to an innocuous level.

2. Is the Montana site safe?

The proposed disposal reservoir (the Gut Bank sandstone, lying at a depth of 3300 to 5200 feet) may very well be an adequately safe reservoir for certain types of liquid waste. The safety of the "site" would depend on other factors as well, such as the local hydrology, geology, and seismology. A large part of Montana is more susceptible to severe

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earthquakes than the vicinity of the Hanford site. Facilities would have to be designed with this in mind.

The American Petroleum Institute study of deep-well injection of high-level radioactive wastes, conducted in 1950, did not consider long distance transportation. The work was based on the postulate that some future fuel-element reprocessing plant might be located where subsurface conditions would permit deep-well injection. As indicated in our previous discussions and correspondence, since 1953 the conversion of high-level wastes to solids has progressed to the point that deep-well disposal of these wastes is less attractive than it was in 1953.

3. Can the waste be efficiently injected into the storage formation?

The answer to this cannot be an unqualified "yes" based solely on the thickness and permeability of the injection formation. Efficiency of an injection well operation is determined by a comparison of injection pressures with the rate of buildup of formation pressure. It may be possible to inject fluids efficiently into the proposed disposal reservoir, but this has not been demonstrated.

4. Is pretreatment of the waste for injection prohibitively expensive?

Whether the cost of pretreatment is prohibitive depends in part on other operating costs. Treatment to effect in-tank solidification is totally incompatible with the pretreatment necessary to prevent plugging of an injection well. Preliminary estimates indicate that the cost of pre-injection treatment of high-activity, high-solids-content wastes would be relatively high.

It is not the case, as stated in your discussion, that radionuclides could be removed from the zeolite materials with treated formation water. Strong acid is required to elute the radionuclides. Furthermore, they would, of necessity, come off in highly concentrated form, and elaborate and expensive facilities would accordingly be required to handle the high levels of radioactivity involved.

5. Is it necessary for certain radionuclides to be saved for possible future use?

This question has no bearing on the Stearns-Roger proposal. The fission-product removal program does not create off-site safety problems, as your answer implies.

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6. Are the climate and ground conditions at Hanford reliable safety factors for waste that might inadvertently escape to the ground?

The inherent advantages of a relatively arid climate and relatively great depth to the water table have never been relied upon as the only barriers to movement of radioactivity that might be inadvertently discharged. Neither Hanford nor likely any other site provides "ideal" environmental conditions for the unconfined, long-term storage of liquid radioactive materials. Conditions like those at Hanford are certainly preferable, however, to those of humid climates and shallow water tables. The conditions at Hanford have been used advantageously for many years for the management and disposal of a wide variety of radioactive wastes without adverse effects.

In your discussion, you fail to consider the fact that Hanford plans to solidify their high level wastes by a combination of long lived radionuclide removal and subsequent adsorption on zeolites together with in-tank solidification of the resulting low heat content wastes. This program is described in detail in the booklet "Radioactive Waste Management" to which you refer several times in your discussion.

Utilization of the Hanford geologic subsurface for disposal of low level wastes has been accompanied by a detailed program of monitoring of waste movement both in and above the zone of ground-water saturation and by an intensive research program on the flow of aqueous solutions of radionuclides through porous media. Please be assured that we are not relying only on consistent weather conditions to protect public health for centuries to come.

If one compares the geohydrologic conditions at Hanford with conditions encountered by a pipeline from the north to northern Montana, the advantages of the Hanford site are readily be seen. The pipeline would have to cross major streams, pass through zones of higher rainfall, and cross through the seismically active belt extending all across western Montana.

In summary, after reviewing the original Stearns-Roger proposal and the material submitted with your letter of April 8, we have confirmed our judgment that the proposal does not warrant AEC support. As my staff pointed out to you last January, the long-distance transportation of gross quantities of radioactive liquid wastes, by any method, would

Dr. William A. Colburn

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entail unacceptable safety hazards not present on the Hanford reservation and would result in unjustified and unnecessary costs for waste management.

Sincerely yours,

Frank K. Pittman, Director
Division of Reactor Development

cc: Stearns-Roger Corp.
Attn: Mr. R. W. Ackleson
Mr. B. Schwartz, P, HQ
Joint Committee on Atomic Energy
Attn: Mr. J. Graham

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R E V I E W

TRANSPORTATION AND STORAGE OF ATOMIC WASTE

April 7, 1964

A review of the correspondence concerning the Atomic Storage Company's proposed methods for the transportation and storage of atomic waste indicates that a few critical issues are not yet resolved.

For convenience, a "question-answer-discussion" form of presentation of the Atomic Storage Company's interpretation of these issues was chosen.

It is respectfully submitted to the United States Atomic Energy Commission for further consideration.

ATOMIC STORAGE COMPANY


William A. Colburn, President

Question 1.

Is there an economically feasible, safe transportation system for atomic waste?

Answer 1.

Yes, but it should be evaluated further under the auspices of the USAEC to be sure that all factors have been considered.

Discussion 1.

This system entails propelling sealed containers through pipelines using conventional pipeline-industry techniques.

General Electric has developed a container (Figure 8, "Radioactive Waste Management") that is intended to store cesium, strontium, and certain rare-earth elements on synthetic zeolites for centuries.

The pipeline industry routinely propels solid devices called "pigs" through pipelines to clean the pipeline, to remove condensed material, and to separate different products which are being transported. For example, when jet fuel is to be followed by crude oil, a "pig" is placed between the two phases as a spacer.

It is proposed that the General Electric container be placed inside another steel cylinder (which actually comprises the body of the "pig") and that the "pig" then be propelled to the storage site through a buried, welded, steel pipeline. The emptied containers would be returned to Hanford through a parallel pipeline. The waste that is in transit will be enclosed by three, separate, high-integrity, steel containers — (1) the General Electric container, (2) the steel body of the "pig", and (3) the welded steel pipeline. Because the General Electric container is already designated as being independently safe for holding the waste for centuries, the other two steel containers are additional factors of safety.

The economic aspects of this transportation system will depend, to a great extent, upon the organization, operation, and purposes for the pipeline.

It is proposed that the pipeline be organized as a common carrier that is capable of carrying water, petroleum products, and other materials in addition to the atomic-waste-laden "pigs". It could be financed in a number of ways including low-interest government loans, quasi-municipal bonds, a public stock corporation, or a corporation formed by private entrepreneurs.

This method of transportation has been reviewed in detail by the engineering staff of a major pipeline company, and no major problems could be found. Special techniques will have to be used for some phases of the pipeline construction and the pumping stations, but all of these techniques are within the art of the trade.

Discussion 1: (Continued)

For simplicity, this discussion was limited to propelling "nugs" containing the General Electric cylinders through the pipelines but, of course, other containers and other radionuclides should be included in further investigations.

