PART U

LICENSING REQUIREMENTS FOR URANIUM AND THORIUM PROCESSING

Sec. U.1 - Purpose. This Part establishes criteria for issuance and terms and conditions upon which the Agency issues licenses to receive title to, receive, possess, use, transfer, or deliver source and byproduct materials and for the operation of facilities for, and the disposition of the byproduct material resulting from, uranium or thorium processing. These regulations also provide for the long-term care and custody of byproduct material and residual radioactive material.

Sec. U.2 - Scope.

a. This Part establishes performance objectives and procedural requirements applicable to any source material milling operation and to waste systems for byproduct material including specific technical requirements for siting, construction, operation, monitoring, decontamination, reclamation and ultimate stabilization, as well as requirements for financial assurance, license transfer and termination, long-term site monitoring, surveillance, ownership and ultimate custody.

b. The requirements of this Part apply to byproduct material or residual radioactive material that is located at a site where milling operations are no longer active, if such site is not covered by the remedial action program of Title I of the Uranium Mill Tailings Radiation Control Act (UMTRCA) of 1978 (92 Stat. 3021; 42 U.S.C. 7901). [The regulations in this Part do not establish criteria and procedures for the issuance of licenses for materials covered under Title I of UMTRCA of 1978 unless remedial action is not completed under that program.].[NOTE: STATES WITHOUT 11 E.(2) BYPRODUCT MATERIAL AUTHORITY SHOULD NOT ADOPT THIS PROVISION.]

c. The requirements of this Part are in addition to, and not in substitution for, other applicable requirements of these regulations.

d. A person subject to the regulations in this part may not receive title to, own, receive, possess, use, transfer, provide for long-term care, deliver or dispose of byproduct material or residual radioactive material as defined in this Part, or any source material after removal from its place of deposit in nature, unless authorized in a specific or general license issued by the Agency under the regulations in this part.

Sec. U.3 - Definitions. As used in this Part, the following definitions apply:

"Active maintenance" means any significant activity needed during the period of long term care, including ongoing activities such as the pumping and treatment of water from a site or one-time measures such as replacement of a disposal site's cover. Active maintenance does not include custodial activities such as repair of fencing, repair or replacement of monitoring equipment, re-vegetation, minor additions to soil cover, minor repair of disposal site cover, and general disposal site upkeep such as mowing grass.

"Aquifer" means a geologic formation, group of formations, or part of a formation capable of yielding a significant amount of ground water to wells or springs. Any saturated zone created by uranium or thorium operations would not be considered an aquifer unless the zone is or potentially is:

(1) Hydraulically interconnected to a natural aquifer;

(2) Capable of discharge to surface water; or

(3) Reasonably accessible because of migration beyond the vertical projection of the boundary of the land transferred for long-term government ownership and care in accordance with Criterion 11 of Appendix A to this Part U.

"As expeditiously as practicable considering technological feasibility", for the purposes of Criterion 6A, means as quickly as possible considering: the physical characteristics of the tailings and the site; the limits of available technology; the need for consistency with mandatory requirements of other regulatory programs; and factors beyond the control of the licensee. The phrase permits consideration of the cost of compliance only to the extent specifically provided for by use of the term available technology.

"Available radon barrier technology" means technologies and methods for emplacing a final radon barrier on uranium mill tailings piles or impoundments. This term shall not be construed to include extraordinary measures or techniques that would impose costs that are grossly excessive as measured by practice within the industry (or one that is reasonably analogous), (such as, by way of illustration only, unreasonable overtime, staffing, or transportation requirements, etc., considering normal practice in the industry; laser fusion of soils, etc.), provided there is reasonable progress toward emplacement of the final radon barrier. To determine grossly excessive costs, the relevant baseline against which cost shall be compared is the cost estimate for tailings impoundment closure contained in the licensee's approved reclamation plan, but costs beyond these estimates shall not automatically be considered grossly excessive.

