RULEMAKING ISSUE
(Notation Vote)

November 7, 1986 SECY-86-328

FOR: The Commissioners

From: Victor Stello, Jr.,
Executive Director for Operations

Subject: 10 CFR PART 60--DEFINITION OF THE TERM "HIGH-LEVEL RADIOACTIVE WASTES"--ADVANCE NOTICE OF PROPOSED RULEMAKING

Category: This paper involves a policy question of interest to other Federal agencies.

Purpose: To request Commission approval to publish an advance notice of proposed rulemaking concerning the definition of the term "high-level radioactive wastes" in 10 CFR Part 60.

Background: In approving the final amendments to 10 CFR Part 60 - Technical Criteria (SECY-83-59 and 59B), the Commission requested that the staff review the need to revise the definition of high-level radioactive wastes (HLW) in 10 CFR Part 60 to conform to the definition of HLW in the Nuclear Waste Policy Act of 1982 (NWPA), Pub. L. 97-425, as part of the ongoing review of the procedural portion of 10 CFR Part 60.1 The staff responded to

[1]Staff requirements memorandum to William J. Dircks and Herzel H. E. Plaine from Samuel J. Chilk, May 27, 1983 (Enclosure D).

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this request with a Commission Paper (SECY-85-309) which recommended publication of an advance notice of proposed rulemaking. A draft advance notice accompanied the Commission Paper. In the subsequent staff requirements memorandum dated December 13, 1985[2], the Commission requested the staff not to publish the advance notice, but to await the results of then-pending legislation. The legislation referred to, the Low-Level Radioactive Waste Policy Amendments Act--P.L. 99-240 (Amendments Act), was signed into law in January 1986. The Amendments Act clarified the issue of State vs. Federal responsibility for various types of radioactive waste. States were made responsible only for low-level radioactive waste with concentrations less than the upper limits of Class C waste as defined in 10 CFR Part 61. The Federal government was given responsibility for all "above Class C" wastes. By establishing relative responsibility for radioactive waste, the Amendments Act effectively dealt with one of the major concerns which the staff tried to address in SECY-85-309. Any revision of the definition of HLW in Part 60 would no longer affect the issue of Federal vs. State responsibility for waste. The revised draft advance notice contained here is the result of the staff's re-examination of the issues involved in revision of the definition of HLW in Part 60 in light of the implications of the Amendments Act, as well as other recent developments.

Discussion: The paper provides an advance notice of proposed rulemaking which identifies and discusses the relevant issues that must be considered in determining how to revise present definitions of HLW in NRC regulations and seeks public comment on these issues (Enclosure A). The staff has chosen the advance notice route (rather than a notice of proposed rulemaking) because the number and complexity of the issues which must be resolved to specify HLW in terms of numerical limits for concentrations of radioactive materials in the waste are sufficiently difficult to warrant the deliberate, cautious approach afforded by the advance notice.

Classification of radioactive wastes as HLW or LLW by the Commission would:

(1) identify wastes subject to the provisions of the NWPA, including the provision for payments to the Nuclear Waste Fund, and

(2) clearly distinguish those wastes which must comply with certain provisions of the Commission's regulations (principally waste packaging requirements) applicable only to HLW.

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[2]Staff requirements memorandum to Victor Stello, Jr. from Samual J. Chilk, dated December 13, 1985 (Enclosure I).

Classification of wastes as LLW or HLW by the Commission would not:

(1) alter the authority, previously established by the Energy Reorganization Act of 1974, for Commission licensing of DOE defense waste disposal facilities,

(2) apply to naturally-occurring or accelerator-produced radioactive materials,

(3) of itself require that any particular type of radioactive waste be disposed of in a specified type of facility. However, since the NWPA authorizes only the development of geologic repositories for HLW disposal classification of waste as HLW would likely mean that it would go to a geologic repository.

(4) affect the types or quantities of waste materials for which the States must provide disposal capacity.

The NWPA defines HLW as:

(A) The highly radioactive material resulting from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing and any solid material derived from such liquid waste that contains fission products in sufficient concentrations; and

(B) Other highly radioactive material that the Commission, consistent with existing law, determines by rule requires permanent isolation (NWPA, Section 2(12)).

It should be noted that the NWPA treats spent fuel separately from HLW, and the accompanying advance notice would have no effect on the regulatory requirements for disposal of spent fuel. The issues concerning the definition of HLW addressed in the advance notice are (1) whether or not the phrase "sufficient concentrations" in Clause (A) needs to be specified numerically by rule, and (2) how to make the determination, called for in Clause (B), regarding what other highly radioactive material requires permanent isolation. The staff sets forth 2 alternative approaches for dealing with Clause (A) and proposes to classify HLW under either Clause (A) or Clause (B) by identifying radioactive wastes which, due to their concentrations of hazardous short-lived radionuclides,, as well as concentrations of

relatively long-lived radionuclides, require that these wastes be permanently isolated. The advance notice proposes concentration limits for determining wastes to be "highly radioactive", and outlines an approach for establishing concentration limits for long-lived radionuclides requiring permanent isolation. The staff has benefited from comments by the National Council on Radiation Protection and Measurements and the Advisory Committee on Reactor Safeguards in the preparation of the advance notice (Enclosures F and G). Congressional staff members have expressed interest in the definition of HLW.

Recommendations: That the Commission:

1. Approve for publication the advance notice of proposed rulemaking dealing with the definition of the term HLW as set forth in the draft Federal Register notice (Enclosure A).

2. Note:

   a. The Subcommittee on Energy and the Environment of the House Interior and Insular Affairs Committee, the Subcommittee on Nuclear Regulation of the Senate Committee on the Environment and Public Works, the Subcommittee on Energy, Nuclear Proliferation and Federal Services of the Senate Committee on Government Affairs, and the Subcommittee on Energy and Power of the House Interstate and Foreign Commerce Committee will be informed by a letter similar to Enclosure E.

   b. If approved, this advance notice of proposed rulemaking would be published in the Federal Register allowing 90 days for public comment.

   c. A draft public announcement similar to Enclosure H will be issued by the Office of Public Affairs.

Victor Stello, Jr.
Executive Director for Operations

Enclosures:
A - Federal Register Advance Notice of Proposed Rulemaking -- 10 CFR Part 60 -- Definition of "High-Level Radioactive Waste"
B - An Evaluation of Radionuclide Concentrations in High-Level Radioactive Waste, NUREG-0946
C - Proposed General Statement of Policy on Licensing Procedures for Geologic Repositories for High-Level Radioactive Wastes (43 FR 53869) November 17, 1978

D - Staff requirements memorandum to William J. Dircks and Herzel H. E. Plaine from Samuel J. Chilk, May 27, 1983
E - Draft Congressional Letter
F - Letter from Dr. Warren K. Sinclair President, National Council on Radiation Protection and Measurements to Honorables W. Ruckelshaus, N. Palladino, D. Hodel, October 15, 1984
G - Memorandum to William J. Dircks from H. W. Lewis, January 15, 1985
H - Draft Public Announcement
I - Staff Requirements Memorandum to Victor Stello, Jr. from Samuel J. Chilk, December 13, 1985

Commissioners' comments or consent should be provided directly to the Office of the Secretary by c.o.b. Tuesday, November 25, 1986.

Commission Staff Office comments, if any, should be submitted to the Commissioners NLT Wednesday, November 19, 1986, with an information copy to the Office of the Secretary. If the paper is of such a nature that it requires additional time for analytical review and comment, the Commissioners and the Secretariat should be apprised of when comments may be expected.

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ENCLOSURE A

NUCLEAR REGULATORY COMMISSION

10 CFR Part 60

Definition of "High-Level Radioactive Waste"

AGENCY: Nuclear Regulatory Commission.

ACTION: Advance notice of proposed rulemaking.

SUMMARY: Radioactive wastes have historically been classified, in part, by the sources where they were generated. One result of this method of classification is that low-level wastes (LLW) and high-level wastes (HLW), as currently defined, span wide and possibly overlapping ranges of radionuclide concentrations. The Commission is considering ways to more precisely define HLW as authorized by the Nuclear Waste Policy Act of 1982 (NWPA). Such classification would also have the effect of more precisely classifying LLW.

The Low-Level Radioactive Waste Policy Act (LLRWPA), as amended, and the NWPA assign governmental responsibility (State or Federal) for providing disposal capacity for LLW and HLW. These statutes also authorize the Commission to classify wastes as LLW or HLW. Such classification:

(1) would identify wastes subject to the provisions of the NWPA, including the provision for payments to the Nuclear Waste Fund, and

(2) might serve to distinguish those wastes which must comply with certain provisions of the Commission's regulations (principally waste packaging requirements) applicable only to HLW.

Classification of certain additional radioactive wastes as HLW under NWPA will facilitate disposal of those wastes by notifying both the owners of those wastes and the U.S. Department of Energy (DOE) of the need to enter into contracts for transfer of those wastes to DOE and for payments into the Nuclear Waste Fund. Identification of wastes as HLW will also allow DOE to design waste handling and disposal facilities to accommodate those wastes. Classification of wastes as LLW or HLW by the Commission would not:

(1) affect the types of facilities which, under the Energy Reorganization Act of 1974, are subject to licensing by the Commission,

(2) apply to naturally-occurring or accelerator-produced radioactive materials,

(3) require that any particular type of radioactive waste be disposed of in a specified type of facility, or

(4) affect the types or quantities of waste materials for which the States must provide disposal capacity.

The Commission has previously adopted regulations for disposal of HLW in geologic repositories (10 CFR Part 60). The Commission is considering changes in the definition of HLW in those regulations so as to follow more closely the statutory definition in the NWPA. In this advance notice of proposed rulemaking (notice), the Commission identifies legal and technical considerations that are pertinent to the definition of HLW, describes the approach being considered by the Commission for modifying the current definition of HLW, and solicits public comment.

The question which the Commission wishes to consider in this rulemaking is whether new or revised rules ought to be adopted by the Commission to implement the NWPA definition of "high-level radioactive waste." By this notice, the Commission advises all interested persons that such rulemaking is contemplated.

DATES: Comment period expires [insert date 90 days after publication of this notice in the FEDERAL REGISTER]. Comments received after this date will be considered if it is practical to do so, but assurance of consideration can be given only for comments received on or before this date.

ADDRESSES: Send comments or suggestions to the Secretary of the Commission, U.S. Nuclear Regulatory Commission, Washington, DC 20555, Attention: Docketing and Service Branch. Copies of comments received may be examined at the NRC Public Document Room, 1717 H Street N.W., Washington, DC.

FOR FURTHER INFORMATION CONTACT: W. Clark Prichard, Division of Engineering Safety, Office of Nuclear Regulatory Research, U.S. Nuclear Regulatory Commission, Washington, DC 20555, telephone (301) 443-7668.

SUPPLEMENTARY INFORMATION:

I. Background

Radioactive wastes contain a wide variety of radionuclides, each with its own half-life and other radiological characteristics. These radionuclides are present in concentrations varying from extremely high to barely detectable. One type of waste, generated by reprocessing spent nuclear fuel, contains both long-lived radionuclides which pose a long-term hazard to human health and other, shorter-lived nuclides which produce intense levels of radiation. This

combination of highly-concentrated, short-lived nuclides together with other very long-lived nuclides has historically been described by the term "high-level radioactive wastes" (HLW). There has long been a recognition that such waste materials require long-term isolation from man's biological environment and that, in view of public health and safety considerations, disposal of such wastes should be accomplished by the Federal government on Federally owned land. This policy was codified by the Atomic Energy Commission (AEC) in 1970 in Appendix F to 10 CFR Part 50.

A. Previous use of the term "HLW." In Appendix F, HLW was defined in terms of the source of the material rather than its hazardous character-istics. Specifically, HLW was defined as "those aqueous wastes resulting from the operation of the first cycle solvent extraction system, or equivalent, and the concentrated wastes from subsequent extraction cycles, or equivalent, in a facility for reprocessing irradiated reactor fuels." As used in Appendix F, "high-level waste" thus refers to the highly concentrated (and hazardous) waste containing virtually all the fission product and transuranic elements (except plutonium) present in irradiated reactor fuel. The term does not include incidental wastes resulting from reprocessing plant operations such as ion exchange beds, sludges, and contaminated laboratory items, clothing, tools, and equipment. Neither are radioactive hulls and other irradiated and contaminated fuel structural hardware within the Appendix F definition.[1]

The first statutory use of the term "high-level radioactive waste" occurs in the Marine Protection, Research, and Sanctuaries Act of 1972 (Marine

[1]See 34 Fed. Reg. 8712, June 3, 1969 (notice of proposed rulemaking), 35 Fed. Reg. 17530 at 17532, November 14, 1970 (final rule). Incidental wastes generated in further treatment of HLW (e.g., decontaminated salt with residual activities on the order of 1,500 nCi/g Cs-137, 30 nCi/g Sr-90, 2 nCi/g Pu, as described in Department of Energy's FEIS on long-term management of defense HLW at the Savannah River Plant, DOE/EIS-0023, 1979) would also, under the same reasoning, be outside the Appendix F definition.

Sanctuaries Act). Congress adopted the Appendix F definition, but broadened it to include unreprocessed spent fuel as well.[2] Two years later, the AEC was abolished and its functions were divided between the Energy Research and Development Administration (ERDA, now the Department of Energy, DOE) and the Nuclear Regulatory Commission (NRC or Commission) by the Energy Reorganization Act of 1974, Pub. L. 93-438, 42 U.S.C. 5811. Under this legislation, certain activities of ERDA were to be subject to the Commission's licensing and regulatory authority. Specifically, NRC was to exercise licensing authority as to certain nuclear reactors and the following waste facilities:

(1) Facilities used primarily for the receipt and storage of high-level radioactive wastes resulting from activities licensed under the [Atomic Energy] Act.

(2) Retrievable Surface Storage Facilities and other facilities authorized for the express purpose of subsequent long-term storage of high-level radioactive waste generated by the Administration [now DOE], which are not used for, or are part of, research and development activities.[3]

Although neither the statute nor the legislative history defines the term "high-level radioactive waste" (HLW), the earlier usages in Appendix F and the Marine Sanctuaries Act are indicative of the meaning. The Commission so

[2]Sec. 3, Pub. L. 92-532, as amended by Pub. L. 93-254 (1974), 33 U.S.C. 1402.

[3]Sec. 202, Pub. L. 93-438, 42 U.S.C. 5842. Nuclear waste management responsibilities were subsequently transferred to the Department of Energy. Secs. 203(a)(8), 301(a), Pub. L. 95-91, 42 U.S.C. 7133(a)(8), 7151(a).

construed the statute when it declared spent nuclear fuel to be a form of HLW and, by the same token, when it found transuranic-contaminated wastes not to be HLW.[4]

A different statutory formula appears in the West Valley Demonstration Project Act (West Valley Act), enacted in 1980. This legislation authorizes the Department of Energy (DOE) to carry out a high-level radioactive waste management demonstration project for the purpose of demonstrating solidification techniques which can be used for preparing HLW for disposal. It includes the following definition:

> The term "high level radioactive waste" means the high level radioactive waste which was produced by the reprocessing at the Center of spent nuclear fuel. Such term includes both liquid wastes which are produced directly in reprocessing, dry solid material derived from such liquid waste and such other material as the Commission designates as high level radioactive waste for purposes of protecting the public health and safety.[5]

The Commission has not yet designated any "other material" as HLW under the West Valley Act. Rather, it has construed the term in a manner equivalent to the 10 CFR 50, Appendix F definition. That is, it is the liquid wastes in storage at West Valley and the dry solid material derived from solidification activities that are regarded as HLW, and it is DOE's plans with respect to such wastes that are subject to the Commission's review.

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[4]Proposed General Statement of Policy, "Licensing Procedures for Geologic Repositories for High-Level Radioactive Wastes," 43 Fed. Reg. 53869, 53870, November 17, 1978; Report to Congress, "Regulation of Federal Radioactive Waste Activities," NUREG-0527 (1979), 2-1, 2-2, Appendix G.

[5]Sec. 6(4), Pub. L. 96-368, 42 U.S.C. 2021a note.

B. Current NRC regulations. The Commission has adopted regulations that govern the licensing of DOE activities at geologic repositories for the disposal of HLW. The regulations define HLW in the jurisdictional sense. That is, if the facility is for the "storage" of "HLW" as contemplated by the Energy Reorganization Act, the prescribed procedures and criteria would apply.[6] The appropriate definition for this purpose draws upon the understanding in 1974, as reflected in Appendix F and the Marine Sanctuaries Act, rather than the words of the West Valley Act of more limited purpose and scope.

It should be emphasized that NRC's existing regulations in Part 60 do not require that any radioactive materials, whether HLW or not, be stored or disposed of in a geologic repository.[7] Nor do they provide that radioactive materials must be HLW in order to be eligible for disposal in a geologic repository. Part 60 expressly provides for NRC review and licensing with respect to any radioactive materials that may be emplaced in a geologic repository authorized for disposal of HLW. The term "high-level radioactive waste" in Part 60 identifies the class of facilities subject to NRC jurisdiction.

[6]NRC regulations are codified in 10 CFR Part 60 (Part 60). DOE is required to have a license to receive source, special nuclear or byproduct material at a geologic repository operations area. § 60.3. A geologic repository operations area is defined to refer to a "HLW facility" which in turn is defined as a facility subject to NRC licensing authority under the Energy Reorganization Act of 1974, note 3, supra. § 60.2. The Part 60 definition of HLW, ibid., is as follows:

> "High-level radioactive waste" or "HLW" means: (1) Irradiated reactor fuel, (2) liquid wastes resulting from the operation of the first cycle solvent extraction system, or equivalent, and the concentrated wastes from subsequent extraction cycles, or equivalent, in a facility for reprocessing irradiated reactor fuel, and (3) solids into which such liquid wastes have been converted.

[7]In the event that commercial reprocessing of irradiated reactor fuel is pursued, Appendix F of 10 CFR Part 50 would require that the resulting reprocessing wastes be transferred to a Federal repository.

The Commission has also adopted regulations related to land disposal of low-level radioactive wastes (10 CFR Part 61). Based on analyses of potential human health hazards, these regulations identify three classes of low-level radioactive wastes which are routinely acceptable for near-surface disposal, with "Class C" denoting the highest radionuclide concentrations of the three. Class C does not, however, denote a maximum concentration limit for low-level wastes. The low-level waste category includes all wastes not otherwise classified, while HLW is currently defined by source (rather than concentration or hazard) and is limited to reprocessing wastes and spent fuel. Thus, there is no regulatory limit on the concentrations of LLW, and some LLW (exceeding Class C concentrations) may have concentrations approaching those of HLW. These are the wastes which the Commission wishes to evaluate for possible classification as HLW. The Appendix to this notice presents information on the volumes and characteristics of wastes with radionuclide concentrations exceeding the Class C concentration limits. (This Appendix was prepared in 1985. DOE is currently carrying out a study of "above Class C" wastes which will update the information presented here.)

C. Nuclear Waste Policy Act of 1982. The Nuclear Waste Policy Act of 1982 (NWPA), Pub. L. 97-425, provides for the development of repositories for the disposal of high-level radioactive waste and establishes a program of research, development, and demonstration regarding the disposal of high-level radioactive waste.[8] The NWPA follows, with some modification, the text of the West Valley Act. For purposes of the NWPA, the term "high-level radioactive waste" means:

[8]For purposes of the NWPA, "spent nuclear fuel" is distinguished from "high-level radioactive waste," but the provisions of the statute dealing with such spent nuclear fuel are not of present concern.

(A) The highly radioactive material resulting from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing and any solid material derived from such liquid waste that contains fission products in sufficient concentrations; and

(B) other highly radioactive material that the Commission, consistent with existing law, determines by rule requires permanent isolation.[9]

It should be noted that the NWPA does not require that materials regarded as HLW pursuant to this definition be disposed of in a geologic repository. Indeed, the NWPA directs the Secretary (of DOE) to continue and accelerate a program of research, development and investigation of alternative means and technologies for the permanent disposal of HLW.[10] Part 60 and the changes discussed in this notice would allow for consideration of such alternatives by the Commission. Nevertheless, the NWPA does not specifically authorize DOE to construct or operate facilities for disposal by alternative means, and new legislative authorization might be needed in order to dispose of HLW by means other than emplacement in a deep geologic repository.

[9]Sec. 2(12), Pub. L. 97-425, 42 U.S.C. 10101(12). Sec. 2(16) also authorizes the Commission to classify certain radioactive material as low-level radioactive waste.

[10]Sec. 222, Pub. L. 97-425, 42 U.S.C. 10202.

II. Considerations for Defining "High-Level Radioactive Waste".

Wastes which have historically been referred to as HLW (i.e., reprocessing wastes) are initially both intensely radioactive and long-lived. These wastes contain a wide variety of radionuclides. Some (principally Sr-90 and Cs-137) are relatively short-lived and represent a large fraction of the radioactivity for the first few centuries after the wastes are produced. These nuclides produce significant amounts of heat and radiation, both of which are of concern when disposing of such wastes. Other nuclides, including C-14, Tc-99, I-129 and transuranic nuclides, have very long half-lives and thus constitute the longer-term hazard of the wastes. Some of these nuclides pose a hazard for sufficiently long periods of time that the term "permanent isolation" is used to describe the type of disposal required to isolate them from man's environment. The Commission considers that these two characteristics, intense radioactivity for a few centuries followed by a long-term hazard requiring permanent isolation, are key features which can be used to distinguish high-level wastes from other waste categories.

The NWPA identifies two sources of HLW, each of which is discussed separately in the following sections.

A. Clause (A).

Clause (A) of the NWPA definition of HLW refers to wastes produced by reprocessing spent nuclear fuel and thus is essentially identical to the

Commission's current HLW definition in 10 CFR Part 60. Clause (A) is, however, different in one respect. The NWPA wording would classify solidified reprocessing waste as HLW only if such waste "contains fission products in sufficient concentrations" --a phrase that may reflect the possibility that liquid reprocessing wastes may be partitioned or otherwise treated so that some of the solidified products will contain substantially reduced concentrations of radionuclides.