Question 2.

Is the Montana site safe?

Answer 2.

Yes. Waste that is placed in the storage formation cannot escape under any conditions including earthquakes.

Discussion 2.

Most of the possible problems associated with the deep-well disposal of atomic waste were evaluated by a very select committee of the American Petroleum Institute in 1958 for the USREC. The only unresolved problem was that of confinement. Fortunately, the injection of waste in low-pressure geologic formations completely resolves even the confinement problem.

Question 3.

Can the waste be efficiently injected into the storage formation?

Answer 3.

Yes, the storage formation is sufficiently thick and sufficiently permeable for efficient injection.

Question 4.

Is pretreatment of the waste for injection prohibitively expensive?

Answer 4.

The exact amount of pretreatment in addition to that already programmed for the Hanford Waste Management Program cannot be accurately determined without detailed knowledge of the Waste Management Program.

Discussion 4.

The Montana storage formation is a structurally competent sandstone so that only the filtration of solids is absolutely necessary.

Discussion 4. (Continued).

If the ion-exchange system is used for all waste which is transported, no plugging of the formation is possible because treated, storage-formation water will be used to remove the radionuclides from the zeolite materials.

Chemical precipitation deep in the reservoir possibly could result if raw waste is injected directly into the formation and if precautionary action is not taken. However, the science, technology, and art of disposing of undesirable fluids in deep wells by the petroleum industry are so well advanced that techniques for taking such precautionary action should be available from the petroleum industry.

Question 5.

Is it necessary for certain radionuclides to be saved for possible future use?

Answer 5.

From information available to the public, it appears that the projected supply of such nuclides from the civilian nuclear industry is greater than the projected need for the nuclides. Production of such nuclides from military applications would further assure an adequate supply. The critical decision is probably whether the ready availability of certain radionuclides outweighs the inherent danger of near-surface storage.

Question 6.

Are the climate and ground conditions at Hanford reliable safety factors for waste that might inadvertently escape to the ground?

Answer 6.

Perhaps not — especially for long periods of time.

Discussion 6.

Unfortunately, reputable geologists have honestly answered an unqualified "yes" to this question and, under ideal conditions, "yes" would be a correct answer. However, ideal conditions cannot be assured to exist or to remain for the centuries over which this waste is intended to be stored. Some of the "ideal" conditions which are required are:

- a) That the "dry" solid must be perfectly homogeneous and must not consist of layers of different pore sizes, permeabilities, porosities, or mineral content. Figure 2 of "Radioactive Waste Management" by GE suggests that this condition does not exist at Hanford.

Discussion 6. (Continued)

The detailed explanation of this requirement depends upon the combination of geologic, petroleum-reservoir-engineering, and soils-mechanics technologies. However, only a simplified discussion will be presented here. If the "dry" soil is composed of layers of coarse and fine soil, any fluid will percolate easily through the coarse material but will be held back to some extent by the finer sediments. Some well-known occurrences of "perched" water tables are examples of such phenomenon. Part of the fluid which is held back by the finer sediments will flow along the tops of the fine sediments in the direction of dip of the beds. Irregularities in the lateral extent, the direction of dip, and the pore-size distribution of the finer beds make monitoring of the flow along these bedding planes almost impossible. Furthermore, because the flow path is largely along bedding planes, only part of the fluid follows the distribution shown in Figure 3 of "Radioactive Waste Management." Moreover, the flow along the beds is often in a very thin layer so that the adsorption of the radioactive nuclides by the minerals may actually be so negligible that the waste may flow great distances almost intact. It would be almost impossible for anyone to positively assure that the flow paths for spilled or cribbed wastes are known if the soil is not completely homogeneous.

- b) That if, for the next few centuries, no single rainfall ever exceeds the average rainfall, then climatic conditions can be considered favorable. However, a surge or "slug" of water which would result from a single moderately heavy rain would, first, greatly amplify the effects described briefly in (a) above and, second, significantly modify and extend the distribution pictured in Figure 3 of "Radioactive Waste Management." The effects of such surges or "slugs" of water through "dry" sediments was studied in great detail by the Petroleum Research Corporation in connection with a secondary recovery method for oil. The results of these studies emphasized that consistent weather conditions cannot be depended upon to protect public health for centuries to come.
- c) That no earthquake activity takes place at or near Hanford. Of course, the intensity of the earthquake will determine what is meant by "near" Hanford.

Some areas can be designated as highly susceptible to earthquake activity, but no area can be guaranteed to be free from earthquake activity for centuries to come. If the Alaskan earthquakes could have been predicted, the grayed cities would not have been built at their present sites. Certainly, no such earthquakes were anticipated.

In the location of cities, calculated risks must be taken. However, when there is even a remote possibility that the Columbia River and the Japanese currents could be contaminated, not even calculated risks should be taken.



UNITED STATES
ATOMIC ENERGY COMMISSION
WASHINGTON 25, D. C.

April 13, 1960

MEMORANDUM FOR : CHAIRMAN MC CONE
COMMISSIONER FLOBERG
COMMISSIONER GRAHAM
COMMISSIONER WILLIAMS
COMMISSIONER WILSON

SUBJECT : BURIAL OF PACKAGED RADIOACTIVE WASTES

The attached report has been prepared by the staff in response to your request of March 17, 1960 for economic information on packaged radioactive waste disposal. The survey of AEC offices and licensees which was completed in the last three weeks revealed that licensees and AEC offices do not maintain cost records which can conveniently provide the information requested in your memorandum. Because of this fact, and because the type of waste, the size and type of containers used, the waste handling techniques and accounting procedures for disposal on land or at sea, vary over a considerable range, the cost comparisons presented can only be considered approximate. Although some of the cost information is approximate, it is felt that the conclusions drawn would not be altered upon receipt of more precise information.

In summary, the conclusions which can be drawn from the information presented in the attached report are:

1. The interim regional burial sites at Oak Ridge and Idaho can immediately begin receiving packaged waste from licensees. Charges of 70¢ per cubic foot of properly packaged waste with a minimum charge of \$21.00 for 30 cubic feet or less have been developed on the basis of our full cost recovery policy. An announcement, similar to Attachment D, will be made on the establishment of Oak Ridge and Idaho as interim regional burial sites.
2. The matter of the need for AEC to make land available for regional burial sites other than existing AEC sites should be re-examined after the AEC obtains, during operation of its interim disposal sites, additional experience and data for a more comprehensive study.

As a result of this review, it appears desirable to also re-examine the earlier conclusion (AEC 180/12) that waste disposal on privately-owned land should be prohibited. Under suitable

Forwarded by memo: 5-9-60

arrangements which would provide for the Government assuming responsibility when the private party could no longer do so, private disposal operations may be feasible. The problem will be the subject of discussion in a forthcoming paper on industrial chemical reprocessing.