"Byproduct material" [as in Part A] [as used in this part means the tailings or wastes produced by the extraction or concentration of uranium or thorium from ore processed primarily for its source material content, including discrete surface wastes resulting from uranium or thorium solution extraction processes. Underground ore bodies depleted by these solution extraction operations do not constitute "byproduct material" within this definition.] NOTE: with the addition of types 11e.(3) and 11e.(4), the Agency may have the entire definition in their part A and can be referenced.

"Closure" means the activities following operations to decontaminate and decommission the buildings and site used to produce byproduct materials and reclaim the tailings and/or waste disposal area.

"Closure plan" means the Agency-approved plan to accomplish closure.

"Commencement of construction" means any clearing of land, excavation or other substantial action related to a proposed activity for specific licensing that would adversely affect the natural environment of a site; this term does not include changes desirable for the temporary use of the land for public recreational uses, limited borings to determine site characteristics as necessary for environmental assessment or other pre-construction monitoring to establish background information related to the suitability of a site, or to the protection of environmental values.

"Compliance period" begins when the Agency sets secondary ground-water protection standards and ends when the owner or operator's license is terminated and the site is transferred to the state or federal agency for long-term care.

"Decommission" means to remove a facility or site safely from service and reduce residual radioactivity to a level that permits (1) release of the property for unrestricted use and termination of the license or (2) release of the property under restricted conditions and termination of the license.

["Decommissioning funding plan" means a written document that contains a cost estimate for decommissioning and a description of the method for assuring for decommissioning, including means of adjusting cost estimates and associated funding levels periodically over the life of the facility.] 1

"Dike" means an embankment or ridge of either natural or man-made materials used to prevent the movement of liquids, sludges, solids, or other materials.

"Disposal area" means the area containing byproduct materials to which the requirements of Criterion 6 of Appendix A to this Part U apply.

"Existing portion" means that land surface area of an existing surface impoundment on which significant quantities of uranium or thorium byproduct material had been placed prior to September 30, 1983.

"Factors beyond the control of the licensee" means factors proximately causing delay in meeting the schedule in the applicable reclamation plan for the timely emplacement of the final radon barrier notwithstanding the good faith efforts of the licensee to complete the barrier in compliance with paragraph (1) of Criterion 6A of Appendix A to this Part U. These factors may include, but are not limited to:

(1) Physical conditions at the site;

(2) Inclement weather or climatic conditions;

(3) An act of god;

(4) An act of war;

(5) A judicial or administrative order or decision, or change to the statutory, regulatory, or other legal requirements applicable to the licensee's facility that would preclude or delay the performance of activities required for compliance;

(6) Labor disturbances;

(7) Any modifications, cessation or delay ordered by state, federal, or local agencies;

(8) Delays beyond the time reasonably required in obtaining necessary government permits, licenses, approvals, or consent for activities described in the reclamation plan proposed by the licensee that result from agency failure to take final action after the licensee has made a good faith, timely effort to submit legally sufficient applications, responses to requests (including relevant data requested by the agencies), or other information, including approval of the reclamation plan; and

1 This definition is from Part S. It a State does not have this definition in their version of either Part A, C or S, it should be listed here.

(9) An act or omission of any third party over whom the licensee has no control.

"Final radon barrier" means the earthen cover (or approved alternative cover) over tailings or waste constructed to comply with Criterion 6 of Appendix A to this Part U (excluding erosion protection features).

"Ground water" means water below the land surface in a zone of saturation. For purposes of Appendix A to this Part U, ground water is the water contained within an aquifer as defined above.

"Leachate" means any liquid, including any suspended or dissolved components in the liquid, that has percolated through or drained from the radioactive material.

"Licensed site" means the area contained within the boundary of a location under the control of persons generating or storing radioactive materials under an Agency license.

"Liner" means a continuous layer of natural or man-made materials, beneath or on the sides of a surface impoundment which restricts the downward or lateral escape of byproduct material, hazardous constituents, or leachate.

"Long term care" means the observation and maintenance of a site following the postclosure period and termination of the license."Milestone" means an action or event that is required to occur by an enforceable date.