The question, then, is whether the Commission should (1) numerically specify the concentrations of fission products which it would consider "sufficient" to distinguish HLW from non-HLW under Clause (A); or (2) define HLW so as to equate the Clause (A) wastes with those which have traditionally been regarded as HLW.

1. Numerically specifying concentrations of fission products.

The first option considered is to numerically define "sufficient concentrations" of fission products. Liquid reprocessing wastes may contain significant amounts of non-radioactive salts, and removal of these salts prior to waste solidification may be desirable for both economic and public health and safety reasons. Removal of salts in this was would result in a smaller volume of highly radioactive wastes, which might reduce the costs and radiological impacts associated with transportation and occupational handling of those wastes. Nevertheless, any salts removed from liquid HLW would retain residual amounts of radioactive contaminants. By establishing numerical limits on the concentrations of fission products, the Commission would be identifying those wastes from reprocessing that require disposal in a deep geologic repository or its equivalent. The proper classification of the salts discussed above would then be made on the basis of the numerical limits on radionuclide concentrations and the salts would be disposed of accordingly. In other cases,

certain radionuclides may be removed from the bulk liquid reprocessing waste (as has been done in removing cesium and strontium from wastes at Hanford), raising similar questions about the classification of the remaining waste and acceptable methods of disposal. For these reasons, there would be merit in numerically specifying the concentrations of radionuclides in solidified reprocessing wastes which would distinguish HLW from non-HLW.

(Clause (A) refers to solidified waste "that contains fission products in sufficient concentrations." No mention is made of the long-lived transuranic radionuclides which are also present in liquid reprocessing wastes but, since the transuranics constitute the predominant long-term hazard of reprocessing wastes, such nuclides must be considered as well in defining reprocessing wastes that should be regarded as HLW. With this view, a numerical classification of solidified wastes under Clause (A) could be derived in the same manner, and contain the same concentration limits, as the numerical definitions developed under Clause (B). Derivation of concentration limits under Clause (B) is discussed in the following section of this notice.)

2. Traditional Definition

The alternative approach is to define HLW so as to equate the category of Clause (A) wastes with those wastes which have traditionally been regarded as HLW under Appendix F to 10 CFR Part 50 and the Energy Reorganization Act. The advantage of this option is that the term HLW retains its utility in defining the facilities that are subject to NRC licensing. That is, all materials that have traditionally been considered HLW for purposes of the Energy Reorganization Act would also be regarded as HLW under the Nuclear Waste Policy Act. The disadvantage is that some materials might continue to fall within the HLW classification even though they do not require the degree of isolation

afforded by a repository. They would be called "HLW" even though the technical community might not so regard them.

3. Other considerations regarding Clause (A) options

The Commission would add two observations regarding the options discussed above.

a. Development of a definition under Clause (A), as suggested by the first option, would not alter the Commission's existing authority to license DOE waste facilities, including defense wastes facilities, under the Energy Reorganization Act of 1974 (ERA). Any classification of wastes as non-HLW on the basis that they do not contain "sufficient concentrations" of fission products would be irrelevant in determining whether such wastes must be disposed of in licensed disposal facilities. For example, if DOE were to pursue its proposal for in-place stabilization of the Hanford "tank" wastes (see DOE/EIS-0113, March, 1986), most or all of the disposal "facilities" for those wastes would need to be licensed by the NRC.

b. Retaining the traditional definition for purposes of Clause (A) does not limit the Commission's ability to establish at some later date criteria to define wastes that require the isolation afforded by a deep geologic repository or its equivalent. That is, wastes requiring such isolation could be identified by terms other than "high-level".

B. Clause (B).

Clause (B) of the NWPA authorizes the Commission to classify "other highly radioactive material" (other than reprocessing wastes) as HLW if that material "requires permanent isolation." The Commission considers that both characteristics (highly radioactive and requiring permanent isolation) must be present simultaneously in order to classify a material as HLW.[11] Each of these characteristics is discussed in turn in the following sections.

1. Highly radioactive.

The Commission proposes[12] to consider a material "highly radioactive" if it contains concentrations of short-lived radionuclides in excess of the Class C limits of Table 2 of 10 CFR Part 61. Such concentrations are sufficient to produce significant radiation levels and to generate substantial amounts of heat. Moreover, the Class C concentration limits for short-lived nuclides approximate the actual concentrations of those nuclides present in some existing reprocessing wastes (see NUREG-0946, Table 4).

[11]The Commission would not find tenable the argument that a material requires permanent isolation because it is highly radioactive. The need for permanent isolation correlates with the length of time a material will remain hazardous. Long half-lives, in turn, correlate with low rather than high levels of radioactivity.

[12]All references to "proposals" by the Commission refer only to its tentative views. No formal proposals will be developed until comments are received in response to this notice.

2. Permanent isolation.

The phrase "permanent isolation" in NWPA is much less subjective than is "highly radioactive." Within the context of NWPA, "permanent isolation" clearly implies the degree of isolation afforded by a deep geologic repository.[13] Thus, a waste "requires permanent isolation" if it cannot be safely disposed of in a facility less secure than a repository. The Commission will determine which wastes require permanent isolation by evaluating the disposal capabilities of alternative, less secure, disposal facilities.[14] Any wastes which cannot be safely disposed of in such facilities will be deemed to require permanent isolation and, if also highly radioactive, would be classified as high-level wastes.

[13]The NWPA includes the following definitions:

> The term "disposal" means the emplacement in a repository of high-level radioactive waste, spent nuclear fuel, or other highly radioactive material with no foreseeable intent of recovery, whether or not such emplacement permits the recovery of such waste.
>
> The term "repository" means any system licensed by the Commission that is intended to be used for, or may be used for, the permanent deep geologic disposal of high-level radioactive waste and spent nuclear fuel, whether or not such system is designed to permit the recovery, for a limited period during initial operation, of any materials placed in such system. Such term includes both surface and subsurface areas at which high-level radioactive waste and spent nuclear fuel handling activities are conducted.

[14]Such facilities might make use of intermediate depth burial or various engineering measures, such as intruder barriers, to accommodate wastes with radionuclide concentrations unsuitable for disposal by shallow land burial.

The approach which the Commission proposes to pursue to determine which wastes require permanent isolation will be an extension of the 10 CFR Part 61 waste classification analyses and consists of the following steps.

a. Establish acceptance criteria. 10 CFR Part 61 currently contains performance objectives for disposal of radioactive wastes in a land disposal facility. These performance objectives will serve as acceptance criteria for waste classification analyses, but might need to be supplemented for specific types of facilities or wastes. For example, some types of land disposal facilities (other than shallow land burial) may be subject to potentially disruptive events or processes which were not considered when the Part 61 performance objectives were developed. The Part 61 performance objectives may also need to be supplemented to accommodate any environmental standards for non-HLW which may be promulgated by the U.S. Environmental Protection Agency pursuant to its authority under the Atomic Energy Act of 1954, as amended.

b. Define disposal facility. The hazard which a radioactive waste poses to public health depends, in part, on the nature of the facility used for its disposal. Thus, a reference disposal facility, less secure than a repository, needs to be defined in terms of the characteristics which contribute to isolation of wastes from the environment. For land disposal facilities, such characteristics might include depth of disposal, use of engineered barriers, and the geologic, hydrologic and geochemical features of a disposal site.

c. Characterize wastes. Wastes will be characterized in terms of the factors which determine their hazard and behavior after disposal, including physical and chemical forms of the waste, the radionuclide concentrations and associated radiological characteristics, the waste volumes, and the heat generation rates. The wide range of types and characteristics of wastes arising from industrial, biomedical and nuclear fuel cycle sources makes this a particularly critical step in the waste classification process -- especially for wastes to be generated in the future (e.g., decommissioning wastes).

d. Develop assessment methodology. Analytical methods (including mathematical models and computer codes) for projecting disposal system performance will be acquired or developed. For land disposal facilities, such methods include models of groundwater flow and contaminant transport. An assessment methodology also includes descriptions of the natural and human-initiated disruptive events or processes which could significantly affect disposal system performance as well as the analytical means for evaluating the impacts of such events or processes.

e. Evaluate disposal system performance. The performance of the alternative disposal facility will be evaluated to estimate the public health hazards from disposal of various types and concentrations of wastes. Hazards below the acceptance criteria of item a. above indicate an acceptable match of waste type and disposal option. Wastes which cannot be safely disposed of in the alternative facility will be classified as requiring permanent isolation.

A practical difficulty with classifying wastes as described here is that alternative disposal facilities are currently unavailable. Thus, classification of wastes in this manner requires many assumptions about the performance of nonexistent disposal facilities. Such analyses will inevitably involve substantial uncertainties.

It is also possible that no alternative disposal facility will ever be needed for commercially-generated "above Class C" wastes. (Disposal of such wastes is a Federal, rather than State, responsibility.) Because of the overhead costs of developing and licensing new facilities, the relatively small volumes of such wastes, and the low heat generation rates of some of these wastes, it might prove most economical to dispose of all such wastes in a repository. Nevertheless, the Commission recognizes a "chicken-and-egg" problem here. Until wastes are classified as HLW or non-HLW, it may be

difficult for the DOE to make decisions regarding appropriate types of disposal facilities. Therefore, despite the uncertainties involved, the Commission proposes to select a hypothetical alternative disposal facility which will serve as the basis for carrying out waste classification analyses.

Previous analyses by the NRC (NUREG-0782, draft EIS for 10 CFR Part 61) suggest that disposal facilities with characteristics intermediate between shallow land burial and geologic repository disposal may be most effective in protecting against short-term radiological impacts associated with inadvertent intrusion into a disposal facility. These "intermediate" facilities may be much less effective in providing enhanced long-term isolation of very long-lived radionuclides. If this preliminary view is supported by subsequent analyses, wastes with concentrations above the Commission's current Class C limits for long-lived nuclides (Table 1 of 10 CFR Part 61) would require permanent isolation. In the following sections, the Commission will assume, for the sake of illustration, that Table 1 is an appropriate interpretation of the term "requires permanent isolation."

3. Conceptual definition of "high-level waste."

The Commission proposes to classify wastes as HLW under Clause (B) of the NWPA definition only if they are both highly radioactive and in need of permanent isolation. As discussed above, the Commission considers that wastes should be considered to be highly radioactive if they contain concentrations of short-lived radionuclides which exceed the Class C limits of Table 2 of 10 CFR Part 61. The Commission also assumes, for illustrative purposes, that the radionuclide concentrations of Table 1 of Part 61 are appropriate for identifying the concentrations of long-lived radionuclides requiring permanent isolation. Solidified reprocessing wastes would similarly be classified as HLW only if they contain both short- and long-lived radionuclides in concentrations exceeding Tables 2 and 1, respectively.

It is assumed that a revised definition of HLW would appear in the definitions section of Part 60, and that the materials encompassed by the definition would be subject to the containment requirements of that regulation. It would also serve incidentally to define the materials covered by DOE's waste disposal contracts. This definition would apply only to wastes disposed of in a facility licensed under Part 60. As discussed elsewhere in this notice, there would be no alteration of the Commission's authority to license disposal of HLW under provisions of the Energy Reorganization Act. Some technical amendments would be needed to preserve the jurisdictional provisions of existing Part 60 - i.e., to indicate that Part 60 applies to the DOE facilities described in Sections 202(3) and (4) of the Energy Reorganization Act, and for that purpose the proposed definition of HLW would not be controlling.

A conceptual, revised definition of HLW could be stated as follows.

"High-level radioactive waste" or "HLW" means: (1) Irradiated reactor fuel, (2) liquid wastes resulting from the operation of the first cycle solvent extraction system, or equivalent, and the concentrated wastes from subsequent extraction cycles, or equivalent, in a facility for reprocessing irradiated reactor fuel, (3) solids into which such liquid wastes have been converted, and solid radioactive wastes from other sources, provided such solid materials contain both long-lived radionuclides in concentrations exceeding the values of Table 1 and short-lived radionuclides with concentrations exceeding the values of Table 2.

Table 1

Radionuclide	Concentration[1] (Ci/m^3)
C-14	8
C-14 in act. metal	80
Ni-59 in act. metal	220
Nb-94 in act. metal	0.2
Tc-99	3
I-129	0.08
Alpha emitting TRU, $t_{1/2}$ > 5 yr	100[2]
Pu-241	3,500[2]
Cm-242	20,000[2]

Table 2

Radionuclide	Concentration[1] (Ci/m^3)
Ni-63	700
Ni-63 in act. metal	7000
Sr-90	7000
Cs-137	4600

Notes for Tables 1 and 2.

[1]If a mixture of radionuclides is present, a sum of the fractions rule is to be applied for each table. The concentration of each nuclide is to be divided by its limit, and the resulting fractions are to be summed. If the sum exceeds one for both tables, the waste is classified as HLW.

[2]Units are nanocuries per gram.

4. Status of wastes not classified as HLW.

The NWPA, the Low-Level Radioactive Waste Policy Act, and the Commission's regulations in 10 CFR Part 61 currently classify wastes as "low-level" if they are not otherwise classified as high-level wastes or certain other types of materials (e.g., uranium mill tailings). Classification of certain wastes as HLW, under Clause (B) of the NWPA definition, would reduce the amount of waste classified (by default) as LLW and, more importantly, would establish a distinct, concentration-based boundary between the two classes of waste.

If this conceptual definition of Clause (B) were adopted, certain wastes with radionuclide concentrations above the Class C limits of 10 CFR Part 61 would not be classified as HLW because they do not contain the requisite combination of short- and long-lived nuclides. These wastes would continue to be classified as special types of low-level wastes analogous to DOE's "transuranic" waste category. Any such wastes generated by defense programs would continue to fall under DOE's responsibility for disposal, and no NRC licensing of facilities intended solely for their disposal, such as the Waste Isolation Pilot Plant (WIPP), would be authorized.

As provided by the amendments to the Low-Level Radioactive Waste Policy Act[15], the Federal government is responsible for disposal of all commercially-generated "above Class C" wastes; it is contemplated, under the amendments, that the NRC would be responsible for licensing the facilities for their disposal. The Commission would continue to permit disposal of wastes containing naturally-occurring or accelerator-produced materials in licensed facilities provided there was no unreasonable risk to public health and safety.

[15]Low-Level Radioactive Waste Policy Amendments Act of 1985, Pub. L. 99-240, Sec. 3, 42 U.S.C. 2021c.

III. Legal Considerations Related to the Nuclear Waste Policy Act.

The exercise of NWPA Clause (B) authority may give rise to a number of legal questions which are discussed below.

A. Disposal of waste generated by materials licensees. The NWPA established a Nuclear Waste Fund composed of payments made by the generators and owners of "high-level radioactive waste" (including spent fuel) that will ensure that the costs of disposal will be borne by the persons responsible for generating such waste. The Nuclear Waste Fund is to be funded with moneys obtained pursuant to contracts entered into between the Secretary of Energy and persons who generate or hold title to high-level radioactive waste.

The statute addresses the particulars of contracts with respect to spent nuclear fuel and solidified high-level radioactive waste derived from spent nuclear fuel used to generate electricity in a civilian nuclear power reactor. It further limits the authority of the Commission to issue or renew licenses for utilization and production facilities -- i.e., for present purposes, nuclear reactors and reprocessing plants -- unless the persons using such facilities have entered into contracts with the Secretary of Energy.

The absence of any reference to materials licensees (e.g., fuel fabricators, some research laboratories) suggests that the Nuclear Waste Fund was not intended to apply to their activities. As a result, there could be a question if the Commission were to define materials licensees' waste as high-level waste, because the waste might thereby become ineligible for disposal in a repository. The reason is that the law prohibits disposal of HLW in a repository unless such waste was covered by a contract entered into by

June 30, 1983 (or the date the generator or owner commences generation of or takes title to the waste, if later). Few contracts have been entered into with materials licensees except those who are also facility licensees. Thus, it can be argued that the Commission should refrain from designating as HLW, under Clause (B),[16] materials generated by materials licensees.

The Commission is not persuaded by such an argument. The statutory language dealing with the Commission's classification of materials as HLW refers solely to considerations relating to the nature of the wastes, and the character of the licensee generating or owning the waste is simply not relevant. If there are good reasons to treat that waste from materials licensees as HLW, the Commission regards it as likely that any statutory impediment to the acceptance of such waste at a geologic repository could be modified.

B. Confidence regarding disposal capacity for power reactors. The availability of waste disposal facilities for wastes generated at commercial power reactors has been the subject of controversy and litigation. The NWPA addresses these concerns by establishing a Federal responsibility to provide for the construction and operation of a geologic repository, leaving undefined (i.e., to the discretion of the Commission) the classes of materials that require permanent isolation in such a facility. Whatever materials they may be, however, they must be transferred to DOE for disposal; and the persons responsible for generating the waste must enter into contracts with DOE which provide for payment of fees sufficient to offset DOE's costs of disposal. Existing facility licensees were required to enter into such contracts by June 30, 1983.

[16]The Nuclear Waste Fund is governed by Sec. 302, Pub. L. 97-425, 42 U.S.C. 10222. The prohibition of disposal of HLW not covered by timely contracts is set out in Sec. 302(b)(2).

The Commission believes that the purpose of the NWPA can best be accomplished if all the highly radioactive wastes generated by facility licensees (reactors and reprocessing plants) which require permanent isolation are covered by waste disposal contracts with DOE. This would assure that DOE can and will accept possession of such wastes when necessary. Further, in the absence of such assurance, the basis for Commission confidence that these wastes will be safely stored and disposed of would be subject to question even if concerns about the disposal of the licensees' spent nuclear fuel had been laid to rest. Accordingly, if there are any highly radioactive materials (other than those previously regarded as HLW) that are generated by facility licensees and that require permanent isolation, the Commission believes that, for purposes of the NWPA, they should be regarded as "high-level waste." The Commission has reviewed the terms of DOE's standard waste disposal contract and believes that classifying such additional materials as HLW would require no changes to the contract terms.

C. Implications with respect to disposal methods. Under the Atomic Energy Act of 1954, the Commission is authorized to establish such standards to govern the possession of licensed nuclear materials as it may deem necessary or desirable to protect health.[17] Under this authority, the Commission may classify materials according to their hazards and may prescribe requirements for the long-term management or disposal thereof. It is not necessary to label materials as HLW under the NWPA in order to require their disposal in a geologic repository or other suitably permanent facility.

[17]Sec. 161b., Pub. L. 83-703, 42 U.S.C. 2201(b).

The Commission exercised this authority with respect to concentrated reprocessing wastes by specifying, in Appendix F to 10 CFR Part 50, that any such wastes generated at licensed facilities are to be transferred to a Federal repository for disposal. More recently, the Commission classified certain low-level wastes as being generally acceptable for near-surface disposal (10 CFR Part 61). On the basis of further consideration, the Commission could specify appropriate disposal means for wastes exhibiting radionuclide concentrations greater that those defined in Part 61. Thus, the Commission need not exercise NWPA Clause (B) authority in order to assure that radioactive wastes from licensed activities are disposed of properly. Moreover, the identification of material as HLW under Clause (B) would not by itself mandate that such material must be disposed of in a geologic repository. Since the NWPA authorizes only a single method of permanently isolating HLW -- geologic repositories -- classification of materials as HLW may effectively preclude disposal of such wastes by other means. Nevertheless, the Commission's regulations will continue to leave open the prospect of disposal by other means if Congress should so authorize.

D. Relationship to State role. Section 3 of the Low-Level Radioactive Waste Policy Act (LLRWPA), Pub. L. 96-573, 42 U.S.C. 2021b., enacted in 1980, defines a State responsibility to provide, pursuant to regional compacts, for the disposal of "low-level radioactive waste" (LLW).[18] Such waste is defined to mean "radioactive waste not classified as high-level radioactive waste, transuranic waste, spent nuclear fuel, or by-product material as defined in Section 11.e.(2) of the Atomic Energy Act of 1954."

[18]States are not responsible for disposal of LLW from atomic energy defense activities or Federal research and development activities.

The Low-Level Radioactive Waste Policy Amendments Act of 1985, Pub. L. 99-240, 42 U.S.C. 2021c., limited the range of LLW for which the States must provide disposal capacity. Specifically, the States are not responsible for wastes with radionuclide concentrations in excess of the Class C limits of 10 CFR Part 61. Instead, the Federal government now assumes responsibility for providing disposal capacity for such wastes. Thus, classification of "above Class C" wastes as HLW or non-HLW will have no impact on State government responsibilities.

E. Impact on existing technical criteria. NRC's regulations in Part 60 include technical criteria to be applied in licensing DOE's receipt and possession of source, special nuclear, and byproduct material at a geologic repository. The regulations would accommodate the disposal of any radioactive materials, including spent fuel, reprocessing wastes, or any other materials which could be disposed of in accordance with the specified performance objectives.

Materials categorized as high-level waste are subject to a containment requirement (§ 60.113(a)(1)(i)(A)) and to specified waste package design criteria and waste form criteria (§ 60.135 (a-c)). These criteria apply to wastes characterized by the presence of fission products generating substantial amounts of heat at the time of emplacement, but with much reduced heat generation after decades or a few centuries.[19] The rule also explicitly provides that design criteria for waste types other than HLW will be addressed on an individual basis if and when they are proposed for disposal in a geologic repository (§ 60.135(d)).

[19]The Commission's expectation that HLW would generate significant amounts of heat is reflected in the discussion of transuranic waste in the notice of proposed rulemaking on the Part 60 technical criteria. 46 Fed. Reg. 35284, July 8, 1981. Reduction of the heat load, for example by removal of cesium-137 and strontium-90, could result in different containment requirements. 48 Fed. Reg. 28196, June 21, 1983 (final rule).

If additional materials were to be designated as high-level waste, the Commission would need to consider whether the existing repository design criteria are appropriate with respect to such materials.