The experience with licensees' waste shipments and the additional time for the more comprehensive study would enable AEC to obtain needed information in the following general areas:

- a. The volume of waste from licensees compared to that from AEC installations.
- b. The economics of a new regional burial ground from which specific conclusions can be drawn on an operating framework with maximum private participation - because of the low volume of waste generated by licensees, a new regional burial site requires waste from AEC installations before it would be an attractive commercial proposition unless the disposal activity would be an adjunct to an existing operation.
- c. State interest in the establishment of waste disposal sites.
- d. The burial of licensee radioactive wastes by the private processor of irradiated fuel.

The decision to re-examine AEC's participation in new regional burial sites should not hamper the development of the nuclear industry because:

- a. Adequate AEC burial land is available to handle all low-level wastes generated in the U. S. during the period 1960-1965.
 - b. The cost of transportation, rail or motor, is not significantly high for shipments not requiring heavy protective shielding and the continuation of Oak Ridge or Idaho as interim disposal sites for an extended period, up to five years, should not be a serious economic burden to licensees as long as suitable land burial areas are set aside.
3. Land burial of low-level radioactive waste, requiring no protective shielding, is generally more attractive economically than sea disposal. The commercial cost of sea disposal (excluding concrete packaging) for drums of waste under a contract LRL has with

Coastwise Marine is approximately \$11.00 per 55-gallon concreted drum (equivalent to \$22.00 to \$33.00 per 55-gallon drum of waste prior to concreting depending on type of waste being packaged in concrete for sea disposal). The Army Chemical Center total concrete packaging and sea disposal costs are expected to be approximately \$29.80 per drum of waste. The quoted sea disposal commercial price to the military for waste delivered f.o.b. Company's facility is \$48.75 per 55-gallon drum (includes cost of concrete packaging and other sea disposal costs by the Company). The Air Force, through negotiations obtained a reduced price of \$41.75 per drum. These unit costs are higher than the AEC land burying charge of \$5.15 per drum of waste for quantities of four drums or more. When transportation and shipper handling costs are included, the total cost of sea disposal is again found to be generally higher than total land burial costs for licensees included in the survey. A similar conclusion is reached for off-site shipments of packaged waste by AEC contractors. However, selection of sea disposal over land disposal could still be made in isolated cases such as:

- a. Companies that own ships could continue to find sea disposal convenient and economically attractive.
 - b. The military use of transportation and sea training programs to off-set some of the costs of disposal places sea disposal on a more competitive basis in the military establishment.
 - c. The small waste generator, e. g., New England Deaconess Hospital, located near the seacoast may continue to pay a premium for a convenient disposal service by their own choice.
4. With respect to shielded containers, the cost contribution of transportation becomes significant. Therefore, Brookhaven and LRL may still find sea disposal more economical than land burial for some of its waste. Up to now, the volume of waste from licensees requiring heavy protective shielding is small.
 5. It should be noted that this paper does not deal with the problem of liquid wastes, particularly in bulk quantities, which are logical candidates for direct dumping at sea without packaging or without solidifying as would be required for land burial.

6. Although Federal, State and Local regulatory or reporting requirements are burdensome, they should not unduly affect the free movement of waste. The one possible future problem area is the proposed action by the railroads to remove irradiated material requiring heavy protective shielding from common carrier status. The railroads have asserted a right to refuse to transport such material for licensees if they are not satisfied with public liability coverage for such shipments.

Since the disposal of low-level solid wastes is more in line with the responsibility of an operating division, I have assigned to the Division of Production the responsibility to coordinate and supervise the operational phase of providing to licensees waste disposal services at AEC sites and to further study the need for AEC to establish additional regional disposal sites. Subsequent reports will be submitted to the Commission on the progress of the program.

A. R. Lindick

General Manager

Enclosures:

Report w/Tables & attachments

BURIAL AND DISPOSAL OF LOW-LEVEL RADIOACTIVE WASTES

This report is limited to low-level solid waste properly packaged for land burial or sea disposal. Such waste includes properly packaged liquid wastes but disposal of bulk liquid wastes is not included. The waste disposed of by licensees usually contains minor quantities of radioactivity. This is illustrated in Table I which summarizes the quantity of radioactive waste now stored by licensees for disposal at sea. The waste does include some AEC generated material. In comparison, AEC operating sites bury and dispose of at sea significant quantities of activity. The radiation level of some equipment buried at Hanford during 1958-1959 is illustrated in Table II.

This report will provide information on the items noted in the Chairman's March 17, 1960 memorandum.

A. AEC CHARGES FOR BURIAL OF WASTE AT OAK RIDGE AND IDAHO

The Oak Ridge and Idaho Operations Offices have each submitted detailed breakdowns on the cost of burying low-level wastes at their respective sites based on the AEC policy of full cost recovery. Procedures for burial of wastes have also been developed for each of the sites. A copy of the Oak Ridge shipment data form is attached (Attachment A) to illustrate the type of data required on each shipment. The proposed unit charge for burial at each of the two sites is 70¢ per cubic foot for properly packaged waste, with a minimum charge of \$21.00 for shipments of 30 cubic feet or less. This is essentially equal to the charges previously used by Oak Ridge. The assumptions which were used in preparing the cost at the two sites are included as Attachment B and the cost elements used to derive the AEC charges are presented in Attachment C.

A public announcement (Attachment D) will be simultaneously released by Washington, Oak Ridge and Idaho after the Commission has reviewed this report.

B. COMPARISON OF LAND BURIAL AND SEA DISPOSAL

I. Licensees

The cost of waste disposal to the licensee was obtained by contacting a number of selected licensees. The licensees were selected so as to include both sea and land disposal operations. Because of the various disposal arrangements which are available and because of the different types of wastes being generated, a wide unit cost range was reported by the licensees. The unit cost breakdown supplied by the licensees was not always complete since the records maintained by licensees were not of the type

which could supply the details on short notice. It is evident from a comparison of Tables III and IV that, in general, the total cost of sea disposal (\$10.00 to \$40.00 per drum) is higher than total cost of land burial (\$10.00 to \$25.00 per drum) for a given quantity of waste. Some anomalies are noted in the Tables, viz., a \$4.00 unit charge for sea disposal and a \$62.00 unit charge for land burial. These are not considered representative in light of price information received from AEC contractors and the military. Companies that use their own ships for disposal could find sea disposal convenient and economically attractive. With respect to an organization such as New England Deaconess Hospital, factors other than economics appear to contribute to the selection of sea disposal over land burial.