"Monitoring" as in Part A of these Regulations. [means the measurement of radiation, radioactive material concentrations, surface area activities or quantities of radioactive material and the use of the results of these measurements to evaluate potential exposures and doses. For purposes of these regulations, "radiation monitoring" and "radiation protection monitoring" are equivalent terms.]

"Natural thorium" means thorium isotopes with a naturally occurring distribution, which is essentially 100 weight percent thorium-232.

"Natural uranium" means uranium isotopes with the naturally occurring distribution of uranium, which is approximately 0.711 weight percent uranium-235, and the remainder by weight essentially uranium-238.

"Operation" means that a uranium or thorium mill tailings pile or impoundment is being used for the continued placement of byproduct material or is in standby status for such placement. A pile or impoundment is in operation from the day that byproduct material is first placed in the pile or impoundment until the day final closure begins.

"Point of compliance" is the site specific location in the uppermost aquifer where the ground-water protection standard must be met.

"Post-closure" means the period of time between site closure and license termination that is used for decontamination, reclamation, and stabilization of the site and disposal area or other activities to determine effectiveness of the closure design and prior to the termination of the license.

“Principal activities” as used in this part, means activities authorized by the license which are essential to achieving the purpose(s) for which the license was issued or amended. Storage during which no licensed material is accessed for use or disposal and activities incidental to decontamination or decommissioning are not principal activities.

"Reclamation plan", for the purposes of Criterion 6A of Appendix A to this Part U, means the plan detailing activities to accomplish reclamation of the tailings or waste disposal area in accordance with the technical criteria of Appendix A to this Part. The reclamation plan must include a schedule for reclamation milestones that are key to the completion of the final radon barrier including as appropriate, but not limited to, wind blown tailings retrieval and placement on the pile, interim stabilization (including de-watering or the removal of freestanding liquids and re-contouring), and final radon barrier construction. (Reclamation of tailings must also be addressed in the closure plan; the detailed reclamation plan may be incorporated into the closure plan.)

"Residual Radioactive Material" means: (1) Waste (which the Secretary of Energy determines to be radioactive) in the form of tailings resulting from the processing of ores for the extraction of uranium and other valuable constituents of the ores; and (2) other waste (which the Secretary of Energy determines to be radioactive) at a processing site which relates to such processing, including any residual stock of unprocessed ores or low-grade materials. This term is used only with respect to materials at sites subject to remediation under title I of the Uranium Mill Tailings Radiation Control Act of 1978, as amended.

"Source material" [as defined in Part A] means:

(1) Uranium or thorium, or any combination thereof, in any physical or chemical form; or

(2) Ores that contain by weight one-twentieth of 1 percent (0.05 percent) or more of uranium, thorium, or any combination of uranium and thorium. Source material does not include special nuclear material.

"Source material milling [uranium milling]" means any activity that results in the production of byproduct material as defined in this Part**.**

"Surface impoundment" means a natural topographic depression, man-made excavation, or diked area, which is designed to hold an accumulation of liquid wastes or wastes containing free liquids, and which is not an injection well.

"Surveillance" means the observation of the site for the purposes of visual detection of the need for maintenance, custodial care, evidence of unauthorized access, and compliance with other license and regulatory requirements.

"Uppermost aquifer" means the geologic formation nearest the natural ground surface that is an aquifer, as well as lower aquifers that are hydraulically interconnected with this aquifer within the facility's property boundary.

Sec. U.4 - Special Requirements for Issuance of Specific Licenses For Source Material Milling. In addition to the requirements set forth in Part C of these regulations, a specific license for source material milling will be issued if the applicant submits to the Agency a complete and accurate application that clearly demonstrates how the requirements and objectives of this Part are met. Failure to clearly demonstrate that the requirements and objectives of this Part are met shall be grounds for refusing to accept an application.