F. Applicability of HLW definition to naturally-occurring and accelerator-produced radioactive materials. Clause (B) of the NWPA provides that the Commission may extend the definition of the term "high-level radioactive waste" to include material requiring permanent isolation only where this is "consistent with existing law." The applicable existing law is the Atomic Energy Act of 1954, under which the Commission has authority to regulate the possession and use of "source material," "special nuclear material," and "byproduct material." There are other radioactive materials, however: naturally-occurring radionuclides, such as radium, and accelerator-produced radionuclides. These are not covered by the Atomic Energy Act and hence there would be no statutory basis, consistent with existing law, for the Commission to require that they be disposed of at facilities licensed by the Commission or otherwise to regulate their possession or use. Accordingly, no legal basis exists for the Commission to classify such materials as HLW or non-HLW.

Nevertheless, as already noted, 10 CFR Part 60 contemplates that "other radioactive materials other than HLW" may be received for emplacement in a geologic repository. This provision of Part 60 would not be altered by expanding the definition of HLW. Part 60 provides that waste package requirements for such wastes will be determined on a case-by-case basis when these wastes are proposed for disposal. Thus, it might be determined, on the basis of technical considerations, that certain naturally-occurring or accelerator-produced radioactive waste materials present hazards similar to licensed materials that are defined as high-level waste and that such material should be disposed of in a geologic repository developed under NWPA. If so, plans for such disposal can be reviewed under Part 60 and the Commission could impose such packaging or other requirements as appropriate to protect public health and safety.

IV. Issues on Which Public Comments are Particularly Sought.

The Commission invites comments on all the issues identified in this notice and any other issues that might be identified. However, comments (with supportive rationale) in response to the following would be particularly helpful.

1. Two options are presented for defining reprocessing wastes under Clause (A) of NWPA. The first option proposes to define the "sufficiency" of fission product concentrations in solidified reprocessing wastes in a manner analogous to its treatment of "highly radioactive" and "requires permanent isolation" under Clause (B) (i.e., by examining the hazards posed by wastes if disposed of in facilities other than a repository). The second option interprets Clause (A) as encompassing all those wastes which have heretofore been considered high-level waste under Appendix F to 10 CFR Part 50 and the Energy Reorganization Act. Which of these two approaches is preferable?

2. The Commission proposes that the current Class C concentration limits of 10 CFR Part 61 serve to identify radionuclide concentrations which are "highly radioactive" for purposes of Clause (B) of the NWPA definition. Would an alternative set of concentration limits be preferable? If so, how should such limits be derived?

3. The Commission proposes to equate the "requires permanent isolation" wording of the NWPA definition with a level of long-term radiological hazard requiring disposal in a geologic repository. Are the Commission's proposed analyses appropriate for identification of concentrations requiring permanent isolation?

4. Although, under Section 121 of NWPA, no environmental review is required with respect to the definition of HLW, the Commission would welcome identification of any environmental consequences associated with the matters discussed in this notice.

5. Some waste materials, such as certain laboratory wastes or some sealed sources, may be highly concentrated, yet contain only relatively small total quantities of radioactive materials. Is there a need for a special provision (e.g., a minimum total quantity of activity) before a waste should be classified as HLW?

6. What difficulties (legal, administrative, financial, or other) would an expanded definition of HLW cause in implementing the provisions of the NWPA?

7. The Commission's regulations do not generally require that any particular type of waste be disposed of in any specified type of facility. Would such a requirement be appropriate?

8. Are there issues other than those identified in this notice which the Commission should consider in developing approaches to implement its authority?

APPENDIX

Volumes and Characteristics of Wastes Exceeding Class C Concentration Limits

For a number of years NRC has had an ongoing program to develop regulations and criteria for disposal of low-level radioactive waste. At the time this program was initiated, there was a well-documented need for comprehensive national standards and technical criteria for the disposal of low-level waste. The absence of sufficient technical standards and criteria was seen to be a major deterrent to the siting of new disposal facilities by states and compacts.

A significant milestone in this program was the promulgation of the regulation 10 CFR Part 61 ("Licensing Requirements for Land Disposal of Radioactive Waste") on December 27, 1982 (47 Fed. Reg. 57446). This regulation establishes procedural requirements, institutional and financial requirements, and overall performance objectives for land disposal of radioactive waste, where land disposal may include a number of possible disposal methods such as mined cavities, engineered bunkers, or shallow land burial. This regulation also contains technical criteria (on site suitability, design, operation, closure, and waste form) which are applicable to near-surface disposal, which is a subset of the broader range of land disposal methods. Near-surface disposal is defined as disposal in or within the upper 30 meters of the earth's surface, and may include a range of possible techniques such as concrete bunkers or shallow land burial. The Part 61 regulation is intended to be performance-oriented rather than prescriptive, with the result that the Part 61 technical criteria are written in relatively general terms, allowing applicants to demonstrate how their proposals meet these criteria for various specific near-surface disposal methods.

A waste classification system was also instituted in the regulation which establishes three classes of waste suitable for near-surface disposal: Class A, Class B, and Class C. Limiting concentrations for particular radionuclides were established for each waste class, with the highest limits being for Class C. The concentration limits were established based on NRC's understanding (at the time of the rulemaking) of the characteristics and volumes of low-level waste that would be reasonably expected to the year 2000, as well as potential disposal methods.

The Class C concentration limits are applicable to all potential near-surface disposal systems; however, the calculations performed to establish the limits are based on postulated use of one near-surface disposal method: shallow land burial. The Class C limits are therefore conservative since there may be other near-surface disposal methods that have greater confinement capability (and higher costs) than shallow land burial.

The regulation states that waste exceeding Class C concentration limits is considered to be "not generally acceptable for near-surface disposal," where this is defined in § 61.55 (a) as "waste for which waste form and disposal methods must be different, and in general more stringent, than those specified for Class C waste." Thus, waste exceeding Part 61 concentrations generally has been excluded from near-surface disposal and is being held in storage by licensees. (This amounts to less than 1% of the approximately 3,000,000 ft^3 of commercial low-level waste annually being generated.) Given the current absence of prescriptive requirements for disposal of waste exceeding Class C concentration limits, the regulation allows for evaluation of specific proposals for disposal of such waste on a case-by-case basis. The general criteria to be used in evaluating specific proposals are the Part 61 performance objectives contained in Subpart C of the regulation.

Current NRC activities include analyses of low-level waste that exceeds Class C concentration limits to determine the extent to which alternative near-surface disposal systems (e.g., concrete bunkers, augered holes, deeper disposal) may be suitable for safe disposal of such waste. These analyses include a more detailed characterization of physical, chemical, and radiological characteristics of wastes that may be close to or exceed Class C concentration limits; as well as development of improved methods for modeling the radiological and economic impacts of disposal of these wastes. A related activity is development of more specific guidance for design and operation of alternative near-surface and other land disposal systems. These activities represent a continuation of the Part 61 rulemaking process as discussed in the December 27, 1982 notice of the final Part 61 regulation (47 Fed. Reg. 57446).

Wastes exceeding Class C concentrations are projected to be generated by nuclear power reactors and other supporting nuclear fuel cycle facilities, and also generated by radioisotope product manufacturers and other facilities and licensees outside of the nuclear fuel cycle. Such wastes can be grouped as follows:

--Plutonium-contaminated nuclear fuel cycle wastes --Activated metals
--Sealed sources --Radioisotope product manufacturing wastes --Other waste

Plutonium-contaminated nuclear fuel cycle wastes. These wastes are being generated from two principal sources. One source of waste arises from operations supporting the nuclear fuel cycle -- i.e., post-irradiation radiochemical and other performance analyses of spent fuel rods from nuclear reactors (e.g., "burnup" studies). These operations generate about 200 ft^3 of plutonium-contaminated waste per year, much of which is believed to exceed Class C concentration limits. This waste consists of solidified liquids and other solid material such as scrap, trash, and contaminated equipment. Eventual decommissioning of the three facilities currently performing these analyses is expected to generate additional waste volumes, a portion of which is expected to exceed Class C concentration limits.

The second source of waste arises from fuel cycle licensees who have previously been authorized to use plutonium in research and development of advanced reactor fuels. None of these licensees is using plutonium now, and there is no prospect in the foreseeable future for such activities. In fact, each of the licensees in this category has either decommissioned, or is in the process of decommissioning, its facility. Some of the licensees have made contractual arrangements to transfer their decommissioning waste to DOE for retrievable storage. Approximately 5,000 to 10,000 ft^3 of waste, however, is projected to be generated on a one-time basis that will not be covered by contract.

Activated metals. Activated metals are typically generated as a result of long-term neutron bombardment of metals forming the structure or internal components of a nuclear reactor used for power production, radioisotope production, or other purposes (e.g., education, testing, research). Activated metal wastes are unlike most other wastes being generated in that the radionuclides form part of the actual metal matrix rather than being mixed with large volumes of other, nonradioactive material such as paper, cloth or resins. Radionuclide release is principally governed by the material corrosion rate, and for most reactor metals of concern (e.g., stainless steel), the corrosion rate is quite low.

To date, only a small fraction (about 200 ft^3/yr) of the activated metal waste currently being generated by nuclear power reactors has been identified as exceeding Class C concentration limits. Such waste appears to primarily consist of in-core instrumentation which is no longer serviceable. An example of this waste is a reactor flux wire which is physically small but may be high in activity. (A flux wire is a wire that is inserted into a tube running the length of the reactor core and used to make neutron flux measurements.)

Larger quantities of activated metal wastes are projected to be generated in the future as a part of reactor decommissioning. Studies by NRC (NUREG/CR-0130, Addendum 3 and NUREG/CR-0672, Addendum 2) indicate that over 99% of the waste volume that is projected to result from nuclear power reactor decommissioning will not exceed Class C concentration limits and the 1% that is projected to exceed these limits will be almost all activated metals from core structures. Conservative estimates presented in these studies indicate that packaged quantities of decommissioning wastes exceeding Class C concentration limits will total about 4700 ft^3 for a large (1175 MWe) pressurized water reactor (PWR) and about 1660 ft^3 for a large (1155 MWe) boiling water reactor (BWR). Much smaller quantities of wastes exceeding Class C concentration limits may also be generated from future decommissioning of test, research, and education reactors.

Another source of activated metal waste is expected to arise as part of consolidation of spent fuel assemblies for storage and/or disposal. Spent fuel assemblies now being periodically discharged from nuclear power reactors are stored in on-site fuel storage pools. Each assembly is composed of a large number of fuel rods arranged in a rectangular array, and held in place by spacer grids, tie rods, metal end fittings, and other miscellaneous hardware. One option under consideration for long-term waste storage and eventual disposal is to remove this hardware from the fuel rods. This allows the fuel rods, which contain the fission products which are of primary interest in terms of geologic repository disposal, to be consolidated into a smaller volume. This enables more economical storage and easier handling for transport and disposal. The hardware, which is composed of various types of corrosion-resistant metals such as Inconel or zircalloy, becomes a second waste stream which could potentially be safely disposed by a less expensive method than a geologic repository.

Based on information from DOE (DOE/RW-0006, September, 1984) about 12 kg of waste hardware would be generated per BWR fuel assembly, and about 26 kg per PWR fuel assembly. Assuming 200 fuel assemblies are replaced per year per large (1000 MWe) BWR, roughly 2400 kg of activated metal hardware would be generated per year per large BWR, and about 1700 kg per PWR. An approximate compacted volume is on the order of 50 ft^3/yr per large reactor, or about 4,000 ft^3/yr over the entire nuclear industry. Depending upon parameters such as the fuel irradiation history and the hardware elemental composition, particular pieces of separated hardware may or may not exceed Class C concentration limits.

Other than perhaps a few isolated cases, all of the spent fuel assemblies are being stored by licensees with the hardware still attached. Under the provisions of the NWPA, operators of nuclear power plants have entered into contracts with DOE for acceptance by DOE of the spent fuel for storage and eventual disposal. (See 48 Fed. Reg. 16590, April 18, 1983 for the terms of the contract.) Acceptance of the spent fuel by DOE implies acceptance of the activated hardware along with the fuel rods, with the result that disposal of the hardware would intrinsically be a Federal rather than a State responsibility. Disposal responsibility becomes less clear if licensees, seeking more efficient onsite storage, consolidate fuel themselves.

Sealed sources. A number of discrete sealed sources have been fabricated for a variety of medical and industrial applications, including irradiation devices, moisture and density gauges, and well-logging gauges. Each source contains only one or a limited number of radioisotopes. Sealed sources can range in activity from a few millionths of a curie for sources used in home smoke detectors to several thousand curies for sources used in radiotherapy irradiators. Sealed sources are produced in several physical forms, including metal foils, metal spheres, and metal cylinders clamped onto cables. The larger activity sealed sources typically consist of granules of radioactive materials encapsulated in a metal such as stainless steel.

Sealed sources are generally quite small physically. Even sources containing several curies of activity have physical dimensions which are normally less than an inch or two in diameter and 6 inches in length. These dimensions are such that, like activated metals, sealed sources may be considered to be a unique form of low-level waste. Characterizing sealed sources in terms of radionuclide concentration certainly appears to be of less utility than characterizing sealed sources in terms of source activity.

Depending upon the application, sealed sources may be manufactured using a variety of different radioisotopes. A review of the NRC sealed source registry was conducted to identify those source designs which may contain radioisotopes in quantities that might exceed Class C concentration limits. The principal possibilities appear to be those containing cesium-137, plutonium-238, plutonium-239, and americium-241. Large cesium-137 sources are generally used in irradiators, and while some large sources can range up to a few thousand curies, most which are sold appear to contain in the neighborhood of 500 curies. Cesium-137 is a beta/gamma emitter having a half-life of 30 years, which suggests that special packaging and disposal techniques can be readily developed for safe near-surface disposal of sources containing this isotope.

The remaining three isotopes are alpha emitters and are longer lived. Sources manufactured using these isotopes can range up to a few tens of curies, although most that have been sold appear to be much less than one curie in strength. Plutonium-239 sources are not commonly manufactured. Plutonium-238 sources have been manufactured for use as nuclear batteries for applications such a heart pacemakers. Plutonium-238 has also been used in neutron sources, although neutron sources currently being manufactured generally contain americium-241. Americium-241 is also used in a wide variety of other industrial applications such as fill level gauges.

Neutron sources produce neutrons for applications such as reactor startup, well logging, mineral exploration, and clinical calcium measurements. These sources contain alpha-emitting radionuclides such as americium-241 plus a target material (generally beryllium) which generates neutrons when bombarded by alpha particles. Neutron sources can contain up to approximately 20 curies of activity.

It is difficult to project potential waste sealed source quantities and activities, since sealed sources as wastes are not routinely generated as part of licensed operations. In addition, sealed sources only become waste when a decision is made by a licensee to treat them as such. In many instances sources held by licensees may be recycled back to the manufacturer when they are no longer usable, and the radioactive material recovered and fabricated into new sources. Finally, source manufacturers are licensed by the NRC and NRC Agreement States to manufacture a particular source design up to a specified radioisotope curie limit. Most actual sources, however, contain activities considerably less than the design limit.

NRC staff estimates that licensees currently possess approximately 10,000 encapsulated sources having activities above a few thousandths of a curie and containing americium-241 or plutonium-238. Given the hypothetical case that all these sources were candidates for disposal, the total consolidated source volume would be only about 35 ft^3. After packaging for shipment, however, the total disposed waste volume would be significantly increased. The total activity contained in the sources is estimated to be approximately 70,000 curies.

Radioisotope product manufacturing wastes. Wastes exceeding Class C concentration limits are occasionally generated as part of manufacture of sealed sources, radiopharmaceutical products, and other materials used for industrial, educational, and medical applications. Volumes and characteristics

of such wastes are difficult to project. However, it is believed that the largest volume of this waste consists of sealed sources which cannot be recycled, plutonium-238 and americium-241 source manufacturing scrap, and waste contaminated with carbon-14.

Sealed sources as a waste form are discussed above. Manufacture of large plutonium-238 and americium-241 sources is concentrated in only a few facilities, from which the generation of waste exceeding Class C concentration limits is believed to total only a few hundred ft^3 per year. Approximately 10 ft^3 per year of carbon-14 waste is generated as a result of radiopharmaceutical manufacturing.

Other wastes. Although the above discussed wastes are believed to be the principal wastes that are expected to exceed Class C concentration limits, other wastes may occasionally also be generated. For example, relatively small quantities of such wastes are currently being generated as part of decontamination of the Three Mile Island, Unit 2, nuclear power plant. However, these wastes are being generated as a result of an accident, are therefore considered abnormal, and are being transferred to DOE under a memorandum of understanding with NRC. Wastes exceeding Class C concentration limits and generated as part of the West Valley Demonstration Project are also being transferred to DOE for storage pending disposal.

Sealed sources and other waste containing discrete quantities of radium-226 may also exceed Class C concentration limits. Products containing radium-226 have been manufactured in the past for a variety of industrial and medical applications. Such wastes are not regulated by NRC but occasionally have been disposed at licensed low-level waste disposal facilities. NRC is currently investigating the impacts of disposal of such waste in order to provide guidance to States and other interested parties on safe disposal methods and any concentration limitations.

LIST OF SUBJECTS IN 10 CFR PART 60

High-level waste, Nuclear power plants and reactors, Nuclear materials, Penalty, Reporting requirements, Waste treatment and disposal.

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Dated at Washington, DC, this _____ day of _____, 1986.

For the Nuclear Regulatory Commission.

_____

Samuel J. Chilk
Secretary of the Commission

ENCLOSURE B

NUREG-0946

AN EVALUATION OF RADIONUCLIDE CONCENTRATIONS IN HIGH-LEVEL RADIOACTIVE WASTES

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ENCLOSURE B

ABSTRACT

This report describes a possible approach for development of a numerical definition of the term "high-level radioactive waste." Five wastes are identified which are recognized as being high-level wastes under current, non-numerical definitions. The constituents of these wastes are examined and the most hazardous component radionuclides are identified. This report suggests that other wastes with similar concentrations of these radionuclides could also be defined as high-level wastes.

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AN EVALUATION OF RADIONUCLIDE CONCENTRATIONS

IN HIGH-LEVEL RADIOACTIVE WASTES

Introduction: It has long been recognized that certain radioactive materials produced in the uranium fuel cycle are sufficiently hazardous to require disposal in a manner that results in permanent isolation from the environment, and these materials have been termed "high-level radioactive wastes" (HLW). The term "high-level radioactive waste" is currently defined qualitatively and refers to the source (namely, spent fuel and waste from reprocessing operations), rather than the hazard of a waste stream. The Nuclear Waste Policy Act (NWPA) recognizes that wastes from other sources may present equivalent hazards and may require treatment and disposal in a similar manner. Thus, under section 2(12)(B) of NWPA, "high-level radioactive waste" means not only wastes from reprocessing but also "other highly radioactive material that the Commission, consistent with existing law, determines by rule requires permanent isolation."

The purpose of this evaluation is to determine whether it is feasible to develop a concentration-based approach which could be used to identify other highly radioactive material requiring permanent isolation. Concentrations are derived from consideration of representative waste streams and forms traditionally considered to be HLW. A table, based on these concentrations, is developed identifying the important radionuclides and associated concentrations. Highly radioactive material containing these radionuclides in similar or higher concentrations could then be classified as HLW. Such an approach is attractive as it would preserve consistency with the Commission's present definitions of HLW, such as set forth in 10 CFR Part 60.

This evaluation seeks to determine the approximate range of radionuclide concentrations which would identify radioactive wastes requiring permanent isolation. Should the Commission decide that a generic numerical definition (in terms of radionuclide concentrations) is an appropriate way to identify such wastes, the values derived in this paper could be used in such a definition. They represent the NRC staff's best current estimate of the radionuclide concentrations which would require permanent isolation. However, additional studies may be needed before formally proceeding with a numerical definition as a proposed rule in order to make certain that the values are low enough to capture most of the wastes that do require permanent isolation without including wastes that do not require such isolation.

Current HLW Definitions: The Atomic Energy Commission staff, in its staff paper regarding the proposed policy "Siting of Commercial Fuel Reprocessing Plants and Related Waste Management Facilities," (ref. 1) defined high-level liquid wastes as:

> "-those which, by virtue of their radionuclide concentration, half-life and biological significance, require perpetual isolation from the biosphere, even after solidification. The only anticipated sources of such wastes in significant quantities are those aqueous wastes resulting from the operation of the first cycle solvent extraction system and the concentrated wastes from subsequent extraction cycles in a facility for reprocessing irradiated reactor fuels."

In the proposed Appendix D to 10 CFR Part 50 that was eventually published in the Federal Register for comment (34 FR 8712), an abbreviated definition was employed:

> "For the purposes of this statement of policy, high-level liquid radioactive wastes means those wastes resulting from the operation of the first cycle solvent extraction system and the concentrated wastes from subsequent extraction cycles in a facility for reprocessing irradiated reactor fuels."

This abbreviated definition, with minor changes to apply to equivalent waste streams from alternative reprocessing systems, was incorporated into the final rule, Appendix F to 10 CFR Part 50 (35 FR 17530), and the term "high-level radioactive waste" was subsequently used in 10 CFR Part 60, pertaining to disposal at a geologic repository, to also include spent nuclear fuel and solidified high-level liquid wastes.

The staff paper did not indicate the range of concentrations, half-lives or biological significance the AEC staff considered would require perpetual isolation. However, the Federal Register notice for the final rule referenced AEC contractor studies that provided the basis for the costs of implementing the final rule (ref. 2). This report contains calculated inventories of radioactive materials in wastes from reprocessed commercial light water reactor and liquid-metal cooled fast breeder reactor fuels for times up to 1,000 years after reprocessing. In the report, high-level wastes are defined as wastes that contain radionuclides in excess of 10^6 times the maximum permissible concentrations for ingestion (MPC_w) recommended by the International Commission on Radiological Protection (ref. 3). The contractor study notes that about five cubic miles of water would be required to dilute to MPC_w the fission products present in the waste obtained from processing one metric ton of fuel that had been irradiated to an exposure of 10,000 Mwd (thermal). The contractor study further notes that the wastes would contain variable quantities of actinides, notably isotopes of Pu, Am and Cm, with half-lives and biological toxicities that impose additional restrictions. The contractor study stated that fission product separation, dilution or decay would not offer a feasible method of managing these wastes.