2. AEC Contractors

Based on operating information from several AEC installations disposing of solid or packaged radioactive wastes off-site, by either land burial or disposal at sea, the following conclusions are drawn:

- a. For wastes not requiring shielding (estimated at greater than 90% of total volume of all waste shipped off-site for disposal), approximately 1.5 to 3 times as much waste (volumetrically) goes into a typical 55-gallon drum package destined for land burial than in a similar package destined for disposal at sea due to the extra concrete required for weighting purposes in the latter packages.
- b. On a cost per 55-gallon drum basis, the total cost for land burial (includes packaging, shipping and burying) ranges from \$9.00 to \$18.84 and for disposal at sea comparable total costs range from \$23.31 to \$69.00 (See Table V).
- c. For disposal by land burial the distribution of unit cost (i. e., \$9.00 to \$18.84) is roughly as follows:
 - 1) Packaging 55 to 67%
 - 2) Shipping 10 to 37% - depending on distance and mode of transportation
 - 3) Disposal 8 to 26%
- d. For disposal at sea the analogous distribution of unit cost (i. e., \$23.31 to \$69.00) is:
 - 1) Packaging 28 to 45%
 - 2) Shipping 5 to 10%
 - 3) Disposal 45 to 66%

e. Cost savings possible by shifting to land burial from sea disposal are indicated by the following examples:

1. In 1959 Bettis shipped 2148 drums of generated waste to Earle, New Jersey, each weighing 900 pounds average and containing about 3 mc/drum. Cost per drum was \$65.95 with \$41.40 or about 63% being the cost for dockside handling and sea transport and disposal. The total cost was \$141,500. If land burial (at ORNL) were utilized, it is estimated that 1075 drums would have been required each weighing 300 pounds and containing about 6 mc/drum. No concreting would be necessary. The estimated cost per drum would be about \$20 with about 1/4 of this cost being disposal cost at the burial ground. The total cost would have been \$21,500 or a savings of \$120,000. For wastes requiring shielding (318 drums from Bettis in 1959), the savings would have been due only to the difference in final disposal costs, i. e., \$41.40/drum for sea disposal out of Earle, New Jersey, versus about \$12.00/drum for land burial. Thus the savings for wastes requiring shielding would have been about \$6175. A similar operation near the New Jersey Coast would increase the total land burial costs by approximately \$25 to \$33 per drum for transportation depending on final drum weight.
2. The LRL, because of shielding requirements for its waste, has determined that no economic advantage is apparent at this time to force a shift from sea disposal to land burial for its waste. With present packaging methods, current estimates show an annual savings of approximately \$60,000 over land burial at Hanford or Idaho. A contract with a private concern for sea disposal of waste included a unit price of \$11.00 per 55-gallon drum of concreted waste.

Since the waste volume per drum would be reduced by one-half or one-third when the waste is prepared for sea disposal, the sea disposal unit cost component to compete with land burying only would be \$21.00 to \$33.00 per drum of waste. The packaging of waste in concrete was done by LRL and the costs are not included.

3. Military

The Army Chemical Center, Edgewood, Maryland, is responsible for sea disposal of radioactive material for the Department of Army. The current disposal rate is about 60-55 gallon drums of waste per month. The contaminated waste covers a wide variety of

materials such as tubes, radium dials, low level reactor wastes, laboratory waste and equipment, etc. The waste has been packaged according to U. S. Navy density specification of 100# per cu. ft. for concreted drums. According to Army experience, the volume increase from unconcreted waste to concreted waste is approximately 50 to 200 percent. The current annual volume of waste being generated within the Department of Army is equivalent to one-tenth of an acre of land burial. The waste volume from the Department of Army is expected to double over the next few years. The other two services have about the same volume of waste being prepared for disposal. The cost of packaging the waste for sea disposal is about \$21.60 per drum of waste. The transportation and sea disposal operations were performed as part of training programs and no charge had been made. The Navy has discontinued the disposal service and future sea disposal service is expected to be provided by the Military Sea Transport Service at about \$10.00 per drum of concreted waste. MSTS has submitted a license application for the sea disposal operation.

The Departments of Army and Air Force received bids from commercial sea disposal companies ranging from \$41.75 to \$48.75 per 55-gallon drum of waste. The Army Chemical Center is now studying the economics of land burial versus sea disposal.

C. TRANSPORTATION OF LOW-LEVEL RADIOACTIVE WASTES

1. Federal, State and Local Regulations on Transportation of Low-level Wastes

It is concluded from a review of the regulatory requirements (Attachment E), that the Federal, State and Local regulations on transportation of low-level radioactive materials do impose operating and procedural conditions which are burdensome to some degree, compared with shipments of non-radioactive, non-hazardous materials, but that they should not unduly impede the free flow of low-level waste shipments nor would they significantly increase the total cost of shipment provided that ICC would continue to allow exemptions as in the past. It is also concluded that securing transportation services should not present a problem at this time and low-level waste packaged in accordance with Interstate Commerce Commission regulations should move freely in commerce.

Increased interest by local authorities in the transportation of radioactive material through their jurisdictional districts has come to our attention. For example, the shipper must now furnish the New York City Department of Health certain advance shipping information. This procedure is virtually unique in that usually the carrier would be required to handle such notifications.

The increased cost to AEC, if the AEC chooses not to use the exemptions provided in the ICC regulations, are indicated by the following examples:

- a) In 1959 GE-ANPD, Evendale, shipped 150 packages to the Oak Ridge National Laboratory under an ICC exemption, i. e., with an escort, at a total cost of \$3500. If ICC requirements were to be met on a non-exempt basis, this cost would have been about \$40,000.
- b) In 1959 KAPL shipped to ORNL 1300 cu. ft. (out of total of about 30,000 cu. ft.) by utilizing the box car as the package, i. e., the wastes not requiring shielding acting as shielding for the material having a high radiation level, at a cost of \$26,000. If each package had to comply with ICC regulations, this cost would have been approximately \$143,000.
- c) Brookhaven National Laboratory estimates that approximately twice as many packages would be required and that this would result in about a 30% cost increase (about \$40,000 in 1959-1960).
- d) Argonne National Laboratory shipments to ORNL have met ICC requirements. This has been accomplished through use of a decay storage facility at ANL.

2. Shipping Costs

Government shipments of low-level waste, by motor or rail carriers, may be made under rates published in (1) carrier tariffs, or (2) carrier quotations by authority of Section 22 of the Interstate Commerce Act as a matter of expediency or economy in lieu of publication in carrier tariffs. Section 22 rates are not available for use by private shippers.

Private common carrier shipments must be made under published rates in tariffs filed by the carriers with the Interstate Commerce Commission. The basic levels of the rates contained in these tariffs are prescribed for use by all shippers, including the Government. Adjustments to these rates may be negotiated through established carrier procedures.