a. An applicant for a license (or to amend or renew an existing license) to receive, possess, and use source material for milling or byproduct material shall submit all information required under

these regulations and such other material as the Agency may deem necessary and shall address the following:

i. Description of the proposed project or action;

ii. Site characteristics including regional and site specific geology, topography, hydrology and meteorology;

iii. Radiological and non-radiological impacts of the proposed project or action, including waterway and groundwater impacts;

iv. Environmental effects of accidents;

v. Tailings disposal and decommissioning;

vi. Site and project alternatives.

b. The applicant shall provide written specifications describing the means employed to meet the following requirements during the operational phase of any project.

i. Milling operations shall be conducted so that all airborne effluent releases are reduced to levels as low as is reasonably achievable.

ii. The mill operator shall conduct at least a daily inspection of any tailings or waste retention systems. The inspection shall be performed by a person who is qualified and approved by the Agency. Records of such inspections shall be maintained for review by the Agency.

iii. The mill operator shall immediately notify the Agency of the following:

(1) Any failure in a tailings or waste retention system which results in a release of tailings or waste into unrestricted areas [the environment]; and

(2) Any unusual conditions which are not contemplated in the design of the retention system and which if not corrected could lead to failure of the system and result in a release of tailings or waste into unrestricted areas [the environment].

c. During any one full year prior to any major site construction, the applicant/licensee shall conduct a preoperational monitoring program to provide complete baseline data on a milling site and its environs. Throughout the construction and operating phases of the mill, the applicant/licensee shall conduct an operational monitoring program to measure or evaluate compliance with applicable standards and regulations, to evaluate performance of control systems and procedures, to evaluate environmental impacts of operation, and to detect potential long-term effects.

d. An application for a license to receive, possess and use source material for milling or byproduct material shall contain proposed specifications relating to the milling operations and the disposition of tailings or wastes resulting from such milling activities to achieve the requirements and objectives set forth in the criteria listed in Appendix A to this Part U. Each application for a new license or for license renewal must clearly demonstrate how the requirements and objectives set forth in Appendix A to this Part U have been addressed.

Sec. U.5 - Pre-licensing Construction. An application for a license, or to amend or renew an existing license, for source material milling shall be filed with the Agency at least nine (9) months prior to the anticipated commencement of construction of the plant or facility in which the activity will be conducted and shall be accompanied by the environmental report required by U.6, unless an exemption from the requirement of furnishing such a report has been obtained from the Agency. No construction shall be commenced until the license has been issued.

Sec. U.6 - Applicant's Environmental Report.

a. For each license application (or application to amend or renew an existing license) to receive, possess, and use source material for uranium or thorium milling or byproduct material, an environmental report shall be required of the applicant and shall contain all information deemed necessary by the Agency**.**

b. The applicant's environmental report, or supplement to applicant's environmental report, as appropriate, shall include information to assist the Agency in the evaluation of the short-term and long-range environmental impact of the project and activity so that the Agency may weigh environmental, economic, technical, and other benefits against environmental costs, while considering available alternatives.

c. The following types of actions require an applicant's environmental report:

   i. Issuance or renewal of a source material milling license;

   ii. Issuance of an amendment that would authorize or result in:

      (1) A significant expansion of a site;

      (2) A significant change in the types of effluents;

      (3) A significant increase in the amounts of effluents;

      (4) A significant increase in individual or cumulative occupational radiation exposure; or

      (5) A significant increase in the potential for or consequences from radiological accidents.

d. If the application is for an amendment to or a renewal of a license for which the applicant has previously submitted an environmental report, the supplement to an applicant's environmental report may be limited by incorporating by reference, updating or supplementing the information previously submitted to reflect any significant environmental change, including any significant environmental change resulting from operational experience or a change in operations or proposed decommissioning activities.

e. In the event that an applicant's environmental report acceptable to the Agency is on file with the Agency in regard to the specific licensed activity authorized under an existing license, and upon request of the applicant to amend or renew an existing license or at the initiation of the Agency, the Agency may grant an exemption of the requirement to submit an additional environmental

report or supplement. The request for exemption shall provide the Agency with such information as the Agency requires of the applicant to demonstrate that no significant environmental impact will result from the licensed activity.