Thus, it is clear that both concentrations and duration of hazard have been important considerations in previous attempts to define HLW.

Other Waste Classifications: In 10 CFR Part 61, "Licensing Requirements for Land Disposal of Radioactive Waste" (47 FR 57446), the NRC defined three classes of radioactive wastes (Classes A, B and C) which are routinely acceptable for disposal in shallow land burial facilities. Class C wastes represent the highest radionuclide concentrations of the three classes, and the maximum Class C concentrations are defined as follows:

Long-lived nuclides:

C-14	8 Ci/m^3
C-14 in activated metal	80 Ci/m^3
Ni-59 in activated metal	220 Ci/m^3
Nb-94 in activated metal	0.2 Ci/m^3
Tc-99	3.0 Ci/m^3
I-129	0.08 Ci/m^3
Alpha emitting TRU, half-life > 5yrs	100 nCi/gm
Pu-241	3500 nCi/gm
Cm-242	20,000 nCi/gm

Short-lived nuclides:

Total all nuclides, half-life < 5 yrs	no limit
H-3	no limit
Co-60	no limit
Ni-63	700 Ci/m^3
Ni-63 in activated metal	7000 Ci/m^3
Sr-90	7000 Ci/m^3
Cs-137	4600 Ci/m^3

When a mixture of radionuclides is present in a waste, a sum-of-the-fractions rule is applied to determine how the mixture should be classified.

The Class C definition of Part 61 identifies waste concentrations routinely acceptable for shallow land burial, but also allows case-by-case evaluations of wastes with concentrations exceeding the Class C limits. These limits are therefore not appropriate for identifying wastes requiring permanent isolation, although they do limit the range of concentrations which might be considered for classification as high-level wastes.

Characterizing the Hazard of HLW: The discussion which follows is largely drawn from reference 4.

As nuclear fuel is irradiated in a nuclear reactor, three types of radioactive products are formed. Fission products are generated by fissioning uranium and plutonium isotopes and, with a few exceptions, are characterized by relatively short half-lives and low radiotoxicity. Actinides are radionuclides with atomic numbers greater than 88, and result from non-fission neutron absorptions in uranium. The actinides typically have longer half-lives and higher radiotoxicities than the fission products. Small quantities of additional radionuclides, called activation products, are produced by neutron absorption in the structural materials which support and contain the fuel in a reactor. The activation products make only a minor contribution to the overall radiotoxicity of HLW, and will not be discussed further.

Figure 1 presents the radioactivity of pressurized water reactor (PWR) spent fuel as a function of time after removal from a reactor, while Figures 2 and 3 present the same information for the wastes which would result from reprocessing the spent fuel from the uranium recycle and mixed oxide fuel cycles, respectively.* (Figures 1-3 are normalized on the basis of one metric tonne of heavy metal (MTHM) initially charged to a reactor.)

---

*In the uranium recycle fuel cycle, it has been assumed that 99.5% of the plutonium in spent fuel is recovered and placed in storage, while the recovered uranium is returned to the fuel cycle. In the mixed oxide fuel cycle, both plutonium and uranium are returned to the fuel cycle. Ref. 5 discusses additional assumptions.

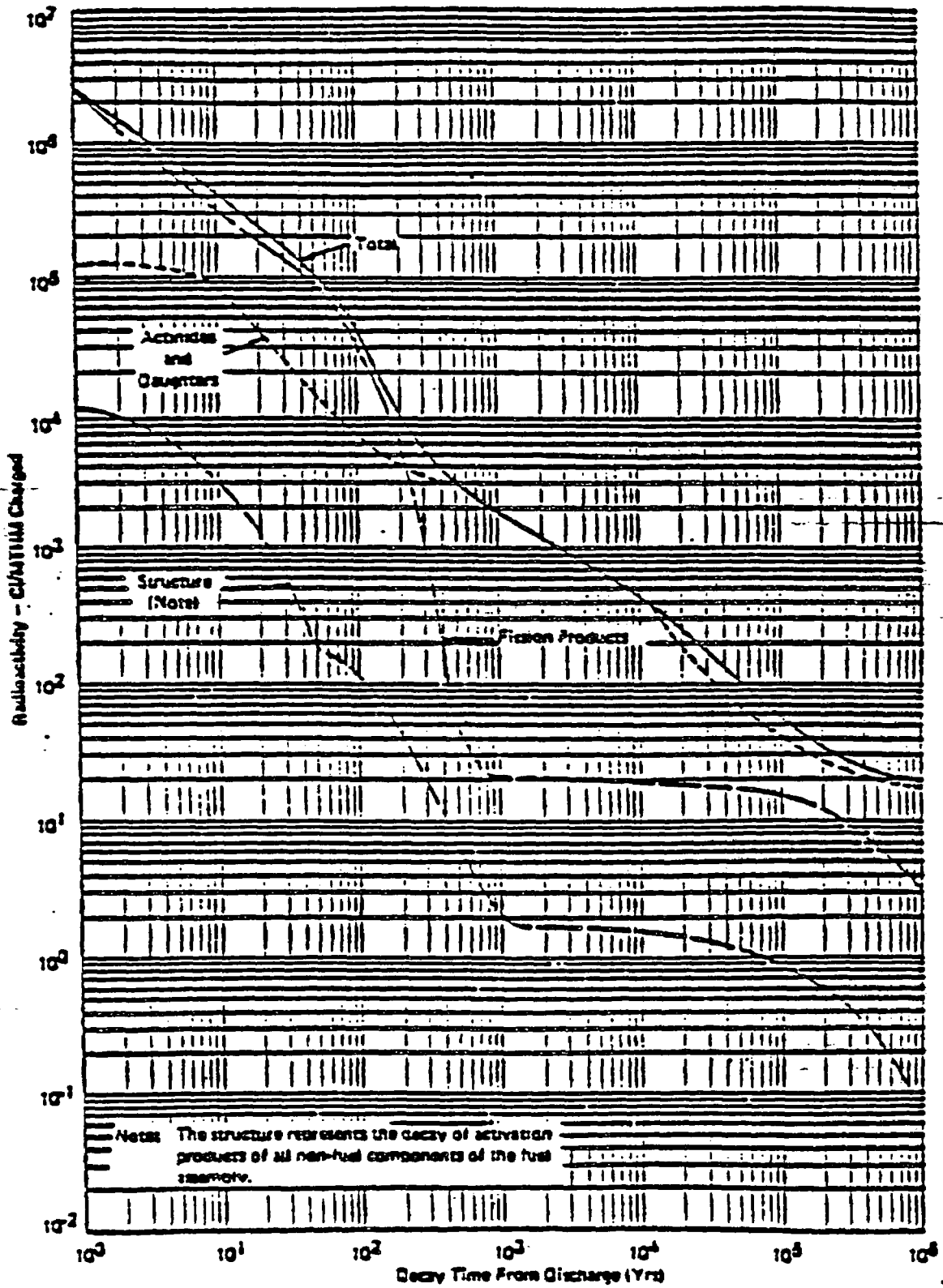

Figure 1. PWR Spent Fuel -- Radioactivity (Ref. 5)

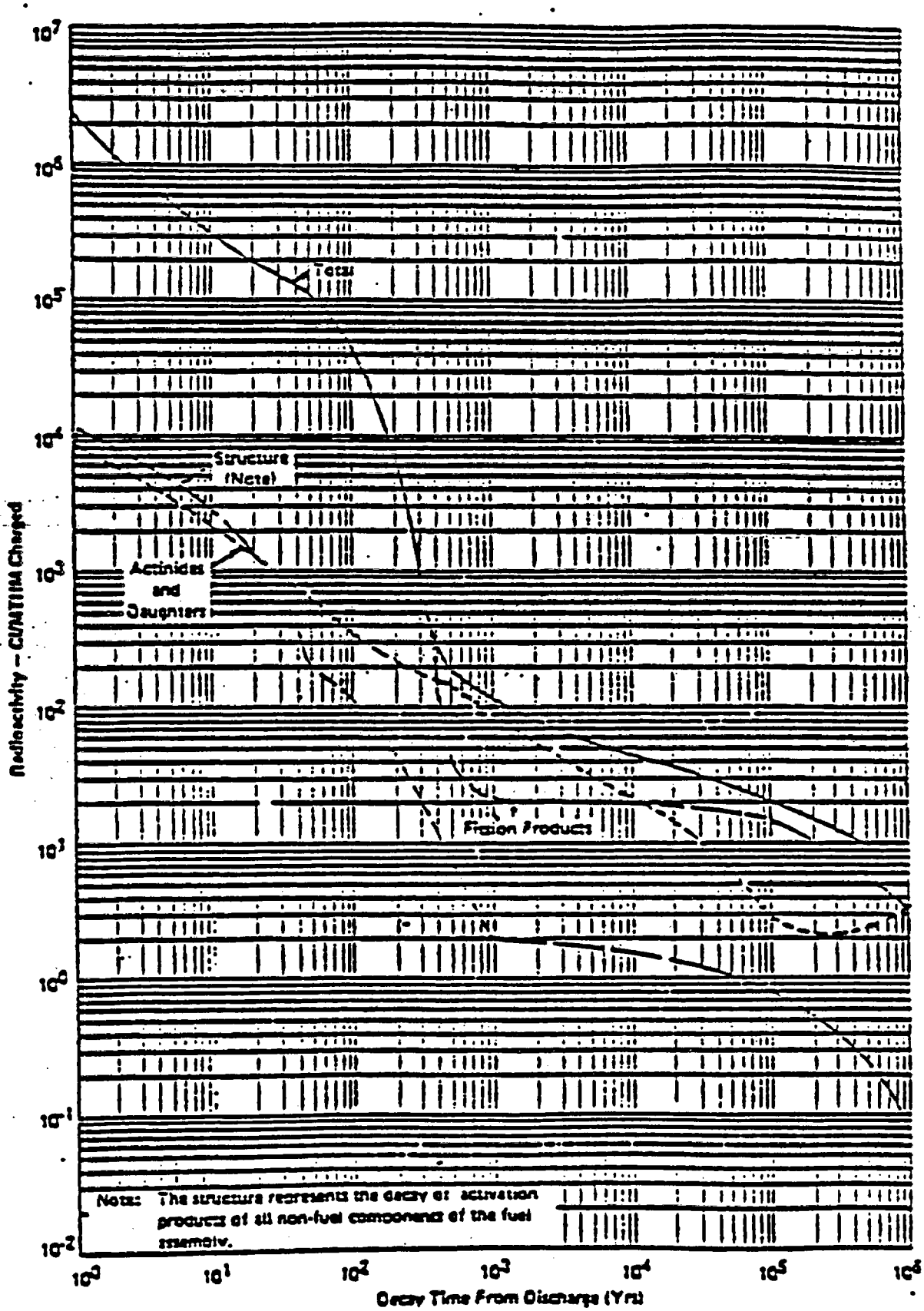

Figure 2. Uranium Recycle Reprocessing Waste -- Radioactivity (Ref. 5)

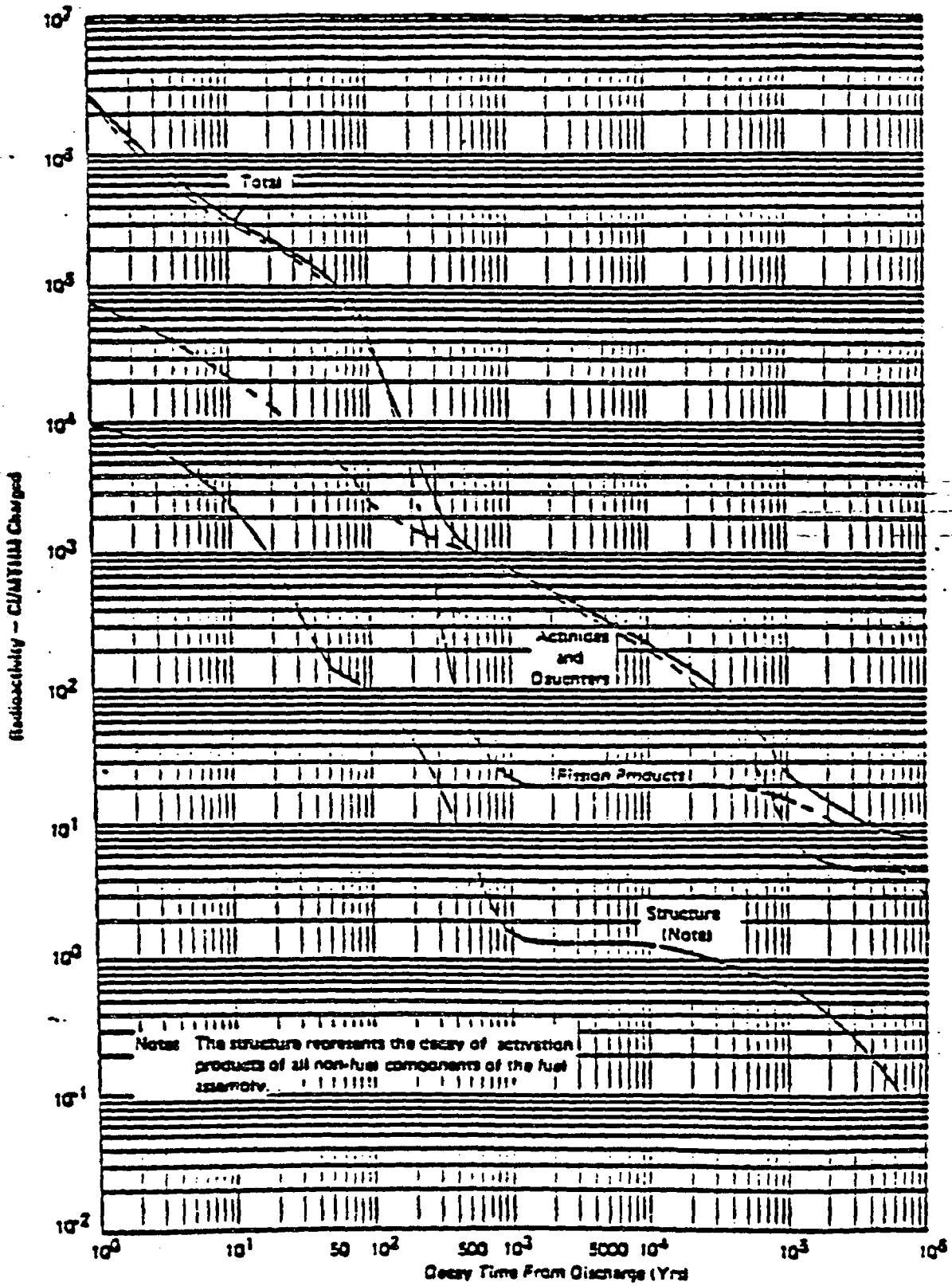

Figure 3. Mixed Oxide Reprocessing Waste -- Radioactivity (Ref. 5)

In all three fuel cycles, the fission product radioactivity decreases by five orders of magnitude during the first thousand years and then stays relatively constant until about 100,000 years after disposal. Much of this change (about 99.9% or more) occurs within the first few hundred years, primarily because of decay of Sr-90, Cs-137 and other short-lived fission products. Some of the shorter-lived actinides such as Pu-238 also decay significantly during the first few hundred years.

The preceding discussion does not address the differing radiotoxicities of the nuclides present in HLW. However, a rough estimate of the intrinsic hazard of a radioactive waste material can be obtained by calculating the "hazard index" or "untreated dilution index" (UDI) defined by:

$$UDI = \Sigma \frac{Qi}{MPC_i}$$

where Qi is the activity of nuclide i in the waste and MPC_i is the concentration limit for the nuclide in effluents as presented in 10 CFR 20.* This "untreated dilution index" then represents the quantity of water (in cubic meters) which would be required to dilute the waste to meet the effluent concentration limits of Part 20. Figures 4, 5 and 6 present this index as a function of time for spent fuel and reprocessing wastes. These figures also include, for perspective, the "untreated dilution index" for an equivalent amount of unmined uranium ore.

*The concentration limits of 10 CFR Part 20 may, for some radionuclides, vary somewhat from the corresponding limits in Ref. 3.

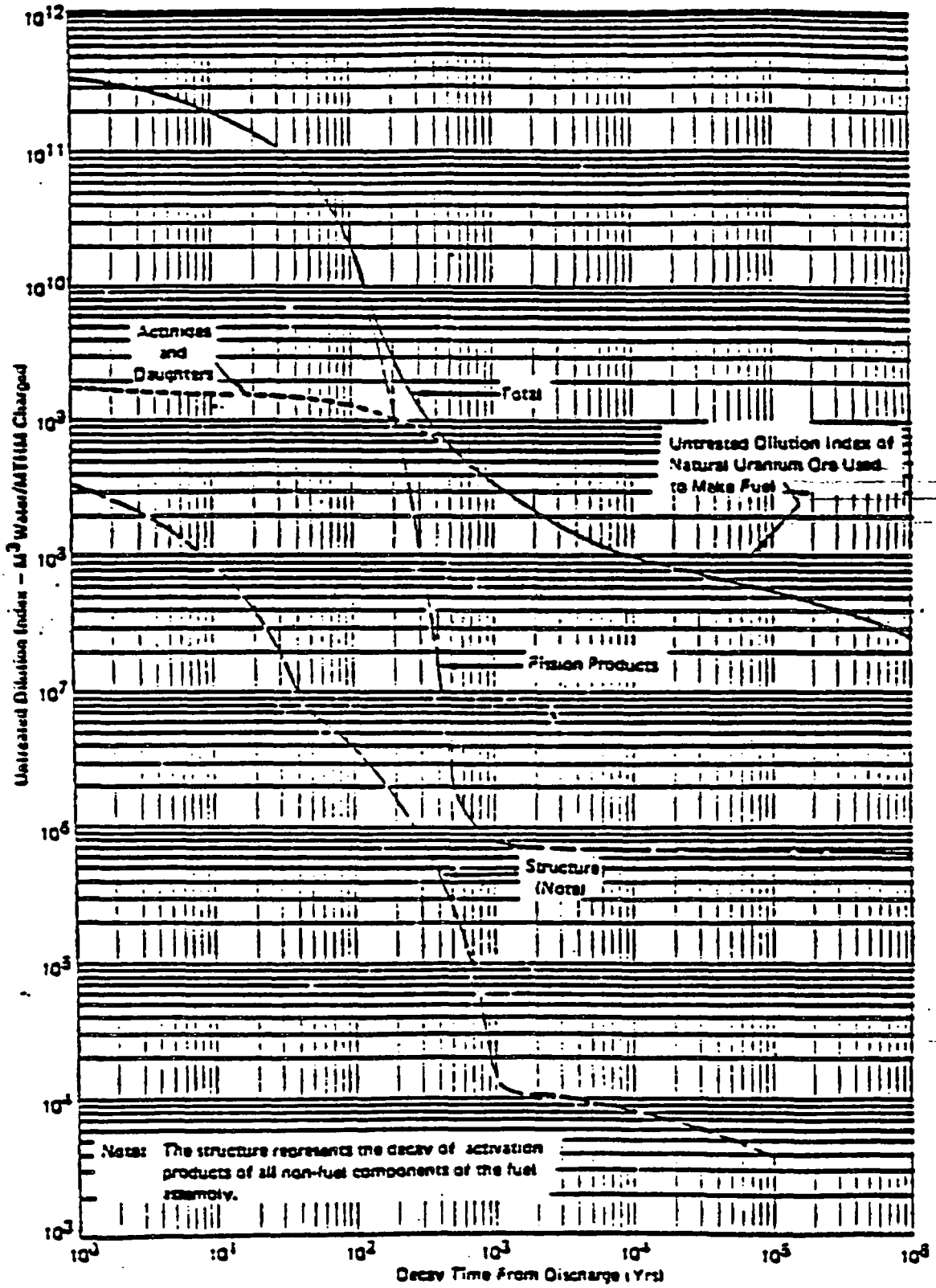

Figure 4. PWR Spent Fuel -- Untreated Dilution Index (Ref. 5)

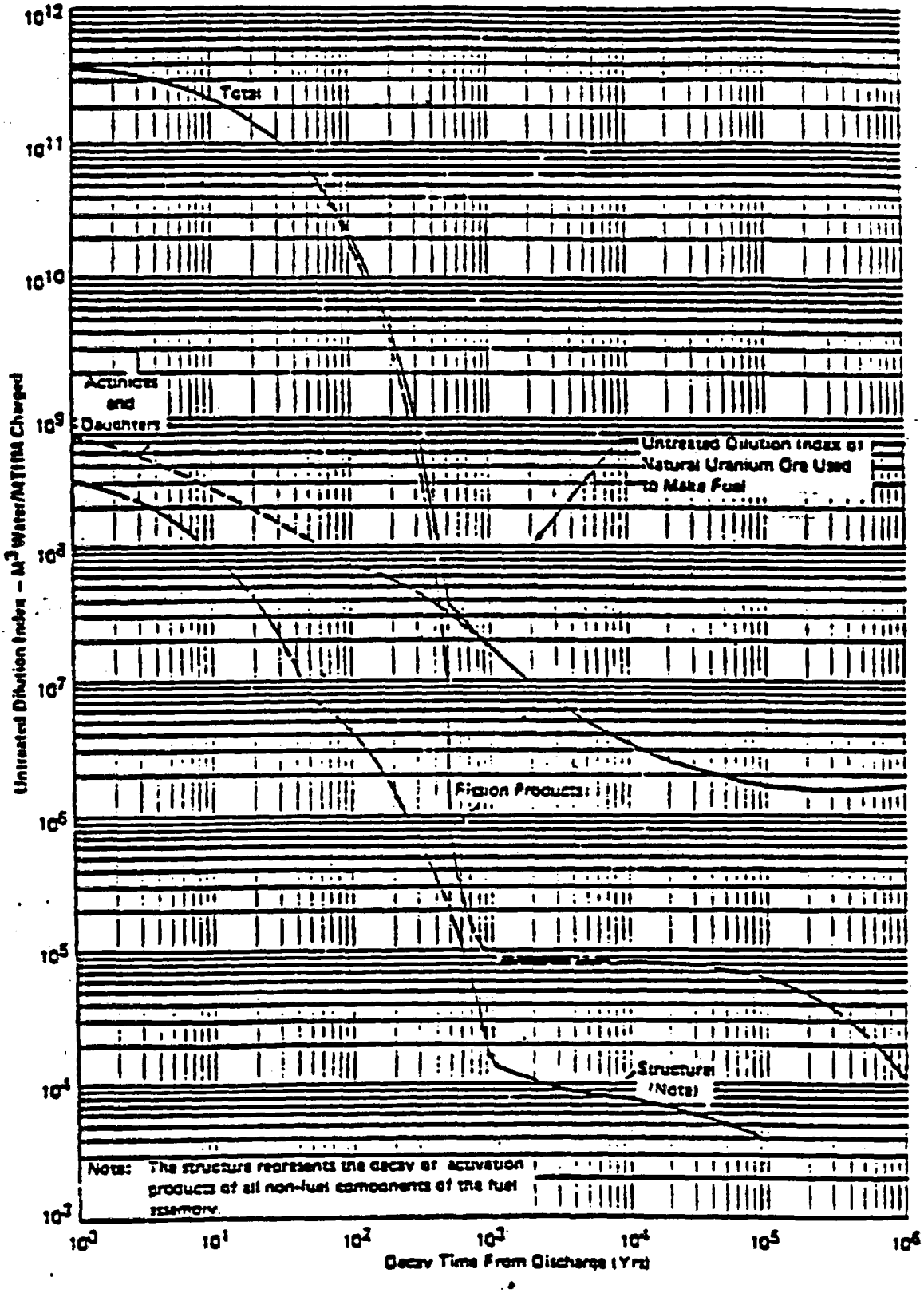

Figure 5. Uranium Recycle Reprocessing Waste -- Untreated Dilution Index (Ref. 5)