The direct transportation charges (exclusive of any packing, local drayage or local costs) are based on a percentage of the Class 100 rates in published tariffs between point of origin and destination. Table VI is a schedule of freight classification ratings as a percentage of Class 100 rates for representative materials currently being shipped as waste. Table VII is a table of approximate Class 100 rates from representative points generating low-level waste to burial areas. For estimating purposes, this scale of rates may be used for rail and motor freight transportation. For example, the

Class 100 freight cost from Los Angeles to San Francisco is \$2.56 per 100 pounds. Shipments of scrap iron would move at 50% of this rate for LCL shipments and 22.5% of this rate for CL shipments.

From Table VII it is seen that there is a large difference in freight cost between Oak Ridge and Idaho for the various points generating waste east of the Mississippi River and a small difference in freight costs between Oak Ridge and Boston (a possible sea disposal point) for the same eastern cities. If the waste is not packaged for sea disposal until arrival at the port, the cost of shipping waste from the eastern cities to either Oak Ridge or Boston is considered not to significantly affect the choice in method of disposal. With respect to the west coast, the cost of transporting waste to Idaho for land burial may have an appreciable effect on the choice of disposal method. Of particular note is that shipping costs play a more important role in the selection of the disposal method if the waste were to require shielding.

A proposed change in a rail Uniform Freight Classification might be interpreted as a future transportation service problem for sea disposal and private land burial operations. The railroads have asserted a right to remove from common carrier status, radioactive materials, irradiated or requiring shielding. This would allow a railroad to refuse shipments if it is not satisfied with the liability coverage. Informal discussions with top-level railroad officials lead us to believe that this rule is intended to apply only on highly irradiated material which would, therefore, remove low-level wastes from its application. Even if the proposed change is applied to low-level waste, it should generally not affect the transportation of low-level waste from a licensee (without Price-Anderson coverage) to Oak Ridge or Idaho or to another licensee having Price-Anderson coverage.

D. PROJECTION OF MAXIMUM LAND BURIAL ACREAGE USAGE

The estimated quantities of low-level waste for which disposal areas must be provided through the next five years from all U. S. operations are presented in Table VIII. A total land usage would be in the order of 22 acres per year. On the basis of AEC experience, a land burial projection of 3/5 of an acre per year was included in the above total for licensee waste. As noted in Table VIII, the land acreage used by licensees could be an additional 1/2 acre per year for the period 1960-1965 and the military waste, now disposed at sea, could add an additional 1/2 acre per year. Even with these additional increases in the volume of waste from non-AEC organizations, a Northeast Regional

burial site would be dependent on AEC for its main source of revenue. Table IX presents 1960-1965 estimates of waste volumes as packaged for disposal by AEC installations shipping off-site.

No difficulty is foreseen in continuing to bury all of U. S. waste at existing AEC land burial sites.

E. OTHER ECONOMIC CONSIDERATIONS

From the projection of waste volume expected from licensees and the effect of transportation on cost of burial, establishment of regional burial grounds, other than existing AEC sites, may not be immediately required if the AEC is willing to provide such services at ORNL and NRTS. Since the AEC will provide this service, AEC participation in the establishment of other regional burial grounds could be re-examined during the operation of the AEC interim sites. The experience obtained by the AEC should provide better information on the waste load distribution and the detailed economics of land burial. The cost of waste disposal for solid package wastes is not a major cost item for industry and a delay in the location of a more convenient regional burial ground is not considered to be serious as long as facilities for handling such waste material are made available. The main interest, at this time, is to have suitable areas set aside to handle the waste being accumulated. This interest has been satisfied at least on an interim basis with the announcement of Oak Ridge and Idaho as interim burial sites.

Enclosures:

Tables I thru IX

Attachments A, B, C. & D & E

Attachment A

X-1007 (Rev. 3-60)

To: Oak Ridge National Laboratory
Laboratory Facilities Department
P. O. Box X
Oak Ridge, Tennessee

WASTE SHIPMENT DATA

Please fill in all blank spaces. If a question does not apply to a particular shipment, or if the answer is not known, it must be so stated.

Name of organization requesting disposal service _____
Date _____

Name of person responsible for initiating this request _____

Purchase Order No. _____

Number of packages in proposed shipment _____ Total weight of shipment _____

Complete description of contents and packaging methods used. Attach extra sheets and drawings if necessary. If information given is inadequate for appraisal of safety of shipment, more information may be requested before approval is given.

Highest radiation levels at outside surface of packages _____

Chemical form of material comprising bulk of waste _____

Does waste contain corrosive acids or bases? _____

If so, what strength? _____

Is any portion of the contents potentially explosive? _____

Will any portion of the contents react violently when exposed to air or water? _____

Radioisotopes contained _____

Estimated quantity in curies _____

Note any special precaution that may be necessary because of material content _____

GENERAL

Other information that may be useful in reducing shipping and handling hazards

Means of transportation proposed _____

Approximate date shipment to be made _____

Signature _____

(Over)

**REGULATIONS AND PROCEDURES GOVERNING SHIPMENTS
OF RADIOACTIVE WASTE FOR DISPOSAL AT
OAK RIDGE NATIONAL LABORATORY**

1. All shipments of radioactive waste, to be acceptable to Oak Ridge National Laboratory, must conform to the ICC Regulations governing such shipments as outlined in Agent M. A. Campbell's Tariff No. 10. Copies of these regulations may be obtained from Mr. M. A. Campbell, Bureau of Explosives, 63 Vesey St., New York 7, N. Y. Administration and interpretation of the regulations is the responsibility of this organization.
2. In general, liquid wastes will not be accepted for disposal. Liquids should be incorporated in concrete, plaster or other similar material and shipped in solid form. In cases where this procedure is not practical, special arrangements must be made with Oak Ridge National Laboratory.
3. Approval in writing must be obtained from Oak Ridge National Laboratory before a shipment is made. The Laboratory will consider giving an approval only after it receives a purchase order and a description of the proposed waste shipment (the form on the reverse side of this sheet completely filled out).
4. Charges for disposal service are based on the gross weight of a shipment at _____. The minimum charge per shipment is _____.
5. In addition to the labels prescribed by the ICC Regulations, "Radioactive Waste" labels must be affixed to the outside of the containers. The Laboratory will furnish all labels with the approval for shipment.
6. All shipments must be prepaid and consigned to Oak Ridge National Laboratory, Laboratory Facilities Department, Oak Ridge, Tennessee.

ATTACHMENT B

PARAMETERS CONCERNING COST STUDIES ON LONG-TERM DISPOSAL

(Assumption - No crisis of major magnitude - no leakage into potable water, etc.)

A. Costs Shall Include:

1. Site Development:

- a. Hydro-geologic surveys
- b. R. R. Spur
- c. Truck access roads
- d. Cost of land - Burial section itself and a reasonable buffer zone about burial area based on specific site characteristics should be used.
- e. Cost of operations building as required during active period.
- f. Caretaker building for full period of storage.
- g. Fence about exclusion area to be replaced as required for full period of storage.