Sec. U.7 - Transmittal of Applicant's Environmental Report for Review and Comment. Upon receipt of the environmental report or any amendment thereto, and of any other documents required, the Agency shall determine the necessity to transmit and, if appropriate, shall transmit the same for review and comment to federal, state, and local agencies having expertise in and jurisdiction over the proposed project and activity. Written comments and reports of reviewing agencies shall be considered by the Agency in its decision-making review process on the license application request.

a. If an environmental impact statement (EIS) is required of a federal agency pursuant to the National Environment Policy Act of 1969 (NEPA) and is provided by such federal agency, it shall be used by the Agency in its decision-making review process on the license application request.

b. The Agency shall consider applicable regulations of federal, state, and local regulatory agencies and permit requirements thereof.

Sec. U.8 - Environmental Impact Analysis.

a. The Agency shall prepare a written analysis for any significant impact on the environment for the following activities: (1) a license application, (2) an application to amend or renew an existing license to receive, possess, and use source material for uranium or thorium milling or, (3) an application to amend or renew an existing license to receive, possess, and use byproduct material. This written analysis shall be available to the public at the time of public notice of hearing. This written analysis shall include:

    i. An assessment of the radiological and non-radiological impacts to the public health;

    ii. An assessment of any impact on any waterway and ground water;

    iii. Consideration of alternatives to the activities to be conducted; and

    iv. Consideration of the long-term impacts of the licensed activities.

b. In preparing the environmental impact analysis, the Agency may use and incorporate by reference the environmental report prepared by the applicant as required by U.6 and environmental assessments prepared by federal, state or local agencies.

c. The environmental impact analysis, or any part thereof, shall be prepared directly by or under supervision of the Agency.

Sec. U.9 - Financial Assurance Arrangements.

U.9.1. Prior to issuance of the license, the applicant shall establish separate financial assurance arrangements, to (1) ensure decontamination and decommissioning of the facility and (2) provide a fund adequate and sufficient to cover the payment of the cost for long-term care and monitoring. These

required financial assurances shall be as set forth in Appendix A, Criteria 9 and 10 of this Part U. [The Agency may consider proposals to combine the two types of financial assurance.] Financial assurance shall be provided prior to commencement of operations.

[9.2. Each holder of a specific license shall submit a decommissioning funding plan in accordance with the criteria set forth in this section. If the licensee submits the certification of financial assurance rather than a decommissioning funding plan, The licensee shall include a decommissioning funding plan in any application for license renewal.]

[9.3. Each decommissioning funding plan must contain a cost estimate for decommissioning and a description of the method of assuring funds for decommissioning from Criteria 9 of Appendix A of this section, including means for adjusting cost estimates and associated funding levels periodically over the life of the facility. Cost estimates must be adjusted at intervals not to exceed 3 years. The decommissioning funding plan must also contain a certification by the licensee that financial assurance for decommissioning has been provided in the amount of the cost estimate for decommissioning and a signed original of the financial instrument obtained to satisfy the financial assurance requirements of 10CFR40.36.(e) or State equivalent].

Sec. U.10 - Operational Requirements. Each licensee authorized to receive, possess and use source material for milling or byproduct material, shall:

a. Operate in accordance with the requirements of this Part U: the procedures required by U.4b., the monitoring required by U.4c., and the requirements and objectives of Appendix A to this Part U.

b. Submit a report to the Agency within 60 days after January 1 and July 1 of each year, specifying the quantity of each of the radioactive materials released to unrestricted areas in liquid and in gaseous effluents during the previous six months of operation, and such other information as the Agency may require to estimate maximum potential annual radiation doses to the public resulting from effluent releases. If quantities of radioactive materials released during the reporting period are significantly above the licensee's design objectives previously reviewed as part of the licensing action, the report shall cover this specifically. On the basis of such reports and any additional information the Agency may obtain from the licensee or others, the Agency may from time to time require the licensee to take such action as the Agency deems appropriate.