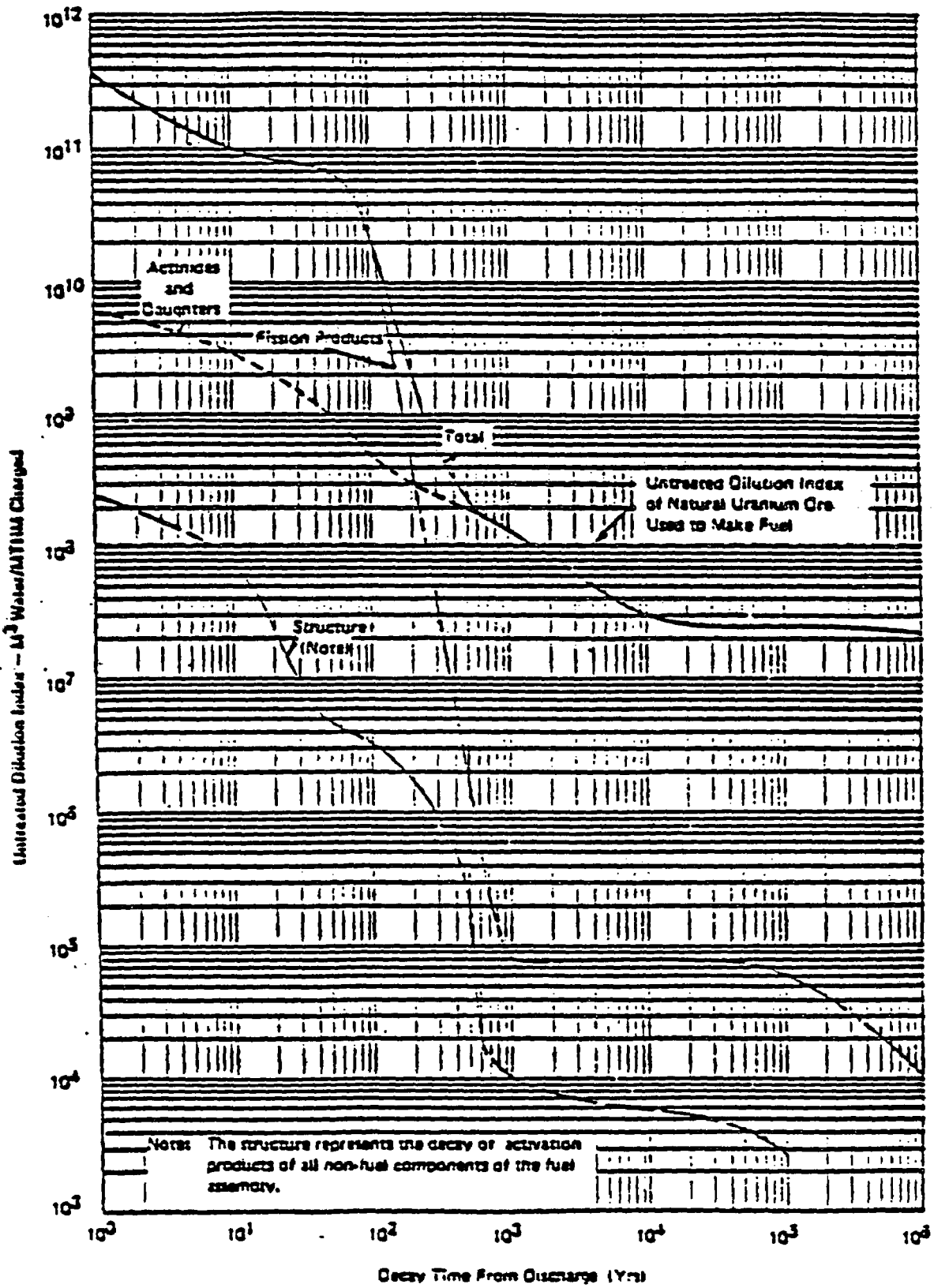

Figure 6. Mixed Oxide Reprocessing Waste -- Untreated Dilution Index (Ref. 5)

Recent revisions in the ICRP's recommendations for dosimetry calculations (ref. 6) would cause some significant changes in this measurement of the relative hazard of HLW as a function of time. This effect has been noted recently in the scientific literature by a number of authors (ref. 7, 8 and 9). Revised curves, based on the more recent ICRP recommendations (ref. 6), are displayed in Figures 7, 8 and 9 for spent fuel and reprocessing wastes. (The NRC has not formally adopted ICRP-30, but the procedures described in it have been used here because it is the most current ICRP publication on internal dosimetry available.) The most significant results of the ICRP revisions are:

1) the hazard of some of the fission products (primarily Sr-90) is reduced,

2) the hazard of several of the long-lived actinides is increased (especially Am-241, Am-243 and Np-237), and

3) the hazard of Ra-226 is reduced and, as a result, the hazard of the original uranium ore is reduced.

The UDI curves of Figures 4-9 indicate that the toxicity decreases substantially (90% - 99.9%) during the first 1000 years for all three waste types and for both dosimetry approaches considered. The toxicity of the fission products decreases by more than five orders of magnitude during the first 1,000 years and then remains essentially constant for the next 100,000 years. Figures 4-9 also indicate that radioactive decay of spent fuel and reprocessing wastes during the first 10,000 years reduces the toxicity of these materials to approximately that of the original uranium ore from which they were derived, although this comparison is strongly dependent on the dosimetry approach employed.

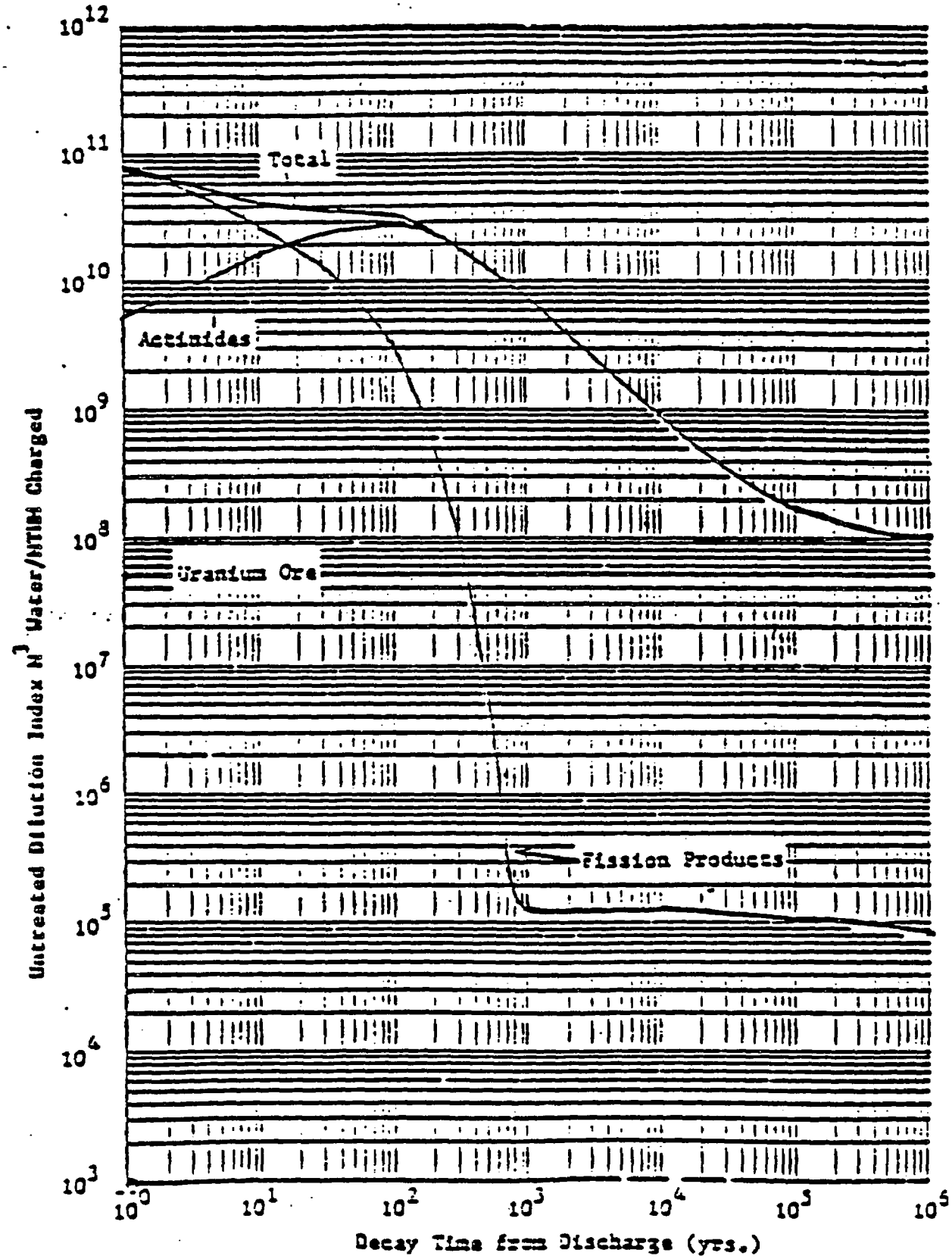

Figure 7. PWR Throwaway Cycle -- Untreated Dilution Index Based on ICRP-30 Dosimetry

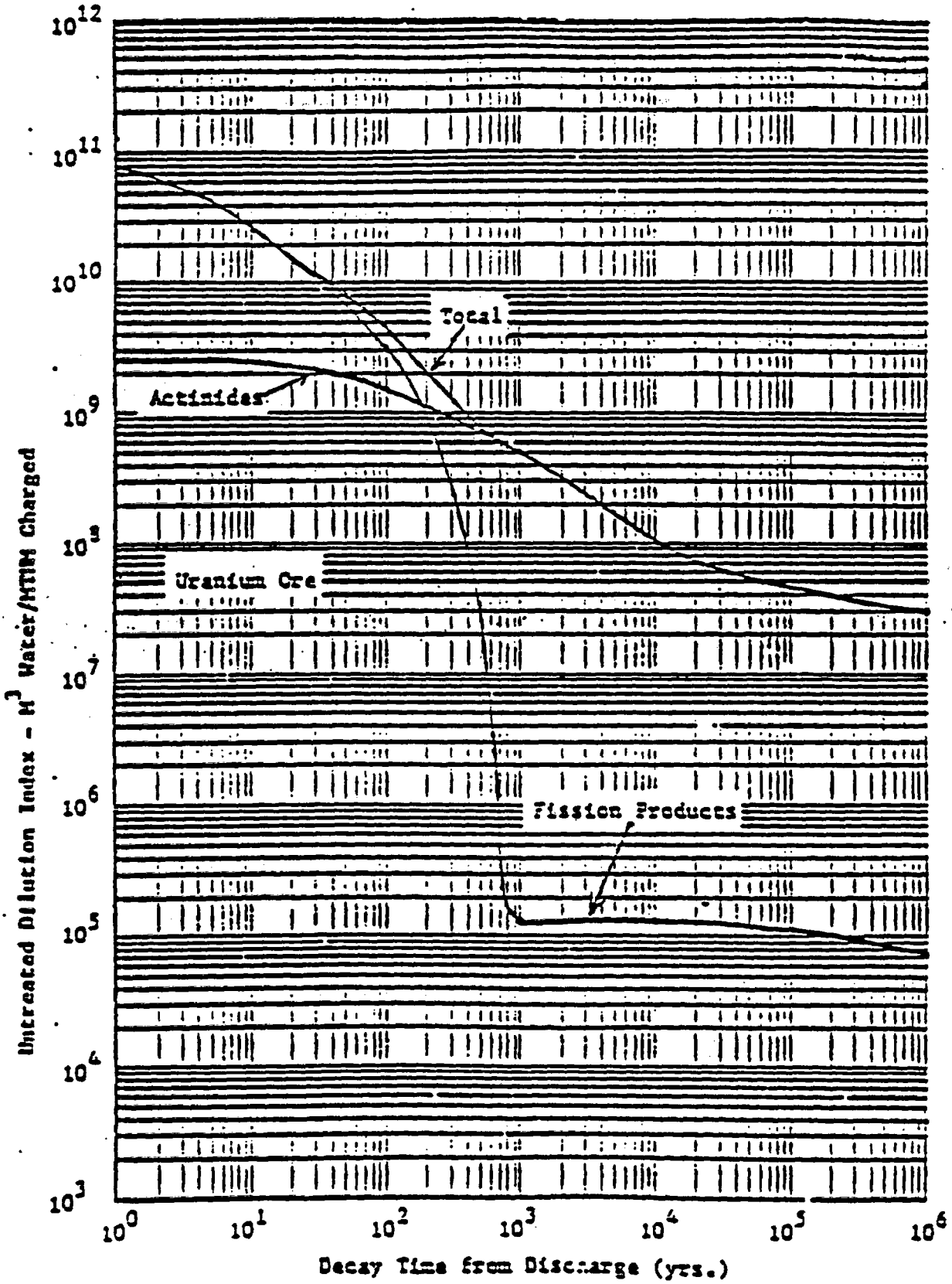

Figure 8. Reprocessed Waste -- Untreated Dilution Index Based on ICRP-30 Dosimetry

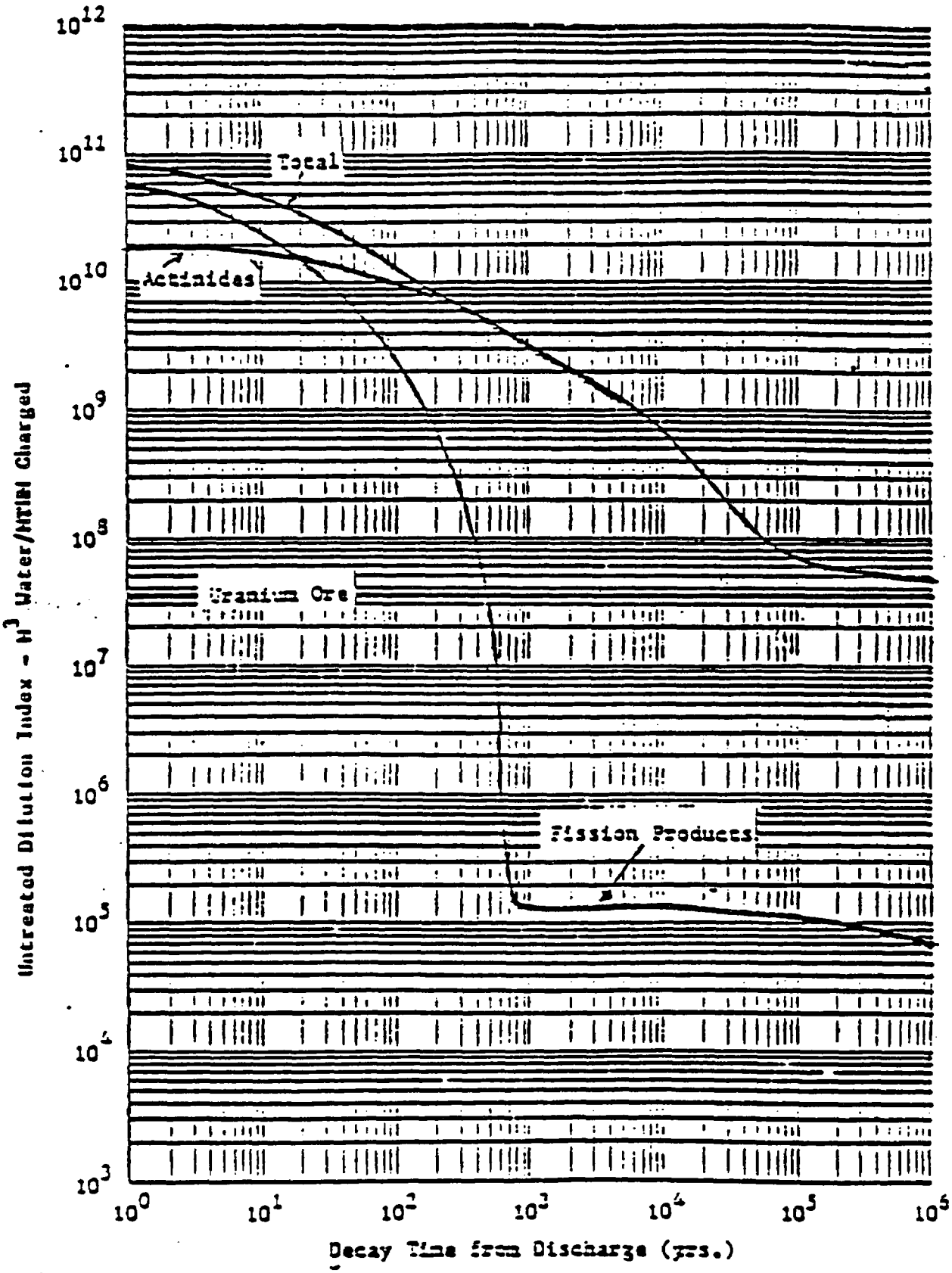

Figure 9. Mixed Oxide Reprocessing Waste -- Untreated Dilution Index Based on ICRP-30 Dosimetry

The "untreated dilution index" can provide some perspective regarding the intrinsic toxicity of a radioactive material, but is subject to the following limitations:

- The UDI does not consider the physical or chemical form of the radioactive material. Properties such as solubility or leachability may significantly affect the true hazard to human health.

- The location of the material and the pathways through which it could reach humans are not considered.

- There is considerable uncertainty inherent in the dosimetry parameters upon which the UDI is based, leading to considerable uncertainty in the index itself.

In the past, the UDI (also referred to as "Ingestion Hazard Index" or simply "Hazard Index") has been widely used to identify the most radiotoxic components of wastes (e.g., ref. 4, 5, 13 and 14). In spite of its limitations, this index can provide an approximate estimate of the relative toxicities of individual nuclides as they exist in a waste. Figures 4 - 9 also give an approximate estimate (as a function of time) of the relative toxicities of wastes and the original uranium ore from which the wastes were derived.

Representative HLW Waste Streams and Forms: Using the Commission's current definitions of HLW, five HLW waste streams and forms were identified as being representative of wastes requiring permanent isolation:

(1) Savannah River Plant (SRP) "fresh" (ref. 10). This waste stream is taken to be representative of the defense high-level liquid wastes being produced when the NRC's current HLW definitions were developed.

This waste is a composite liquid waste stream containing both "first cycle" and subsequent cycle wastes resulting from reprocessing defense wastes six months after removal from a reactor. The reprocessing technology employed at SRP is representative of recent (and probably of future) defense waste processing, although it is not representative of some of the earliest separations technology employed at the Hanford site*.

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*Two defense HLW inventories at Hanford and Idaho were deemed not to be representative for purposes of deriving the concentration limits.

(1) While the defense wastes at the Hanford site represent a sizeable inventory, they were not included in this work for two reasons. First, little relevant information is available. Published information gives estimates of the total waste inventories at Hanford, but does not provide detailed information on radionuclide concentrations. Second, the wastes at Hanford are not particularly representative of the types of wastes which the Commission has defined as HLW. Some of the wastes were separated using chemical process technologies now considered obsolete, and some of the wastes have been processed as many as three times for separation of plutonium, uranium and high-heat generating nuclides (Sr-90 and Cs-137). In addition, the variety of reactors and operating conditions employed at Hanford argue against considering the Hanford wastes as "typical" HLW. For these reasons, the SRP wastes were selected as being more representative of defense HLW.

(2) The defense wastes at Idaho were also excluded from this study for the purpose of determining representative concentrations of waste constituents. These wastes were derived from naval reactor fuels with compositions and burn-ups substantially different from other defense and commercial reactor fuels, and therefore are not considered to be representative of the bulk of the high-level wastes likely to be disposed of in the future.

(2) Savannah River Plant "reconstituted" (ref. 10). This waste is representative of the inventory of defense wastes currently in storage and is considered to be the most representative of defense HLW concentrations likely to be disposed of during the next few decades. These wastes include both "first-cycle" wastes and "concentrated intermediate" wastes, and represent the waste stream which would result if the wastes currently stored in SRP tanks (both sludge and supernatant) were reconstituted to a slurry for removal from the tanks. Because most of the wastes have been stored for several years, most of the short-lived nuclides have decayed away.