2. Cost of Operation During Active Burial Period (Per AEC Manual Chapter 1701).

3. Monitoring Costs. (Full Cost Recovery)

- a. Wells - number, depth and life as appropriate for the site.
- b. Samples
 - (1) One sample per well per month for full period of life
 - (2) Ecologic samples (equal to "3.b.(1)")
 - (3) Samples may be assumed taken by "caretaker" but analysed by commercial analytical laboratories.

4. Activities After Burial Area is Filled Up. (Full Cost Recovery)

- a. Full pay caretaker. One shift coverage. "4.b." may be support after initial establishment.
- b. Period of caretaker guardianship may be based on the following conservative assumptions.
 - (1) a 55-gal. drum containing 1 curie of waste
 - (2) Waste is Sr^{90}
 - (3) Guardianship exercised until SR^{90} equals allowable for 168 hr. week in drinking water, i. e., 1×10^{-6} micro curies/cs
 - (4) Note - based on some preliminary calculations, it is believed that costs are not affected by length of storage when storage exceeds 200 years.

B. Basis of Charging:

1. Shall be on ft. ³ basis.
2. Each user shall pay for ft. ³ used after total usable ft. ³ of area has been divided into the gross cost calculation.
3. Customer shall provide packages to meet standards for burying as specified by burial site.
4. Weight limits may be specified.
 - a. A surcharge scale for various weights may be in order.
5. Long-term costs are to be paid for by assuming a 4% annuity.
6. Inflation will be assumed as an independent element at 1 1/8% per year.

ATTACHMENT "C"

DERIVATION OF PROPOSED BURIAL CHARGES

| FUNDS REQUIRED TO BE SUPPLIED
DURING 20 YEAR OPERATING PERIOD | | |
|--|-------------------------|-------|
| Idaho ^{1/} | Oak Ridge ^{1/} | Total |

| | | | |
|---|--------------|--------------|--------------|
| Site and Development (Including $\frac{1}{2}$ % interest
on unamortized balance) | \$ 817,240 | \$ 589,880 | \$ 1,407,120 |
| Cost of operations (during burial period)
(Including 15% added factor and inflation
factor) | 2,027,287 | 2,078,148 | 4,105,435 |
| Custodial period costs (after burial ground
area is filled) (Including 15% added factor
and inflation factor) | | | |
| Fences | 9,000 | 21,700 | 30,700 |
| Wells | 38,540 | 8,320 | 46,860 |
| Water samples, caretaker, building
maintenance, etc. | 234,664 | 320,320 | 554,984 |
| TOTAL | \$ 3,126,731 | \$ 3,018,368 | \$ 6,145,099 |

Estimated volume of waste material to be buried in 80 acres (cu.ft.)
5,400,000 3,920,000 9,320,000

Cost per unit $6,145,099 - 9,320,000 = \0.659 per cu. ft.

Recommended minimum charge: \$21.00 for 30 cu. ft. or less.

Recommended price: Round \$0.659 to \$0.70 per cu. ft.

^{1/} Costs are based on figures supplied by Idaho and Oak Ridge Operations
Offices in accordance with attachment "B".

ATTACHMENT D

UNITED STATES
ATOMIC ENERGY COMMISSION
Washington 25, D. C.

Tel. Hazelwood 7-7831
Ext. 3446

FOR IMMEDIATE RELEASE

AEC ESTABLISHES CHARGES FOR LAND BURIAL
OF PACKAGED RADIOACTIVE WASTES AT OAK
RIDGE AND IDAHO

As announced by the Commission on January 28, 1960, the AEC will receive at interim disposal sites now designated as the Oak Ridge National Laboratory and the National Reactor Testing Station, packaged wastes from non-Commission users of radioactive materials. It was also announced that charges and procedures for receiving such wastes at these two sites were being developed. These sites are now ready to receive material from all users of radioactive material. The charges are 70¢ per cubic foot for properly packaged waste with a minimum charge of \$21.00 for shipments of 30 cubic feet or less. Requests for information regarding burial of wastes should be directed to the following:

At Oak Ridge -

Oak Ridge National Laboratory
P. O. Box F, Oak Ridge, Tennessee
Attention: Mr. E. J. Witkowski

At Idaho -

Phillips Petroleum Company
P. O. Box 2067, Idaho Falls, Idaho
Attention: Controller Branch

ATTACHMENT E

TRANSPORTATION OF LOW-LEVEL RADIOACTIVE WASTES

REGULATORY REQUIREMENTS

There are certain operational and procedural restrictions against the shipment of radioactive materials which have been promulgated by Federal, State and Local governmental authorities and are motivated by a desire to insure public health and safety. These limitations parallel and are consistent with similar restrictions placed on the movement of explosives, flammables and other dangerous articles.

1. Federal Regulatory Requirements - A basic prerequisite to shipment of radioactive materials is that they must be shipped in accordance with the requirements of the transportation regulatory agencies, such as the I.C.C., F.A.A. and the U. S. Coast Guard. Shipments of radioactive materials, made by the AEC or under its direction or supervision, which are escorted by personnel specially designated by the AEC, are exempt from the I.C.C. regulations. In addition, certain AEC shipments exceeding the regulatory standards are made without escorts through the issuance of special permits obtained from the B. of E. (i.e. container approval and deviations from published curie limitations) or the I.C.C. on other matters. In the course of normal industrial shipping procedures, compliance is the responsibility both of the purchaser of the transportation service and the carrier, and exemptions to the regulatory standards, similar to Government exemptions, may be made through the use of special permits.
2. State Regulatory Requirements - A number of states have regulations on marking and packaging of radioactive material, similar to I.C.C. regulations. In addition, a few states (e.g., New York) have proposed that prior notification be given of shipments of radioactive material.
3. Local Regulatory Requirements - Indicative of such requirements are prohibitions against transporting dangerous articles through, over and on strategic tunnels, bridges and car ferries, and the New York Port Authority prohibitions against transporting dangerous articles through the Holland and Lincoln Tunnels, the New York Bridge Authority requirement for prior notification of arrival at a transport vehicle carrying dangerous articles, the Pennsylvania Turnpike Authority restriction against transporting dangerous articles over the turnpike without prior permit, and the notification of shipment procedures required by the New York City Department of Health. Regulation by the New York City Department of Health, and possibly other localities, creates a slightly different problem in that the burden of notification is on the shipper rather than the carrier. However, since the potential destinations are

limited in number, the individual shipper no doubt in the initial planning stages of the shipment can ascertain these areas of local regulations and, in conjunction with advice from the carrier industry, bypass these areas. On the other hand, prior knowledge of such areas affords the opportunity of negotiating a workable operating procedure to facilitate notification to and passage through these localities.