(3) West Valley "Tank 8D2" (ref. 11). The West Valley wastes represent an actual waste inventory requiring disposal. This waste is analogous to the SRP "reconstituted" waste in that it is a hypothetical waste stream which would result if the sludge and supernatant of Tank 8D2 were reconstituted to a slurry for removal from the tank. Both commercial and defense wastes are present in Tank 8D2. Although some commercial wastes were reprocessed at West Valley, burn-ups were generally low and the radionuclide concentrations are only moderately higher than for defense wastes.

(4) Commercial Liquid HLW (ref. 12). This is a hypothetical waste stream based on reprocessing light-water reactor fuels with burn-ups typical of current commercial operating practices, and represents a potential waste stream requiring disposal in the future in the event that reprocessing of commercial reactor fuels is undertaken.

(5) Spent Fuel (ref. 12). In the absence of commercial reactor fuel reprocessing, disposal of spent fuel is expected to be the major source (in terms of radioactivity) of commercial high-level wastes in the future. This waste stream gives a rough estimate of the radionuclide concentrations in the fuel pins of spent light-water reactor fuel. The diluting effect of cladding, hardware, and void spaces between fuel pins was not included. Thus, this waste stream overestimates the actual nuclide concentration in a waste package containing spent fuel.

Characteristics of Wastes: Table 1 displays the concentrations of many of the radionuclides in the five waste streams described above. Also presented in Table 1 are the ratios of these concentrations to the maximum permissible concentrations (MPC) for ingestion (taken from 10 CFR Part 20 which is based, with a few modifications, on the recommendations of ref. 3) to allow a comparison with the high-level waste definition used in ref. 2.*

Each of the five waste streams exceeds the high-level waste definition of ref. 2 (10^6 times MPC) by at least three orders of magnitude, suggesting that these wastes were clearly considered to be high-level wastes when the Commission's current definition of the term was developed. The most prominent nuclides, in terms of their ratios to MPC, are Sr-90 and Cs-137, with the actinides being present at ratios closer to the ref. 2 definition.

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*This is not to suggest that the HLW definition of Ref. 2 should be adopted by the NRC. Rather, a comparison with the Ref. 2 definition is presented to gain some perspective regarding the types of radioactive materials which were considered to be "high-level" at the time Ref. 2 (and the NRC's current HLW definition) were published.

Nuclide	SRP (fresh) Ci/m³	SRP (fresh) Ratio to MPC	SRP (reconstituted) Ci/m³	SRP (reconstituted) Ratio to MPC	West Valley Tank 80Z (Total) Ci/m³	West Valley Tank 80Z (Total) Ratio to MPC	10 Y Old Comm Liquid HLW Ci/m³	10 Y Old Comm Liquid HLW Ratio to MPC	10 Y Old Spent Fuel Ci/m³	10 Y Old Spent Fuel Ratio to MPC
Ce-144, Pr-144	1.8E+4	1.8E+9	5.0E+1	5.0E+6	1.1E-2	1.1E+3	2.7E+2	2.7E+7	1.6E+3	1.6E+8
Pm-147	3.0E+3	1.5E+7	2.0E+2	1.0E+6	3.0E+1	1.5E+5	1.1E+4	5.5E+7	6.4E+4	3.2E+8
Ru-106, Rh-106	1.0E+3	1.0E+8	7.9E+0	7.9E+5	1.1E-1	1.1E+4	1.1E+3	1.1E+8	6.8E+3	6.8E+8
Sr-90	8.0E+2	2.7E+9	5.5E+2	1.8E+9	3.3E+3	1.1E+10	8.7E+4	2.9E+11	5.2E+5	1.7E+12
Cs-137	8.0E+2	4.0E+7	5.8E+2	2.9E+7	4.4E+3	2.2E+8	1.2E+5	6.0E+9	7.5E+5	3.8E+10
Cs-134	3.0E+2	3.3E+7	- No Data -		1.0E+1	1.1E+6	9.5E+3	1.1E+9	5.7E+4	6.3E+9
Sm-151	2.0E+1	5.0E+4	1.8E+1	4.5E+4	1.0E+2	2.5E+5	1.8E+3	4.5E+6	1.1E+4	2.8E+7
Tc-99	1.0E-1	5.0E+2	- No Data -		9.5E-1	4.8E+1	2.2E+1	1.1E+5	1.3E+2	6.5E+5
Eu-154	3.0E-2	1.5E+3	- No Data -		6.5E+1	3.2E+6	6.2E+3	3.1E+8	3.7E+4	1.8E+9
Zr-93	3.0E-2	3.8E+1	- No Data -		1.2E-1	1.5E+2	2.8E+0	3.5E+3	1.7E+1	2.1E+4
Cs-135	1.0E-2	1.0E+2	- No Data -		1.8E-2	1.8E+2	4.5E-1	4.5E+3	2.7E+0	2.7E+4
Sn-126	3.0E-3	1.0E+3	- No Data -		6.0E-2	2.0E+4	1.6E+0	5.3E+5	9.6E+0	3.2E+6
Se-79	3.0E-3	1.0E+3	- No Data -		2.5E-2	8.3E+3	5.8E-1	1.9E+5	3.5E+0	1.2E+6
I-129	3.0E-4	5.0E+3	- No Data -		2.4E-3	4.0E+4	2.8E-4	4.7E+3	3.3E-1	5.5E+6
Pu-238	3.0E+0	6.0E+5	2.6E+0	5.2E+5	7.5E-1	1.5E+5	5.2E+1	1.0E+7	2.0E+4	4.0E+9
Pu-241	5.0E-1	2.5E+3	- No Data -		3.5E+1	1.8E+5	5.5E+2	2.8E+6	6.9E+5	3.4E+9
Cm-244	3.0E-1	4.3E+4	2.6E-1	3.7E+4	4.4E+0	6.3E+5	1.4E+3	2.0E+8	9.0E+3	1.3E+9
Am-241	3.0E-1	7.5E+4	2.6E-1	6.5E+4	1.0E+1	2.5E+6	6.1E+2	1.5E+8	1.6E+4	4.0E+9
Pu-239	1.0E-1	2.0E+4	1.1E-1	2.2E+4	9.0E-1	1.8E+5	2.4E+0	4.8E+5	2.9E+3	5.8E+8
Pu-240	2.0E-2	4.0E+3	- No Data -		4.8E-1	9.6E+4	5.5E+0	1.1E+6	4.5E+3	9.0E+8
Np-237	1.0E-4	3.3E+1	- No Data -		1.2E-2	4.0E+3	7.8E-1	2.6E+5	3.1E+0	1.0E+6
Am-243	- No Data -		- No Data -		1.1E-1	2.8E+4	2.2E+1	5.5E+6	1.4E+2	3.5E+7
Totals	2.3E+4	4.7E+9	1.4E+3	1.8E+9	7.9E+3	1.1E+10	2.4E+5	3.0E+11	2.1E+6	1.8E+12

Table 1: Concentrations and Ratios to MPC for Five Wastes.

Because of the recent revisions in the ICRP's recommendations for dosimetry calculations (ref. 6), a new index was developed to provide an updated perspective on the relative hazards of the constituents of wastes. This index is defined as the ratio of the activity in a unit volume of waste to the Annual Limit of Intake defined in ref. 6, and represents the number of ALI's present in a unit volume of waste. Thus,

$$HI_i = C_i/ALI_i$$

where HI_i is the modified hazard index, C_i is the concentration, and ALI_i is the Annual Limit of Intake (for non-occupational exposure) for nuclide i. This index is, of course, a function of time and will change as a radionuclide concentration changes due to radioactive decay.

Table 2 displays the radionuclide concentrations and the corresponding ratios to the Annual Limit of Intake (ALI) for the same five wastes as in Table 1. Table 2 indicates the same general features as Table 1, with Sr-90 and Cs-137 dominating the hazard, although to a lesser extent than with the older dosimetry recommendations.

It has generally been recognized (e.g., ref. 15) that institutional controls are likely to be effective in controlling the hazards of wastes for at least a century after disposal, and it is therefore appropriate to consider the relative hazards of individual radionuclides at the end of a period of institutional control. Table 3 presents the radionuclide concentrations and ratios to ALI after 100 years of decay for each of the five wastes. At this time, the dominance of Sr-90 and Cs-137 has been reduced so that their hazard is within about an order of magnitude of the total hazard of the actinides, with the other fission products still representing a substantially lower hazard.

Nuclide	SRP (fresh) Ci/m^3	SRP (fresh) Ratio to ALI	SRP (reconstituted) Ci/m^3	SRP (reconstituted) Ratio to ALI	West Valley Tank 8D2 (Total) Ci/m^3	West Valley Tank 8D2 (Total) Ratio to ALI	10 Y Old Comm. Liquid HLW Ci/m^3	10 Y Old Comm. Liquid HLW Ratio to ALI	10 Y Old Spent Fuel Ci/m^3	10 Y Old Spent Fuel Ratio to ALI
Ce-144, Pr-144	1.8E+4	9.0E+8	5.0E+1	2.5E+6	1.1E-2	5.5E+2	2.7E+2	1.4E+7	1.6E-3	8.0E+7
Pm-147	3.0E+3	7.5E+6	2.0E+2	5.0E+5	3.0E+1	7.5E+4	1.1E+4	2.8E+7	6.4E+4	1.6E+8
Ru-106, Rh-106	1.0E+3	5.0E+7	7.9E+0	4.4E+5	1.1E-1	5.5E+3	1.1E+3	5.5E+7	6.8E-3	3.4E+8
Sr-90	8.0E+2	2.7E+8	5.5E+2	1.8E+8	3.3E-3	1.1E+9	8.7E+4	2.9E+10	5.2E+5	1.7E+11
Cs-137	8.0E+2	8.0E+7	5.8E+2	5.8E+7	4.4E+3	4.4E+8	1.2E+5	1.2E+10	7.5E+5	7.5E+10
Cs-134	3.0E+2	4.3E+7	- No Data -		1.0E+1	1.4E+6	9.5E+3	1.4E+9	5.7E+4	8.1E+9
Sm-151	2.0E+1	2.0E+4	1.8E+1	1.8E+4	1.0E+2	1.0E+5	1.8E+3	1.8E+6	1.1E+4	1.1E+7
Tc-99	1.0E-1	2.5E+2	- No Data -		9.5E-1	2.4E+3	2.2E+1	5.5E+4	1.3E+2	3.2E+5
Eu-154	3.0E-2	6.0E+2	- No Data -		6.5E+1	1.3E+6	6.2E+3	1.2E+8	3.7E+4	7.4E+8
Zr-93	3.0E-2	3.0E+2	- No Data -		1.2E-1	1.2E+3	2.8E+0	2.8E+4	1.7E+1	1.7E+5
Cs-135	1.0E-2	1.4E+2	- No Data -		1.8E-2	2.6E+2	4.5E+1	6.4E+3	2.7E+0	3.9E+4
Sn-126	3.0E-3	1.0E+2	- No DATA -		6.0E-2	2.0E+3	1.6E+0	5.3E+4	9.6E+0	3.2E+5
Se-79	3.0E-3	5.0E+1	- No Data -		2.5E-2	4.2E+2	5.8E+1	9.7E+3	3.5E+0	5.8E+4
I-129	3.0E-4	6.0E+2	- No Data -		2.4E-3	4.8E+3	2.8E-4	5.6E+2	3.3E-1	6.6E+5
Pu-238	3.0E+0	4.3E+6	2.6E+0	3.7E+6	7.5E-1	1.1E+6	5.2E+1	7.4E+7	2.0E+4	2.9E+10
Pu-241	5.0E-1	1.7E+4	- No Data -		3.5E+1	1.2E+6	5.5E+2	1.8E+7	6.9E+5	2.3E+10
Cm-244	3.0E-1	1.5E+6	2.6E-1	1.3E+6	4.4E+0	2.2E+7	1.4E+3	7.0E+9	9.0E+3	4.5E+1
Am-241	3.0E-1	3.0E+6	2.6E-1	2.6E+6	1.0E+1	1.0E+8	6.1E+2	6.1E+9	1.6E+4	1.6E+1
Pu-239	1.0E-1	1.7E+5	1.1E-1	1.8E+5	9.0E-1	1.5E+6	2.4E+0	4.0E+6	2.9E+3	4.8E+9
Pu-240	2.0E-2	3.3E+4	- No Data -		4.8E-1	8.0E+5	5.5E+0	9.2E+6	4.5E+3	7.5E+9
Np-237	1.0E+4	1.4E+4	- No Data -		1.2E-2	1.7E+6	7.8E-1	1.1E+8	3.1E+0	4.4E+8
Am-243	- No Data -		- No Data -		1.1E-1	1.1E+6	2.2E+1	2.2E+8	1.4E+2	1.4E+9
Totals	2.3E+4	1.3E+9	1.4E+3	2.5E+8	7.9E+3	1.7E+9	2.4E+5	4.9E+10	2.1E+6	5.1E+1

Table 2: Concentrations and Ratios to Annual Limit of Intake (ALI) for Five Wastes.

Nuclide	SRP (fresh) Ci/m^3	SRP (fresh) Ratio to ALI	SRP (reconstituted) Ci/m^3	SRP (reconstituted) Ratio to ALI	West Valley Tank 802 (Total) Ci/m^3	West Valley Tank 802 (Total) Ratio to ALI	10 Y Old Comm. Liquid HLW Ci/m^3	10 Y Old Comm. Liquid HLW Ratio to ALI	10 Y Old Spent Fuel Ci/m^3	10 Y Old Spent Fuel Ratio to ALI
Ce-144, Pr-144	--	--	--	--	--	--	--	--	--	--
Pm-147	--	--	--	--	--	--	--	--	--	--
Ru-106, Rh-106	--	--	--	--	--	--	--	--	--	--
Sr-90	7.3E+1	2.4E+7	5.0E+1	1.6E+7	3.0E+2	1.0E+8	7.9E+3	2.6E+9	4.7E+4	1.5E+10
Cs-137	8.1E+1	8.1E+6	5.8E+1	5.8E+6	4.4E+2	4.4E+7	1.2E+4	1.2E+9	7.6E+4	7.6E+9
Cs-134	--	--	--	--	--	--	--	--	--	--
Sm-151	9.5E+0	9.5E+3	8.5E+0	8.5E+3	4.8E+1	4.8E+4	8.5E+2	8.5E+5	5.2E+3	5.2E+6
Tc-99	1.0E-1	2.5E+2	- No Data -		9.5E-1	2.4E+3	2.2E+1	5.5E+4	1.3E+2	3.2E+5
Eu-154	4.2E-6	8.3E-2	- No Data -		9.0E-3	1.8E+2	8.6E-1	1.7E+4	5.1E+0	1.0E+5
Zr-93	3.0E-2	3.0E+2	- No Data -		1.2E-1	1.2E+3	2.8E+0	2.8E+4	1.7E+1	1.7E+5
Cs-135	1.0E-2	1.4E+2	- No Data -		1.8E-2	2.6E+2	4.5E-1	6.4E+3	2.7E+0	3.9E+4
Sn-126	3.0E-3	1.0E+2	- No DATA -		6.0E-2	2.0E+3	1.6E+0	5.3E+4	9.6E+0	3.2E+5
Se-79	3.0E-3	5.0E+1	- No Data -		2.5E-2	4.2E+2	5.8E-1	9.7E+3	3.5E+0	5.8E+4
I-129	3.0E-4	6.0E+2	- No Data -		2.4E-3	4.8E+3	2.8E-4	5.6E+2	3.3E-1	6.6E+5
Pu-238	1.4E+0	2.0E+6	1.2E+0	1.7E+6	3.4E-1	5.0E+5	2.4E+1	3.4E+7	9.0E-3	1.3E+1
Pu-241	3.9E-3	1.3E+2	- No Data -		2.8E-1	9.4E+3	4.3E+0	1.4E+5	5.4E-3	1.8E+8
Cm-244	6.5E-3	3.3E+4	5.6E-3	2.8E+4	9.6E-2	4.8E+5	3.0E+1	1.5E+8	2.0E+2	9.8E+8
Am-241	2.6E-1	2.6E+6	2.2E-1	2.2E+6	8.5E+0	8.5E+7	5.2E+2	5.2E+9	1.4E+4	1.4E+1
Pu-239	2.2E-1	3.7E+5	2.4E-1	4.0E+5	2.0E+0	3.3E+6	5.3E+0	8.8E+6	6.4E+3	1.0E+
Pu-240	2.0E-2	3.3E+4	- No Data -		4.8E-1	8.0E+5	5.5E+0	9.2E+6	4.5E+3	7.5E+
Np-237	1.3E+4	1.8E+4	- No Data -		1.5E-2	2.1E+6	9.8E+1	1.4E+8	3.9E+0	5.5E+
Am-243	- No Data -		- No Data -		1.1E-1	1.1E+6	2.2E+1	2.2E+8	1.4E+2	1.4E+
Totals	1.7E+2	3.7E+7	1.2E+2	2.6E+7	8.0E+2	2.4E+8	2.1E+4	9.5E+9	1.7E+5	2.0E+

Table 3: Concentrations and Ratios to ALI After 100 Years Decay for Five Wastes.

The information presented in Tables 1-3 suggests that the hazard of high-level wastes is primarily due to three constituents: Sr-90, Cs-137 and actinides. (Because of the dynamics of chain decay in the actinide group, it appears inappropriate to single out individual nuclides as major contributors to the overall hazard.)

In order to gauge the hazards of high-level wastes relative to wastes suitable for shallow land burial, Table 4 was constructed. This table displays the ratios of radionuclide concentrations to the current Class C limits for each of the five wastes. On this basis of comparison, the high-level wastes are more concentrated (and therefore more hazardous) than Class C wastes by a factor of 30 or more for each waste considered.

Nuclide	SRP (fresh) Ci/m³	SRP (fresh) Ratio to Class C	SRP (reconstituted) Ci/m³	SRP (reconstituted) Ratio to Class C	West Valley Tank 802 (Total) Ci/m³	West Valley Tank 802 (Total) Ratio to Class C	10 y Old Comm Liquid HLW Ci/m³	10 y Old Comm Liquid HLW Ratio to Class C	10 y Old Spent Fuel Ci/m³	10 y Old Spent Fuel Ratio to Cla
Ce-144, Pr-144	1.8E+4	--	5.0E+1	--	1.1E-2	--	2.7E+2	--	1.6E+3	--
Pm-147	3.0E+3	--	2.0E+2	--	3.0E+1	--	1.1E+4	--	6.4E+4	--
Ru-106, Rh-106	1.0E+3	--	7.9E+0	--	1.1E-1	--	1.1E+3	--	6.8E+3	--
Sr-90	8.0E+2	1.1E-1	5.5E+2	7.9E-2	3.3E+3	4.7E-1	8.7E+4	1.2E+1	5.2E+5	7.4E+1
Cs-137	8.0E+2	1.7E-1	5.8E+2	1.3E-1	4.4E+3	9.6E-1	1.2E+5	2.6E+1	7.5E+5	1.6E+2
Cs-134	3.0E+2	--	- No Data -		1.0E+1	--	9.5E+3	--	5.7E+4	--
Sm-151	2.0E+1	--	1.8E+1	--	1.0E+2	--	1.8E+3	--	1.1E+4	--
Tc-99	1.0E-1	3.3E-2	- No Data -		9.5E-1	3.2E-1	2.2E+1	7.3E+0	1.3E+2	4.3E+1
Eu-154	3.0E-2	--	- No Data -		6.5E+1	--	6.2E+3	--	3.7E+4	--
Zr-93	3.0E-2	--	- No Data -		1.2E-1	--	2.8E+0	--	1.7E+1	--
Cs-135	1.0E-2	--	- No Data -		1.8E-2	--	4.5E-1	--	2.7E+0	--
Sn-126	3.0E-3	--	- No Data -		6.0E-2	--	1.6E+0	--	9.6E+0	--
Se-79	3.0E-3	--	- No Data -		2.5E-2	--	5.8E-1	--	3.5E+0	--
I-129	3.0E-4	3.8E-3	- No Data -		2.4E-3	3.0E-2	2.8E-4	3.5E-3	3.3E-1	4.2E+0
Pu-238	3.0E+0	3.0E+1	2.6E+0	2.6E+1	7.5E-1	7.5E+0	5.2E+1	5.2E+2	2.0E+4	2.0E+5
Pu-241	5.0E-1	1.4E-1	- No Data -		3.5E+1	1.0E+1	5.5E+2	1.6E+2	6.9E+5	2.0E+5
Cm-244	3.0E-1	3.0E+0	2.6E-1	2.6E+0	4.4E+0	4.4E+1	1.4E+3	1.4E+4	9.0E+3	9.0E+4
Am-241	3.0E-1	3.0E+0	2.6E-1	2.6E+0	1.0E+1	1.0E+2	6.1E+2	6.1E+3	1.6E+4	1.6E+5
Pu-239	1.0E-1	1.0E+0	1.1E-1	1.1E+0	9.0E-1	9.0E+0	2.4E+0	2.4E+1	2.9E+3	2.9E+4
Pu-240	2.0E-2	2.0E-1	- No Data -		4.8E-1	4.8E+0	5.5E+0	5.5E+1	4.5E+3	4.5E+4
Np-237	1.0E-4	1.0E-3	- No Data -		1.2E-2	1.2E-1	7.8E-1	7.8E+0	3.1E+0	3.1E+1
Am-243	- No Data -		- No Data -		1.1E-1	1.1E+0	2.2E+1	2.2E+2	1.4E+2	1.4E+3
Totals	2.3E+4	3.8E+1	1.4E+3	3.2E+1	7.9E+3	1.8E+2	2.4E+5	2.1E+4	2.1E+6	7.2E+5

Table 4: Concentrations and Ratios to Class C Limits for Five Wastes.