While these operating and procedural conditions are burdensome to some degree, they should not unduly impede the free flow of low-level waste shipments, nor should they significantly increase the total cost of shipment.

TABLE I
COMMERCIAL SEA WASTE DISPOSAL ACTIVITIES
THROUGH MARCH 1960

| Licensee | Sea Disposal to Date | | On Hand for Sea Disposal | | | |
|---|----------------------|--|--------------------------|----------|---------------------------------|---------------------|
| | Equivalent <u>2/</u> | Total | Concreted | | Not Concreted <u>1/</u> | |
| | Activity | Activity | Equivalent <u>2/</u> | Activity | Equivalent <u>2/</u> | Activity |
| | Drums | Curies | Drums | Curies | Drums | Curies |
| New England Tank Clean.
Company - Boston, Mass. | -- | -- | 17 | 0.027 | 4 | 10(H ³) |
| American Mail Line
Seattle, Washington | 54 | 0.68 | 16 | 0.1 | -- | -- |
| Isotope Specialists, Div.
of Nuclear Corp. of Amer.
Burbank, Calif. | | | 130 | 17 | 1,100 | 39 |
| Crossroads Marine <u>3/</u>
Boston, Mass. | 1,000 | 2,438 (incl.
1,900 H ³) | 12 | 6 | 116 | 175 |
| Coastwise Marine Disposal
Co. - Long Beach, Calif. | 2,247 | 9 | 495 | 1 | 370 | 1 |
| American Electron., Inc. <u>4/</u>
Culver City, Calif. | 14 | 0.065 | -- | -- | -- | -- |
| Nuclear Engrg. Company -
Kearny, N.J. & Walnut Creek
California | 320 | 101 | 4,025 | 278 | 3,494 (solid)
1,120 (liquid) | 266 |

- 1/ Each unconcreted drum makes 1.5 to 3 concreted drums depending on the type of waste being handled.
- 2/ Since the bulk of the drums are 55 gal. drums, the total volume of waste was expressed in equivalent 55 gal. drums. This standard unit is used to conveniently illustrate the volume of waste being handled.
- 3/ Crossroads Marine disposal records from 1946 through 1958 were partially destroyed by fire. The above represents an estimate made by the president of the company. This figure was reported at JCAE Hearing on waste disposal in July 1959.
- 4/ This firm's license expired on Jan. 31, 1959, and was not renewed.

TABLE II

Contamination Readings on Some Equipment Buried at Hanford
During 1958 - 1959

| <u>Equipment</u> | <u>Material of Const.</u> | <u>Dimensions</u>
<u>dia. length</u> | <u>Average Readings</u> |
|---|---------------------------|---|--|
| 1. 2 - Redox Vessels | Stainless Steel | 8' x 9' | 450-700 mr/hr at 60"
through concrete box |
| 2. 2 - Purax pulse columns | Stainless Steel | 24' x 33' | 3000 mr/hr at 2' |
| 3. 4 - Redox Heat Exchanger
Tube Bundles | Stainless Steel | 3' x 10' | 600 mr/hr at 50"
through concrete box |
| 4. 6 - Purax Waste Concentrator | Stainless Steel | 4' x 15' | 300 mr/hr at 200 ft. |

TABLE III

Land Disposal Costs of five Selected Licensees
(July to December 1959)

| Licensee | Disposal Site | Current Cost per Drum of Waste ^{1/} | | | | No. and
Type container |
|---|---------------|--|------------------|--------------------|--------------|---------------------------|
| | | <u>Transpt.</u> | <u>Packaging</u> | <u>Disposal</u> | <u>Total</u> | |
| Tracerlab Co.
Boston, Mass. | ORNL | 2.30 | 5.00 | 2.50 ^{1/} | 10.00 | 30 each 35 gal. drums |
| General Motors
Detroit, Mich. | ORNL | 7.00 | 40.00 | 15.00 | 62.00 | 30 each 55 gal. drums |
| Purdue University
Lafayette, Indiana | ORNL | 12.00 | 4.00 | 5.00 ^{1/} | 21.00 | 9 each 55 gal. drums |
| Abbott Laboratories
Oak Ridge, Tennessee | ORNL | - | - | - | 15.00 | 24 each 50 gal. drums |
| Squibb Pharmaceutical
New Brunswick, N. J. | ORNL | - | - | - | 25.00 | 30 five gallon cans |

^{1/} The above charges are attributed to the combining of wastes with others collected by private waste collectors for ultimate disposal at ORNL. Current charges for disposal are based on approximately \$.64 per cubic ft. The minimum charge per shipment is \$15.00.

TABLE IV

Sea Disposal Costs of Five Selected Licensees

(July to December 1959)

| Licensee | Disposal Site | Cost per Drum of Waste | | | | No. and type of Container |
|---|--|------------------------|-----------|----------|--------|---|
| | | Transpt. | Packaging | Disposal | Total | |
| Shell Development
Emeryville, California | Nuclear Engineering
Walnut Creek, Calif.
(Pacific Ocean) | - | \$2.00 | \$2.00 | \$4.00 | 2- 5 gal. cans
1-20 gal. Fiber
board bbl. |
| New England Desconess
Boston, Mass. | Crossroads Marine
Boston, Mass. | - | - | - | 40.00 | 1-30 gal. can |
| Tracerlab
Boston, Mass. | Crossroads Marine
Boston, Mass. | 0 | 5.00 | 28.00 | 33.00 | 4-35 gal. bbls. |
| Socoxy Mobile Oil
Paulsboro, N. J. | Atlantic
(via own ship) | - | - | - | 38.00 | 1-20 gal. bbl. |
| California Research Corp.
Richmond, California | Pacific
(via own ship) | - | - | - | 10.00 | 5-50 gal. drums |

TABLE V

PACKAGED WASTE DISPOSAL COSTS

| | | COST DISTRIBUTION | | | | |
|---------------------|-------------------|------------------------------------|------------------|-----------------|-----------------|--------------------------|
| | | <u>Total
Cost Per
Drum</u> | <u>Packaging</u> | <u>Shipping</u> | <u>Disposal</u> | <u>Disposal
Site</u> |
| <u>Land Burial</u> | | | | | | |
| ANL | | \$ 18.84 | \$ 11.30 | \$ 3.77 | \$ 3.77 | ORNL |
| GEANPD | | 12.00 | 7.80 | 1.08 | 3.12 | ORNL |
| KAPL | | 9.00 | 6.03 | 1.53 | 1.44 | ORNL |
| R. F. | | 10.90 | 6.00 | 4.03 | .87 | NETS |
| <u>Sea Disposal</u> | | | | | | |
| BNL | - AEC Cost | 20.15 | 17.33 | 2.82 | 0 | |
| | - AEC & Navy Cost | 60.15* | 17.44 | 3.01 | 39.70 | |
| FWR | - AEC Cost | 29.00 | 24.07 | 4.93 | 0 | |
| | - AEC & Navy Cost | 69.00* | 19.32 | 4.83 | 44.85 | |
| WAPD | - AEC Cost | 24.55 | 20.38 | 4.17 | 0 | |
| | - AEC & Navy Cost | 64.55* | 25.18 | 5.16 | 34.21 | |
| AI | - AEC Cost | 14.35 | 9.61 | 2.44 | 2.30 | |
| | - AEC & Navy Cost | 54.35* | 19.57 | | 34.78 | |
| LRL | - AEC Cost | 23.31 | 10.49 | | 12.82 | |

* Navy costs assumed to be \$40 per drum - charge not currently being made but AEC has received indication that U.S.N. will begin to charge for the service; sea disposal monitoring costs are excluded.