Conclusions: Tables 1-3 indicate that three constituents of high-level wastes contribute predominantly to the hazards of these wastes: Sr-90, Cs-137 and the actinides. The comparison with Class C limits in Table 4 shows the concentrations of these components of high-level wastes to be approximately a factor of 30 or more higher than the Class C limits for each high-level waste considered. It might therefore be appropriate to consider wastes with concentrations more than 30 times the Class C limits (at the time they are being classified for disposal) as representing hazards approximately equivalent to wastes currently defined as "high-level," and to require that these wastes be disposed of in a manner which provides permanent isolation from the environment. The specific radionuclide concentrations which would require permanent isolation are:

Radionuclide Concentrations
Requiring Permanent Isolation

Sr-90	210,000 Ci/m^3
Cs-137	138,000 Ci/m^3
Alpha-emitting TRU, Half-life > 5 yrs	3,000 nCi/gm
Pu-241	105,000 nCi/gm

with a requirement to apply a sum-of-the-fractions rule as when applying the Class C limits.

References:

1) "Siting of Commercial Fuel Reprocessing Plants and Related Waste Management Facilities," AEC 180/52, May 1, 1969.

2) Oak Ridge National Laboratory, "Siting of Fuel Reprocessing Plants and Waste Management Facilities," ORNL-4451, 1970.

3) International Commission on Radiological Protection, "Recommendations of the International Commission on Radiological Protection, Report of Committee II on Permissible Dose for Internal Radiation (1959)," ICRP Publication 2 (New York: Pergamon Press), 1960.

4) "Rationale for the Performance Objectives in 10 CFR Part 60," Enclosure G of SECY-83-59, February 9, 1983.

5) A. D. Little, "Technical Support of Standards for High-Level Radioactive Waste Management," EPA 520/4-79-007A, Arthur D. Little, Inc., for U. S. Environmental Protection Agency, 1977.

6) International Commission on Radiological Protection, "Limits for Intake of Radionuclides by Workers," ICRP Publication 30 (New York: Pergamon Press), Referred to as ICRP 30, 1979.

7) Croff, A. G., "Potential Impact of ICRP-30 on the Calculated Risk from Waste Repositories," Transactions of the American Nuclear Society, Vol. 39, pp. 74-75, Nov., 1981.

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9) Runkle, G. E., "Comparison of ICRP-2 and ICRP-30 for Estimating the Dose and Adverse Health Effects from Potential Radionuclide Releases from a Geologic Waste Repository," Sandia National Laboratories, Proceedings of Waste Management 82, Vol. 3, p. 59, University of Arizona, 1982.

10) Cheung, H., B. G. Knaizewycz, and D. J. Kvam, "Characteristics of Defense High-Level Waste," NUREG/CR-0685, 1979.

11) U. S. Department of Energy, "Final Environmental Impact Statement: Long-Term Management of Liquid High-Level Radioactive Wastes Stored at the Western New York Nuclear Service Center, West Valley," DOE/EIS-0081, 1982.

12) U. S. Department of Energy, "Technology for Commercial Radioactive Waste Management," DOE/ET-0028, 1979.

13) Kocher, D. C., A. L. Sjoreen and C. S. Bard, "Uncertainties in Geologic Disposal of High-Level Wastes--Groundwater Transport of Radionuclides and Radiological Consequences," NUREG/CR-2506, 1983.

14) National Research Council, "A Study of the Isolation System for Geologic Disposal of Radioactive Wastes," Waste Isolation Systems Panel, Board on Radioactive Waste Management, National Academy Press, Washington, D. C., 1983.

15) U. S. Nuclear Regulatory Commission, "Draft Environmental Impact Statement on 10 CFR Part 61 'Licensing Requirements for Land Disposal of Radioactive Waste'," NUREG-0782, 1981.

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tion, in the need for repetitive and time-consuming question and answer cycles subsequent to docketing.

RECOMMENDATION No. 5

MODIFY CURRENT REVIEW PROCESS BY DEVELOPING EARLY SAFETY EVALUATION REPORT

In order to achieve the full measure of the benefits envisioned in implementing Recommendations No. 3 and No. 4, the present safety review sequence will be altered somewhat in this experimental program. Because of the increased pretendering coordination with applicants and the expanded and restructured Acceptance Review, it is expected that the two rounds of questions which are a part of the present review sequence would be essentially eliminated, and the review would be performed on the basis of the contents and quality of the application as docketed and supplemented by the applicant's responses to the staff questions asked during the expanded and restructured Acceptance Review. The staff's positions would be reflected in a Safety Evaluation Report which would be issued within about 6 months of docketing.

After evaluating the results of this experimental program, appropriate changes will be made to pertinent staff documents concerning procedures and practices in licensing reviews. If required, changes to Commission rules and regulations will be initiated. Pending any changes in the regulations after this evaluation, it is the intent of the Commission to proceed with the Acceptance Reviews of any applications, involved in the experimental program and where Recommendation 4 is to be implemented, on a case-by-case basis notwithstanding the provisions of the current regulation in 10 CFR 2.101 concerning the time limit and content of Acceptance Reviews.

In addition, the Commission has directed the staff to implement Recommendation No. 6:

INCREASE PUBLIC PARTICIPATION DURING STAFF REVIEW

Although the hearing process provides an opportunity for public participation, there is very little practical opportunity for interested members of the public, particularly those in the vicinity of the proposed site, to become aware of the staff's role during review of construction permit applications. It is the intent of the Commission to provide increased opportunity for the public to observe and participate in the licensing process in a meaningful way without imposing an undue burden upon the resources of staff manpower.

While the most efficient way to handle interaction of the staff with the applicant on licensing matters is to hold meetings in Bethesda where it is possible to have access to various elements of the staff, the costs and distance make it almost impossible, except for certain well-established intervenor organizations, for members of the public living near the proposed site to participate in these meetings. On the other hand, to arrange all such meetings near the proposed plant site would impose significant burdens upon the staff without necessarily providing commensurate improvement in public understanding of the licensing process.

Past experience with staff interaction with the public has shown that:

(1) The public appears to be most interested in the licensing process in the pre-docketing and/or early stages of the review.

(2) The number of people who attend public meetings appears to be directly correlated with the time of day at which the meetings are held. Past experience has shown that many more people attend meetings held in the evening than during the working day.

Based on the above considerations, a number of working meetings between the staff and construction permit applicants, both prior to and after docketing of an application, normally held at Commission offices in Bethesda, Md., will be held in the vicinity of the proposed site. Whenever possible, these meetings will be held in the evenings or on weekends.

These meetings will provide an opportunity for interested members of the public to listen to the staff and applicant discussions and observe the staff's role in the review of applications. Appropriate provisions will be made for public comments and questions and responses by the applicant and the staff.

Recommendation No. 6 is to be implemented by the staff to the extent permitted by resource considerations on all ongoing and future license application reviews. In this respect, it differs from the implementation of Recommendations No. 3, 4, and 5, which are being conducted on an experimental basis for selected applications.

Finally, whatever improvements that accrue in efficiency as a result of these recommendations will not be permitted to reduce the quality of the licensing review.

Future statements concerning the other recommendations of NUREG-0292 will be issued as appropriate.

43 FR 53869
Published 11/17/78
Comment period expires 1/16/79

LICENSING PROCEDURES FOR GEOLOGIC REPOSITORIES FOR HIGH-LEVEL RADIOACTIVE WASTES

Proposed General Statement of Policy

AGENCY: U.S. Nuclear Regulatory Commission.

ACTION: Proposed General Statement of Policy.

SUMMARY: The U.S. Nuclear Regulatory Commission (NRC) has under consideration the following proposed policy statement regarding establishment of procedures for licensing geologic high-level waste repositories to be constructed and operated by the U.S. Department of Energy (DOE). This NRC policy statement is intended to inform DOE, interested States and members of the public of the procedures with which DOE will be required to comply to receive a license to construct and operate a repository. The policy, as finally adopted, may be codified as part of the Commission's regulations.

DATE: Comments are due on or before January 16, 1979.

ADDRESSES: Send comments and sugestions to: Secretary of the Commission, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555, attention: Docketing and Service Branch. Copies of comments may be examined in the: U.S. Nuclear Regulatory Commission Public Document Room, 1717 H Street NW., Washington, D.C.

FOR FURTHER INFORMATION CONTACT:

James C. Malaro, Chief, High-Level and Transuranic Waste Branch, Division of Fuel Cycle and Material Safety, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555.

SUPPLEMENTAL INFORMATION: The Commission is considering the procedures to be used in the licensing of high-level waste repositories, and believes that it would be useful to solicit the views of interested persons prior to making any final decision. Accordingly, the Commission is publishing for comment the Proposed General Statement of Policy on high-level radioactive waste repository licensing procedures set forth below. The Proposed General Statement of Policy could also be used by DOE for interim planning purposes pending a final Commission decision on repository licensing procedures.

Under present statute, it is not clear whether NRC would have licensing authority over DOE's planned Waste Isolation Pilot Plant (WIPP) proposed to be located at Carlsbad, N. Mex. However, if the WIPP facility is subject to NRC licensing, NRC expects to apply these procedures in the licensing

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review.

NRC licensing authority over DOE waste management activities is derived from sections 202(3) and 202(4) of the Energy Reorganization Act of 1974. These sections confine NRC licensing authority over DOE waste management activities to certain DOE facilities for receipt and storage of high level radioactive waste. If WIPP is to be used exclusively for disposal of transuranic wastes from the defense program and 1,000 commercial spent fuel rod assemblies, then WIPP might not be licenseable. While the 1,000 commercial spent fuel rod assemblies would be "high level radioactive waste,"[1] the transuranic wastes would not be, and the facility would not be "primarily" for receipt and storage of "high level radioactive wastes" (section 202(3) of the Energy Reorganization Act). If WIPP is to be used for disposal of defense program high level wastes, then it would be licenseable under section 202(4) of the Act provided it was not "used for, or . . . part of, research and development activities." It is possible that, depending upon the exact program proposed by DOE, WIPP could be regarded as a research and development facility exempt from licensing.

Introduction

The U.S. Nuclear Regulatory Commission ("NRC" or "Commission") is vested with licensing authority over certain DOE high-level radioactive waste repositories by sections 202(3) and 202(4) of the Energy Reorganization Act of 1974. These sections refer to:

(3) Facilities used primarily for the receipt and storage of high-level radioactive wastes resulting from activities licensed under such Act (Atomic Energy Act).

(4) Retrievable Surface Storage Facilities and other facilities authorized for the express purpose of subsequent long-term storage of high-level radioactive waste generated by the Administration, which are not used for, or are part of, research and development activities.

Under the Energy Reorganization Act of 1974, as amended, and the Atomic Energy Act of 1954, as amended, such repositories would not be licensed as "production" or "utilization" facilities. Rather, they would be licensed under those provisions of the Atomic Energy Act dealing with receipt and possession of "byproduct" and "special nuclear" materials. However, the Commission has authority under the Atomic Energy Act to fashion procedures for licensing of byproduct and special nuclear material that are tailored to the kinds of activities being authorized and the potential hazards involved. For example, although a license for possession and use of plutonium in a sealed calibration source and a license for possession and use of plutonium for purposes of processing and fuel fabrication are both special nuclear materials licenses, the former license may be issued after a single review (and indeed may even be generally licensed without the need for filing and review of a specific license application—see 10 CFR 70.19), while the latter license may only be issued after a review process resembling in many respects the two-step licensing review provided in the Atomic Energy Act for production and utilization facilities (see 10 CFR 70.22(f) and 70.23(b)).

In fashioning the procedures which follow, several unique features of geologic high-level waste repositories were carefully considered. For such a repository, the suitability of the site becomes crucial, for the integrity of the site itself is essential to assure containment of the radioactive materials. Thus, sound policy suggests that the Commission be afforded the opportunity to participate in DOE's site selection process, though—considering the tentative character of the activities involved—only in an informal advisory capacity. Also, for such an application, construction of a repository shaft would constitute the first major penetration of the geologic containment. If improperly constructed or sealed, it could impair the ability of the geologic containment to isolate wastes over long periods of time. At the same time, construction of this shaft is expected to dispel some of the uncertainties in the accuracy of data necessary for design of the underground repository. Thus, while a safety review prior to sinking of a shaft would be appropriate, the scope of review and the findings required need to take into account the possibility that only limited data may be available. Further, there should be a formal safety review of the main repository design features before substantial commitments are made and alterations become impracticable to implement. Finally, the Commission believes that it should examine the methods of construction and any new information that may have been developed during construction before formally authorizing receipt and storage of radioactive materials at the repository.

If a repository is subject to the NRC licensing authority, the entire repository will be subjected to licensing review, including those activities which by themselves might not be within the scope of NRC responsibility. This comprehensive review will be necessary because loss of integrity in any part of a repository could imperil the integrity of the entire repository.

The Commission believes it should prepare an environmental impact statement pursuant to section 102(2)(C) of the National Environmental Policy Act of 1969 ("NEPA") prior to authorizing construction of the main repository shaft. This statement could be updated prior to receipt and storage of radioactive materials at the repository should new information warrant.

Early Notification to States and Other Interested Parties

In order to provide opportunity for early input from States and other interested parties, the Commission would, upon receipt of a DOE license application or request for an informal early site review, (1) publish in the Federal Register a notice of such receipt (2) make a copy of the application or request available at the Public Document Room, and (3) transmit copies of such request to the Governor of the State and to the Chief Executive of the municipality in which the respository is tentatively planned to be located and to the Governors of any contiguous States. Also, the staff would offer to meet with State and local officials to provide them with information about the Commission's review and to explore the possibilities of State and local participation in the Commission licensing process.

Licensing Procedures

The proposed repository licensing procedures are divided into four parts: review of DOE site selection, review of repository development, repository licensing, and respository closure.

1. *Review of DOE site selection.* There would be informal NRC staff comments to DOE on site suitability matters after DOE's site selection. Such informal consultation, which might take the form of written NRC staff comments supplemented by one or more open meetings between the two agency staffs, would enable the NRC staff to point out those aspects of a location which in its judgment might require special attention or present special problems, and would help to define the kinds of information that might be needed for the Commission to make licensing decisions.

As indicated, the interaction between NRC staff and DOE at this early stage would be consultive in nature. That is, NRC staff may provide comments and advice, but the Commission will neither make formal findings nor take other formal action. DOE would remain at liberty to come forward later with any license application that it believed would conform to Commission requirements, and the Commission would be free, as the evidence might warrant, to formally approve or disapprove the application.

2. *Review of repository development.* The formal Commission licensing review process would begin with the filing of an application for a license by DOE prior to commencement of construction of a repository shaft. The application would be docketed for review after a preliminary review for completeness, notice of the application would be published in the Federal Register offering an opportunity for

[1] Even though spent fuel which is to be disposed of in a geologic repository may have some resource value, it contains radioactive waste. Thus, it is clearly a "high level" radioactive waste because it contains all the toxic and long-lived radionuclides contained in the liquid wastes from reprocessing that have traditionally been regarded as a form of high level radioactive waste.

interested persons to intervene and request a hearing, and a public announcement would be issued.

The application would include information on site suitability and repository design features important to safety. An environmental report prepared by DOE addressing the matters set forth in section 102(2)(C) of NEPA would be submitted with or prior to the application.

It is probable that some information necessary to make a definitive finding of the repository's safety will not then be available. Nevertheless, the Commission[3] could authorize construction of the repository upon completion of a review of all NEPA, safety, and common defense and security issues, and upon finding (1) after considering reasonable alternatives that the benefits of the proposal exceed the costs under NEPA, and (2) that there is reasonable assurance that the types and amounts of wastes described in the application can be stored in a repository of the design proposed without unreasonable risk to the health and safety of the public or being inimical to the common defense and security. Construction would commence with the sinking of the main repository shaft. In the alternative, where insufficient information is available prior to shaft sinking to permit the Commission to make the complete findings set forth above, on request by DOE or on the Commission's own initiative, the Commission could allow the safety review to be conducted in two phases. Construction of the shaft could commence upon finding (1) after considering reasonable alternatives, that the benefits of the proposal exceed the costs under NEPA, and (2) that there is reasonable assurance that: (a) The site is suitable for a repository within which high-level wastes of the kinds and quantities described in the application can be stored without unreasonable risk to the health and safety of the public or being inimical to the common defense and security, and (b) the plans for construction of the main shaft and related structures can be implemented in a manner compatible with the use of the site for a respository. The full findings set forth previously would, then, have to be made before the start of construction of surface and underground structures. Safety issues that could not be resolved based upon the available information might be deferred until the repository operating license review provided that: (1) an adequate program has been developed to resolve the issue prior to that time, and (2) there is reasonable assurance that the issue can be resolved in a favorable manner at the later date. The Commission requests public comments on this possible course of action.

The NEPA environmental review would address, to the extent possible based on available information, environmental impacts and alternatives associated directly or indirectly with siting, construction, and operation of the repository. Any hearing held upon request of an interested person would be conducted in accordance with subpart G of 10 CFR Part 2.

The applicant will be required to report to the NRC, during the course of construction, any site characterization data obtained which are not within the predicted limits upon which the repository design was based. Also, it would be required to report deficiencies in design and construction which, if uncorrected, could have a significant adverse effect upon the safety of the repository at any future time.

3a. *Repository licensing.* Prior to receipt of any radioactive material at the repository, DOE will need to file an updated license application with the Commission. The license authorizing actual receipt and storage of radioactive materials would be issued after the Commission has conducted a final review of health and safety and common defense and security issues in the light of (1) any additional geologic, hydrologic, and other data obtained during construction; (2) conformance of construction of repository structures, systems, and components with the earlier received design; (3) results of research programs carried out to resolve questions identified during prior reviews; (4) plans for startup and routine operations; and (5) plans for identifying and responding to any unanticipated releases of radioactive material from the repository. Issuance of a license will require a definitive finding under the Atomic Energy Act that the receipt, possession, and use of the special nuclear and byproduct materials at the repository will not constitute unreasonable risk to the health and safety of the public or be inimical to the common defense and security. If warranted by new information which the staff judges could materially alter the NEPA cost-benefit balance, the earlier environmental impact statement will be updated. Also, if requested by a person whose interest may be affected, a hearing in accordance with subpart G of 10 CFR Part 2 would be held prior to license issuance.

3b. *License amendment (as needed).* If special restrictions such as retrievability or a limit on amounts or types of wastes have been imposed in the license, an amendment will be required prior to committing waste to irretrievable disposal or prior to the receipt of additional waste. It is anticipated that the required review procedures and findings will be similar to those described above for initial licensing, taking into account additional information obtained during the retrievable storage phase or during operation with limited inventory.

DOE will be required to conduct and monitor its operations, to keep records, and to submit routine and special reports, in accordance with Commission regulations and orders. All operations will be subject to such continuing NRC inspection activities as may be found to be appropriate.

4. *Review of repository closure.* After the repository has been developed and filled to maximum capacity but prior to final closure of the underground excavations and shafts and the decommissioning of surface facilities, and NRC review and approval will be required of the licensee's proposed program for compliance with regulations governing sealing of the underground repository, decommissioning of surface facilities, storage of permanent records, and long-term monitoring. Following completion of the review, a change in license status may be warranted.

[3]For hearings granted on an application, the Commission expects, as in a nuclear power reactor licensing proceeding, to designate an Atomic Safety and Licensing Board to hear and initially decide the contested issues. As in any licensing case, it would be possible for the Board to render partial decisions on several discrete issues, such as NEPA issues.

43 FR 58377
Published 12/14/78
Comment Period expires 2/12/79
(extended 3/14/79)

GENERIC RULEMAKING TO IMPROVE NUCLEAR POWER PLANT LICENSING

Interim Policy Statement

AGENCY: U.S. Nuclear Regulatory Commission.

ACTION: Interim Policy Statement.

SUMMARY: An interim policy is presented to govern the consideration of preliminary proposals and plans by the Nuclear Regulatory Commission to pursue rulemaking on generic licensing issues as one of several initiatives to improve the effectiveness and efficiency of licensing of nuclear power plants. Although planning for expanded rulemaking of this nature was initiated with an NRC study group recommendation of June 1977, the present interim statement fully supports Executive Order 12044 of March 23, 1978, requesting improvement of existing and future government regulations so as to be as simple and clear as possible and avoid imposing unnecessary burdens on the economy, on individuals, on public and private organizations, or on State and local governments. Comments received by February 12, 1979, will be considered before adopting and implementing the final policy and plan for such expanded rulemaking.

ENCLOSURE D

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555

OFFICE OF THE SECRETARY

IN RESPONSE, PLEASE REFER TO: M830523C

ACTION - Minogue
Cys: Dircks
Roe
Rehm
Stello
Davis
Comella
MBell
JWolf
GCunningham
Felton
Philips
Besaw
Shelton

May 27, 1983

MEMORANDUM FOR: William J. Dircks, Executive Director for Operations

Herzel H.E. Plaine, General Counsel

FROM: Samuel J. Chilk, Secretary

SUBJECT: STAFF REQUIREMENTS - AFFIRMATION/DISCUSSION AND VOTE, 3:30 P.M., MONDAY, MAY 23, 1983, COMMISSIONERS' CONFERENCE ROOM, D.C. OFFICE (OPEN TO PUBLIC ATTENDANCE)

I. SECY-83-117 - Review of ALAB-701 - In the Matter of Philadelphia Electric Co., et al.

The Commission, by a 3-2 vote (Chairman Palladino and Commissioners Gilinsky and Asselstine agreeing) approved an order that holds in abeyance a decision whether or not to review ALAB-701 until the completion of the Commission's current review of the requirement for control and stabilization of uranium mill tailings piles. Commissioners Ahearne and Roberts provided separate views.

(Subsequently, on May 27, 1983 the Secretary signed the Order with the separate views attached.)

II. SECY-83-59/83-59B - 10 CFR Part 60 -- Disposal of High-Level Radioactive Wastes in Geologic Repositories: Technical Criteria and Conforming Amendments

The Commission, by a vote of 5-0, approved the final amendments to 10 CFR Part 60 as attached.

The Commission requested that the staff review the need to revise the definition of high-level waste in 10 CFR Part 60 to conform to the definition of high-level waste in the Nuclear Waste Act of 1982 during the ongoing review of the procedural portion of 10 CFR Part 60. A recommendation as to possible revision should be provided along with the other changes to the procedural portion of 10 CFR Part 60.

(~~EDO~~) ~~(SECY Suspense: 9/1/83)~~
RES (EDO Suspense: 8/25/83)

001307

Rec'd Off. EDO
Date 6-1-83
Time 8:15 A

ENCLOSURE D

You should revise the final rule as indicated in the attached copy and return it for signature and publication in the Federal Register.

(~~EDO~~) RES (SECY Suspense: 6/17/83)

You should also advise the appropriate Congressional Committees, issue the public announcement, and provide copies of the rule to all who submitted comments on the rule.

(~~EDO~~/OCA/OPA) (SECY Suspense: 6/30/83)
RES

Attachments: (TO EDO ONLY)
As stated

cc: Chairman Palladino
Commissioner Gilinsky
Commissioner Ahearne
Commissioner Roberts
Commissioner Asselstine
Commission Staff Offices
PDR - Advance
DCS - 016 Phillips

ENCLOSURE E

DRAFT CONGRESSIONAL LETTER

Dear Mr. Chairman:

Enclosed for your information is a copy of an advance notice of proposed rulemaking to be published in the Federal Register.

The enactment of the Nuclear Waste Policy Act of 1982, Pub. L. 97-425, led the Commission to reexamine some of the provisions of 10 CFR Part 60 in order to conform with the new law. As a result of this review, the Commission is considering revising the definition of the term "high-level radioactive wastes" in 10 CFR Part 60. In view of the complexity of the issues presented the Commission seeks additional information before proposing a particular amendment to its rules. The Commission is taking this opportunity to obtain public comment by means of the enclosed advance notice of proposed rulemaking.

Sincerely,

, Director
Office of Nuclear Regulatory Research

Enclosure: As stated

ENCLOSURE E

ENCLOSURE F

NCRP

National Council on Radiation Protection and Measurements

7910 WOODMONT AVENUE SUITE 1016 BETHESDA MARYLAND 20814-1095 AREA CODE 301-657-2652

WARREN K. SINCLAIR PhD President
S. JAMES ADELSTEIN MD Vice President
W. ROGER NEY JD Executive Director

October 15, 1984

Honorable William D. Ruckelshaus
Administrator
U.S. Environmental Protection Agency
401 M Street, S.W.
1200 West Tower
Washington, D.C. 20460

Honorable Donald Paul Hodel
Secretary
U.S. Department of Energy
1000 Independence Avenue, S.W.
Washington, D.C. 20585

Honorable Nunzio J. Palladino
Chairman
U.S. Nuclear Regulatory Commission
1717 H Street, N.W.
11th Floor
Washington, D.C. 20555

Gentlemen:

As indicated in my letter of March 26, 1984, the National Council on Radiation Protection and Measurements (NCRP) undertook an examination of the definitions applicable to radioactive waste. In part, the work was initiated because of our belief that control measures for radioactive waste must be based on rational evaluations of the potential hazard of the waste, rather than on artificial considerations such as the source of the waste.

The Panel on the Definition of High Level Radioactive Waste, established as a Task Group under Scientific Committee 38, convened on March 9 and May 9, 1984. The panel was chaired by Merril Eisenbud and included Drs. Edward Albenesius, Melvin Carter, John Matuszek, Dade Moeller, Frank Parker and Martin Steindler. The affiliations of these individuals are listed in the attachment. The Task Group was briefed by representatives of the Department of Energy, the Environmental Protection Agency, and the Nuclear Regulatory Commission.

This letter summarizes the conclusions of the Task Group based on (1) the information provided during these briefings, (2) our review of a number of relevant documents submitted to us and, (3) our collective experience with the subject of radioactive waste management.

ENCLOSURE I

There appears to be an urgent need for a generally accepted definition of high-level waste. The absence of such a definition, which seems strange in view of the importance of the subject, is due to the number of federal agencies that have been involved during the past 40 years and the considerable number of federal laws and regulations that exist, all developed at different times and under different circumstances. There has been an evident failure of interagency coordination. The first legal definition of high-level waste was published in 1970 in Appendix F to 10 CFR, Part 50. A total of seven legal definitions have come to our attention, none of which are as comprehensive as is necessary.

Radioactive waste defined as "high level" will be isolated in deep geological repositories to insure protection of the public. It is therefore important that the wastes be classified properly so that those requiring permanent isolation can be identified correctly and that wastes for which a lesser degree of protection will be sufficient are not required to be placed in deep geological repositories that are expensive to build and will be of limited capacity. While the primary goal of waste management must be to protect the health of the public, it is important that this goal be achieved with due attention to economic factors. In this connection, the Task Group noted that a criterion, 10 nanocuries per gram, which until recently served as cutoff between shallow land burial and other disposal modes for transuranic waste, was established a number of years ago with an insufficient technical basis. Upon investigation by the NCRP, it was found that the criterion could be increased tenfold without increasing the risks either to workers or the public. This change, which was recently made by the Nuclear Regulatory Commission, has already resulted in a savings of $250 million.

It is planned that only two high-level waste repositories will be built by the end of the century and that they will cost about $20 billion. It is important that the valuable capacity of these repositories not be filled by radioactive waste that can be disposed of by some lesser means. Since the definition of high-level waste will determine whether a given waste goes to a geological repository or elsewhere, the definition should be precise and the various federal agencies should adopt definitions that are mutually consistent. The Task Group was pleased to learn that the Nuclear Regulatory Commission is about to propose a new definition which, according to the Environmental Protection Agency representative, would be acceptable to the Agency. This is a gratifying forward step. We also stress the importance of assuring that the Nuclear Regulatory Commission's proposed definition rests on a firm technical basis and recommend that the technical bases for the definition be made available for external scientific review.

The Task Group largely limited its attention to high-level waste. However, the Task Group noted that new Nuclear Regulatory Commission regulations governing the disposal of low-level waste (for which a definition has been provided in 10 CFR 60) have been promulgated. The decision of the Commission to classify such waste into three categories of required confinement according to activity level and half-life appears to be an appropriate step forward that provides a more scientific basis for low-level disposal options. The Task Group found that such a classification is consistent with the philosophy that the classification of radioactive wastes

should be based upon those factors which determine radiation risk. This will include type of emission and biological factors related to chemical form. Incorporation of a de minimis criterion, as is being contemplated by the Nuclear Regulatory Commission for 10 CFR 20, may provide the final link necessary for a comprehensive waste classification and disposal system. The NCRP could provide a review of the bases for low-level and de minimis classifications simultaneously with an assessment of the high-level waste definition. This process would make available, for the first time, a scientific review of the bases of the numerical criteria for classifying the full spectrum of radioactive waste from the de minimis to the highest levels that will become available.

In summary, the Task Group found that definitions of waste as promulgated by Federal agencies and the Congress are largely uncoordinated and thus promise to cause unneeded confusion and possible expense. The recommendations of the Task Group, based on the results of the briefings and other sources, are as follows:

1. Federal agencies involved in High Level Radioactive Waste (HLW) should participate in a study that seeks to provide a common, comprehensive, and functional definition of HLW (and other wastes) for governmental use. Such a study could be carried out by one of several groups, including and perhaps especially, the NCRP, but success will require the participation and the acceptance of the results by all affected agencies.

2. Definitions of HLW, and other waste types, should be based on estimates of risk rather than origin of the waste. This approach appears to require disposal methods to be identified, but these methods can and should be defined on a generic basis rather than a site-specific basis.

3. Federal agencies should, in the course of examination of the definitions of waste classes, orient their decisions to the practical recognition that nuclide content of wastes may represent a continuum. The disposal methods applicable to the waste are also likely to represent a continuum which may be fragmented by practical considerations of economics and technology.

4. New regulations concerning nuclear wastes and their disposal issued by Federal agencies should be accompanied by their scientific and technologic bases and should be subjected to peer review before being issued for public comment.

5. Each Federal agency concerned with radioactive materials and waste should be encouraged to coordinate its activities that may arise in diverse departments. Particular attention should be given by agencies to the integration of activities that deal with similar materials arising from a variety of sources (e.g., accelerator-produced, naturally-occurring, and fission-produced nuclides). Regulations based on risk and subjected to thorough peer review should be the bases of action throughout the agencies.

6. The Executive branch of government should integrate the requirements of Federal agencies for the management of radioactive materials and present to the Congress recommendations that will remove the fragmentation and conflicts resulting from the provisions in several laws.

I hope that these recommendations will prove helpful in moving forward on the important problem of defining high-level waste. I can assure you that the NCRP stands ready to help in any way that we can.

Sincerely yours,

Warren K. Sinclair
President

WKS:WRN/mh

Attachment

NATIONAL COUNCIL ON RADIATION PROTECTION AND MEASUREMENTS
7910 Woodmont Avenue, Suite 1016
Bethesda, Maryland 20814

Panel on the Definition of High Level Radioactive Waste

Dr. Merril Eisenbud, Chairman
Professor
Institute of Environmental Medicine
New York University Medical Center
P. O. Box 817
Tuxedo, New York 10987

Dr. Edward L. Albenesius
E. I. DuPont de Nemours & Co.
Savannah River Laboratory
Aiken, South Carolina 29801

Dr. Frank L. Parker
Environmental and Water
Resources Engineering
Vanderbilt University
Nashville, Tennessee 37235

Dr. Melvin W. Carter
Neely Professor
School of Nuclear Engineering
Emerson Building, Room 237
Georgia Institute of Technology
Atlanta, Georgia 30332

Dr. Martin Steindler
Associate Director
Chemical Engineering Div.
Argonne National Laboratory
Argonne, Illinois 60439

Dr. Dade W. Moeller
Harvard School of Public Health
Department of Environmental
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Boston, Massachusetts 02115

Dr. John M. Matuszek
Director
Radiological Sciences Institute
Center for Laboratory
and Research
Empire State Plaza
Albany, New York 12201

ENCLOSURE G

UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, D. C. 20555

January 15, 1985

Mr. William J. Dircks
Executive Director for Operations
U.S. Nuclear Regulatory Commission
Washington, D. C. 20555

Dear Mr. Dircks:

SUBJECT: SUBCOMMITTEE COMMENTS ON HIGH LEVEL WASTE REPOSITORY

During a meeting on December 19-20, 1984, the ACRS Waste Management Subcommittee met with the NRC Staff to discuss staff efforts in reviewing the upcoming application of the U.S. Department of Energy for a license to construct a high level waste repository. During this meeting, the Subcommittee prepared a summary report of its observations and comments.

During its 297th meeting on January 10-12, 1985, the Advisory Committee on Reactor Safeguards considered this report and approved the forwarding of a copy to you for consideration by the NRC Staff.

Sincerely,

H. W. Lewis
Acting Chairman

Attachments:
1. Summary Comments Waste Management Subcommittee
   Advisory Committee on Reactor Safeguards
   dated January 14, 1985

EDO — 000283
ENCLOSURE G

January 14, 1985

SUMMARY COMMENTS
WASTE MANAGEMENT SUBCOMMITTEE
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

During a meeting on December 19-20, 1984, the ACRS Waste Management Subcommittee met with the NRC Staff to discuss their efforts in reviewing the upcoming application of the U.S. Department of Energy (DOE) for a license to construct a high level radioactive waste (HLW) repository. Subunits of the discussion included a review of current plans for the establishment by DOE of a Monitored Retrievable Storage (MRS) facility and efforts by the NRC Staff to revise and upgrade the official definitions of the various categories of radioactive wastes.

As a result of these discussions, the Subcommittee offers the following comments:

1. In its attempts to meet the regulatory requirements of the Nuclear Waste Policy Act, the NRC Staff has encountered several instances where different interpretations of the Congressional intent are possible. One example is the specific requirements of what is meant by "permanent isolation." Rather than responding solely on the basis of providing a range of options, depending on the meaning of such a phrase, we suggest that the Staff consider identifying which interpretation it considers to be the most appropriate or reasonable. This "strawman" approach would provide greater assurance that this rulemaking effort could be brought to completion promptly.

2. In terms of upgrading the current definitions of radioactive wastes, the Subcommittee offers the following comments:

    a. The classification of a radioactive waste should be based on its potential for human exposure, both external and internal. Such potential is influenced by factors such as the mode of decay, the half-life, the concentration, the chemical form, and the radiotoxicity of the radionuclides involved. Although the source of the waste may be important in certain instances, it should not be a dominant consideration. These factors, in turn, dictate the methods for immobilization and confinement that are required to assure that the associated risk is acceptable.

    b. We believe that the NRC Staff, in its consideration, should include the full gamut of wastes, ranging from HLW that must be placed in a secure repository, down to wastes that contain such minute concentrations of radionuclides that they can be considered not to be of regulatory concern. The ACRS commented

on this matter in our letter of February 13, 1984 to the NRC Chairman (Attachment 1).

c. Although the NRC Staff should acknowledge that waste categories represent a continuum from those of negligible to those of high risk, for practical reasons such wastes must be grouped into categories. To the extent possible these categories should be discrete and unambiguous. For some waste categories, such as those that might be classified as "intermediate level" and are currently low in volume, it may be more judicious to place them in a repository than to develop specific procedures for their disposal. Nevertheless, it should be recognized that longer range considerations may make it necessary to develop methods for confining such wastes in a manner more secure than that provided by shallow land burial but less sophisticated than that provided by a repository.

d. It should be recognized that adequate confinement need not always necessitate placing comparatively high risk radioactive wastes within a repository. Such confinement may be attained for certain wastes, such as those containing the transuranic radionuclides, through converting them to appropriate physical or chemical forms and placing them in a less elaborate facility.

e. In terms of the approaches being proposed for dealing with various waste categories, the Subcommittee recommends that the NRC Staff determine how many case-by-case issues will need to be addressed under options "b" and "c" (See Attachment 2). If they are substantial in number, option "a" may be the logical choice.

f. In view of the urgency of all of the above matters relative to ongoing high level and low level radioactive waste disposal activities, we urge that the NRC Staff give priority to their resolution.

3. The Subcommittee endorses the administrative structure that has been developed by the Division of Waste Management for handling its review of the Environmental Assessments that are being developed by DOE for each of the nine proposed repository sites. We also endorse the close communication links that have been established with the DOE and EPA, and the assignment of NRC representatives to the proposed repository sites in Washington and Nevada and at the ONWI/Battelle Memorial Institute in Ohio.

4. The Subcommittee encourages the NRC Staff to continue to keep in mind that an important goal is to assure that the HLW repository meets the regulatory standards of the Environmental Protection Agency. Although the NRC has established subsystem criteria which, if met, will assure compliance with the EPA

Standards, it should be recognized that trade offs among the various subsystems may be necessary.

5. As a next step, the Subcommittee, with the concurrence of the NRC Staff, plans to conduct a review and evaluation of:

   a. The "Standard Review Plan for Draft Environmental Assessments," that was recently issued by the Division of Waste Management.

   b. The criteria developed and used by the DOE in ranking the nine sites proposed for the first repository. Included in this review will be an assessment of the weighting factors assigned by the DOE to each of the items considered in their evaluations.

The Subcommittee will also be available to assist the NRC Staff on any specific problems that may arise in their ongoing evaluations of the Environmental Assessments for each of the nine proposed sites.

Attachments:
1. Letter for Hon. Nunzio J. Palladino, Chairman, NRC, from J. C. Ebersole, Chairman, ACRS, Subj: Establishment of De Minimis Values, dated Feb. 13, 1984.
2. Portion of the handout material provided by D.J. Fehringer of the NRC/WM Staff for his presentation at the WM Subcommittee Meeting on December 19, 1984, entitled "Advance Notice of Proposed Rulemaking, Definition of High-Level Waste."

UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, D. C. 20555

February 13, 1984

Honorable Nunzio J. Palladino
Chairman
U. S. Nuclear Regulatory Commission
Washington, DC 20555

Dear Dr. Palladino:

SUBJECT: ESTABLISHMENT OF DE MINIMIS VALUES

During its 286th meeting, February 9-11, 1984, the Advisory Committee on Reactor Safeguards met with the NRC Staff and a representative of the Edison Electric Institute to discuss the desirability of the establishment by the NRC of de minimis values for radiation exposures. This subject was also discussed by our Subcommittee on Reactor Radiological Effects at a meeting on January 23-24, 1984, during which discussions were held with representatives from the U. S. Environmental Protection Agency (EPA), the Atomic Industrial Forum, the Edison Electric Institute, the Society of Nuclear Medicine, the National Council on Radiation Protection and Measurements (NCRP), the International Atomic Energy Agency, the University of Pittsburgh, the radiopharmaceutical industry, and the state of South Carolina.

As a result of these discussions, we offer the following comments:

1. As considered here, a de minimis value would be a dose equivalent, exclusive of natural radiation background, that is deemed to have an associated risk that is trivial and would be of no regulatory concern.

2. Establishment of such values would complement the Commission's efforts to establish safety goals. Although de minimis values might be expressed as a dose equivalent rate or total dose equivalent, implementation or enforcement of such values would involve the development of specific guidance for a range of applications. Such applications might include the specification of radionuclide concentrations in wastes that need not be handled as radioactive; the total quantities of given radionuclides that might be released without restrictions; radionuclide concentrations in, or contamination levels on, reclaimed equipment that could be released for public use; and dose equivalents for which claims for radiation injury are not justified. Such values would also provide a "floor" for ALARA considerations, and would set bounds in space and time for calculating population collective doses.

3. Establishment of de minimis values would foster consistency, equity, and reasonableness in regulation; it would help in setting regulatory priorities; and it would help expedite the solving of certain regulatory problems. In addition, such values would reduce regulatory and compliance costs by obviating the need to devote resources to consideration of trivial levels of radiation exposure. Establishment of such values would

ATTACHMENT 1

also promote better public understanding and acceptance of the potential effects of radiation.

4. Although the Commission could establish de minimis values by a policy decision, we believe that it might be preferable to establish them through rulemaking. Although the proposed revisions to 10 CFR 20 (Standards for Protection Against Radiation) include a recommendation for a de minimis value, we believe this is such an important matter and has the potential for such far-reaching benefits, both in terms of cost savings and regulatory simplification, that the specification of a more complete set of values should be given early consideration.

The Committee supports the current NRC Staff efforts on the development of de minimis values, and we encourage them to continue to coordinate this work with other federal agencies, such as the EPA, the Department of Energy, and the Department of Transportation, as well as appropriate professional societies and industrial groups, the NCRP, and the Conference of (state) Radiation Control Program Directors and other state representatives. Such coordination will assure that the magnitudes of the values selected reflect consideration of all relevant factors and available scientific data. The ACRS would be pleased to work with the NRC Staff on this matter.

Sincerely,

Jesse C. Ebersole

Jesse C. Ebersole
Chairman

ENCLOSURE H

NRC CONSIDERS REVISIONS TO DEFINITION OF HIGH-LEVEL NUCLEAR WASTE

The Nuclear Regulatory Commission is considering enlarging the category of radioactive wastes classified as "high-level," in an effort aimed at helping to ensure a disposal home for all wastes.

Currently only irradiated nuclear reactor fuel and certain liquid and solid wastes resulting from the reprocessing of irradiated reactor fuel are classified as high level. However, certain other wastes are not generally considered acceptable for the near-surface land disposal currently in use at the three operational low-level radioactive waste repositories. The NRC's regulations allow for evaluation of specific proposals for the disposal of such waste on a case-by-case basis, but the waste is for the most part being held in storage by licensees. It amounts to less than 1% of the approximately 3,000,000 cubic feet of commercial low-level waste being generated annually.

The additional wastes that the Commission is considering classifying as high level include:

- Activated metals--resulting from reactor operations, spent fuel hardware and decommissioning reactor core components.

- Transuranics--resulting from fuel burnup lab operation, fuel burnup lab decommissioning, plutonium fuel fabrication plant decommissioning, sealed source manufacturing operations, sealed source manufacturing decommissioning and materials license decommissioning.

ENCLOSURE H

- Pharmaceuticals

- Large sealed sources

As indicated in an advance notice of proposed rulemaking published in the Federal Register on _____, the Commission is considering options for amending its regulations to classify additional radioactive materials as high-level wastes.

Interested persons are invited to submit written comments to the Secretary, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555, Attention: Docketing and Services Branch, by _____ (90 days after publication of the Federal Register notice).

ENCLOSURE I

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555

OFFICE OF THE SECRETARY

ACTION - Minogue
Cys: Dircks
Roe
Rehm
Stello
GCunningham
Davis
Kerr, SP
Prichard, RES
Fehringer, NMSS
Wolf, ELD
Philips
Denton

December 13, 1985

MEMORANDUM FOR: William J. Dircks
Executive Director for Operations

FROM: Samuel J. Chilk, Secretary

SUBJECT: STAFF REQUIREMENTS -- SECY-85-309, "10 CFR PART 60 -- DEFINITION OF THE TERM 'HIGH-LEVEL RADIOACTIVE WASTES'-- ADVANCE NOTICE OF PROPOSED RULEMAKING"

The subject paper requests Commission approval to publish an advance notice for proposed rulemaking (ANPR) concerning the definition of the term igh-level radioactive wastes" in 10 CFR Part 60.

All Commissioners agree that the term "high-level radioactive wastes" requires defining. However, the majority (with Chairman Palladino and Commissioners Roberts and Bernthal agreeing) also believe that the ANPR should be delayed pending the outcome of ongoing legislative action by Congress to amend the Low-Level Radioactive Waste Policy Act (LLRWPA).

Individual Commissioners' comments were provided on their vote sheets.

The staff is hereby directed not to promulgate the ANPR at this time and, to await completion of the current Congressional Session/ or passage of the legislation amending the LLRWPA. Upon completion of the current Congressional Session/ or passage of the legislation amending the LLRWPA, the staff is to resubmit for Commission approval the ANPR with appropriate modifications to reflect the Commissioners comments and legislative actions.

If Congress does pass legislation which addresses the waste classification and jurisdictional issues raised in the ANPR, the staff should consider the feasibility of proceeding

Rec'd Off. EDO
Date 12-16-85
Time 8A

ENCLOSURE I

directly to prepare a notice of proposed rulemaking on the remaining technical issues for Commissioner review and approval.

(EDO) (SECY SUSPENSE: 1/31/86)

cc: Chairman Palladino
Commissioner Roberts
Commissioner Asselstine
Commissioner Bernthal
Commissioner Zech
OGC
OCA
OPE