TABLE VI
SCHEDULE OF FREIGHT CLASSIFICATION RATINGS

| <u>RAIL*</u> | <u>Ratings</u>
<u>(% of class 100)</u> | |
|---|---|------------|
| | <u>LCL</u> | <u>CL</u> |
| Aluminum Scrap, NOIBN | 55 | 27½ |
| Cullett..... | 50 | 20 |
| Clothing, old..... | 85 | 27½
22½ |
| Paper Waste, Not Sensitized..... | 85 | 27½
22½ |
| Rubber Scrap, NOIBN..... | 50 | 27½ |
| Iron Scrap, NOIBN..... | 50 | 22½ |
| Lead Scrap, NOIBN..... | 55 | 27½ |
| Leather Scrap, NOIBN..... | 60 | 27½ |
| Pottery, Broken | 55 | 22½ |
| Scrap Brass, Bronze, Copper, NOIBN..... | 55 | 27½ |
| Rags, NOIBN..... | 85 | 27½
22½ |
| Shoes, Old, Worn Out, Leather..... | 70 | 35 |
| <u>MOTOR</u> | | |
| Radioactive Materials, Including Radioisotopes,
in shipping containers specified in Rule 5½
(Rule 5½ refers to the ICC Regulations regard-
ing shipment of dangerous articles) | 70 | 35 |

* No distinction being made by railway between low level radioactive waste properly packaged and non-radioactive scrap.

TABLE VII

TABLE OF APPROXIMATED CLASS 100 RATES
FROM REPRESENTATIVE POINTS
GENERATING LOW-LEVEL WASTES TO
DISPOSAL SITES

| FROM: | TO: Oak Ridge,
Tenn.
(per 100#) | TO: Scoville,
Idaho
(per 100#) | TO: Boston,
Mass.
(per 100#) |
|----------------------|---------------------------------------|--------------------------------------|------------------------------------|
| Chicago, Ill. | \$ 3.20 | \$ 7.43 | \$ 4.51 |
| New Brunswick, N. J. | 3.85 | 10.29 | 2.29 |
| Linden, N. J. | 3.98 | 10.29 | 2.23 |
| Boston, Mass. | 4.57 | 10.61 | -- |
| Detroit, Mich. | 3.13 | 8.30 | 3.78 |
| Ithaca, N. Y. | 4.18 | 9.65 | 2.60 |
| Phila., Pa. | 3.65 | 10.13 | 2.52 |
| Lafayette, Ind. | 2.80 | 7.66 | 4.44 |
| New York, N. Y. | 3.98 | 10.29 | 2.23 |
| Shippingport, Pa. | 3.25 | 8.94 | 3.65 |
| Pittsburgh, Pa. | 3.25 | 8.94 | 3.65 |
| San Francisco, Cal. | -- | 5.42 | |
| Los Angeles, Cal.* | -- | 5.52 | |

* Freight cost to San Francisco site of sea disposal is \$2.56.

TABLE VIII

ANALYSIS OF AEC LAND BURIAL

| <u>SITE</u> | <u>ACRES</u> | <u>CUMULATIVE BURIAL LAND USED</u>
<u>(FEB. 1960)</u> | | | | <u>ANNUAL CY 1959</u> | | | | <u>CUMULATIVE THRU 1965</u>
<u>(CY 1959 RATE)</u> |
|----------------|------------------|--|---------------|-----------------|-----------------|-----------------------|---------------|-----------------|---------------|--|
| | | <u>Acres</u> | <u>Volume</u> | <u>Cu. Yds.</u> | <u>Curies</u> | <u>Acres</u> | <u>Volume</u> | <u>Cu. Yds.</u> | <u>Curies</u> | <u>Acres</u> |
| Oak Ridge | 45 ^{1/} | 30 | - | - | - | 5 ^{2/} | 12,000 | - | - | 55 ^{1/} |
| Idaho | 80 | 13 | 30,000 | 64,000 | 3 ^{3/} | 6,000 | 24,000 | 24,000 | 24,000 | 28 ^{3/} |
| Savannah River | 85 | 30 | 50,000 | 200,000 | 3.5 | 7,000 | 25,000 | 25,000 | 25,000 | 47 |
| Hanford | 113 | 93 | 30,600 | - | - | 11 | 3,670 | - | - | 148 |

^{1/} Additional 20 acres could possibly be made available for use provided impact on ecological program is determined not to be significant. The cumulative land usage by licensees could increase an additional 0.5 acres per year the area for military wastes if sea disposal is discontinued would amount to 0.5 acres per year or a cumulative land usage of 60 acres.

^{2/} Includes 2.5 acres used by AEC contractors other than Oak Ridge and by licensees. Most of this acreage is for AEC contractors.

^{3/} Includes Rocky Flats shipments.

TABLE IX

Estimates of Waste Volumes
as Packaged for Disposal
(AEC Installations Shipping Off-Site)

1960-65

| | | <u>Total Cubic Feet</u> | |
|----------------------|---------|-------------------------|----------------------|
| | | <u>Sea Disposal</u> | <u>Land Disposal</u> |
| <u>Land Burial</u> | | | |
| ANL | | | 141,000 |
| GE-ANPD | | | 63,000 |
| KAPL | | | 203,000 |
| Rocky Flats | | | 426,000 |
| Mound | | | 120,000 |
| Others | | | 240,000 |
| | | Subtotal: | 1,193,000 (18 acres) |
| <u>Sea Disposal*</u> | | | |
| BNL | 56,000 | | 25,000 (eq.) |
| FRR | 17,000 | | 8,400 (eq.) |
| WAPD | 110,000 | | 75,000 (eq.) |
| AI | 176,000 | | 95,000 (eq.) |
| LEL | 250,000 | | 167,000 (eq.) |
| | Total | 609,000 | 1,563,400 |

* The first column assumes the sites continue using sea disposal. The second column assumes the sites use land disposal. Cubic feet measurements for land disposal are equivalent cubic feet of total waste to be disposed. Both columns reflect disposal of the same amount of activity.