Sec. U.11 - Decommissioning Requirements.
[U.11.1 Decommissioning Timeliness. [As in Part O.]

a. The licensee shall notify the Agency in writing within 60 days of the occurrence of any of the following:

    i. The licensee has decided to permanently cease principal activities at the entire site or in any separate building or outdoor area that contains residual radioactivity such that the building or outdoor area is unsuitable for release in accordance with these regulations; or,

    ii. No principal activities under the license have been conducted for a period of 24 months; or,

iii. No principal activities have been conducted for a period of 24 months in any separate building or outdoor area that contains residual radioactivity such that the building or outdoor area is unsuitable for release in accordance with these regulations.

b. From the date of notification of the Agency required in U.11.1.a., the licensee shall either:

i. Begin decommissioning activities; or

ii. Within 12 months of notification submit a decommissioning plan, if required by Appendix A [or U.11] of this Part, and begin decommissioning upon Agency approval of that plan.

c. Coincident with the notification of the Agency required in U.11.1.a., the licensee shall maintain in effect all decommissioning financial assurances established by the licensee pursuant to Part S of these regulations in conjunction with a license issuance or renewal or as required by Appendix A to this Part. The amount of the financial assurance must be increased, or may be decreased, as appropriate, to cover the detailed cost estimate for decommissioning established pursuant to U.11.2.

d. The Agency may approve an alternate schedule for the submission of plans and for the completion of decommissioning as required pursuant to U.11.1.a.. if the Agency determines that the alternate schedule (1) is necessary to effectively conduct decommissioning, (2) presents no undue risks to public health and safety, and (3) is otherwise in the public interest. The request must be submitted no later than 30 days before notification pursuant to Part C.32b. of these regulations. The schedule for decommissioning may not commence until the Agency has made a determination on the request.]

U.11.2. Decommissioning Plan.

a. In addition to the information required by Part C [and Part O] of these regulations, each licensee authorized to receive, possess and use source material for milling or byproduct material shall submit a plan for completion of decommissioning if the procedures necessary to carry out decommissioning:

i. Have not been previously approved by the Agency; and

ii. Could increase potential health and safety impacts to workers or to the public, such as in any of the following cases:

(1) Procedures would involve techniques not applied routinely during cleanup or maintenance operations; or

(2) Workers would be entering areas not normally occupied where surface contamination and radiation levels are significantly higher than routinely encountered during operation; or

(3) Procedures could result in significantly greater airborne concentrations of radioactive materials than are present during operation; or

(4) Procedures could result in significantly greater releases of radioactive material to the environment than those associated with operation.

b. Procedures with potential health and safety impacts may not be carried out prior to approval of the decommissioning plan.

c. The proposed decommissioning plan, if required by U.11a. or by license condition, must include:

   i. Description of planned decommissioning activities;

   ii. Description of methods used to assure protection of workers and the environment against radiation hazards during decommissioning;

   iii. A description of the planned final radiation survey; and

   iv. An updated detailed cost estimate for decommissioning, comparison of that estimate with present funds set aside for decommissioning, and plan for assuring the availability of adequate funds for completion of decommissioning.

d. For decommissioning plans calling for completion of decommissioning later than 24 months after plan approval, the plan shall include a justification for the delay. The proposed decommissioning plan will be approved by the Agency if the information therein demonstrates that the decommissioning will be completed as soon as is reasonable and that the health and safety of workers and the public will be adequately protected.

e. After submittal and upon approval of the decommissioning plan by the Agency, the licensee shall decommission in accordance with the approved plan. As a final step in decommissioning, the licensee shall submit the information required in Part C [and Part O] of these regulations and shall certify the disposition of accumulated wastes from decommissioning.

f. If the information submitted hereunder does not adequately demonstrate that the premises are suitable for release for unrestricted use, the Agency will inform the licensee of the appropriate further actions required for termination of license.

Part U

APPENDIX A

CRITERIA RELATING TO THE OPERATION OF MILLS

AND THE DISPOSITION OF RADIOACTIVE TAILINGS OR WASTES

Introduction: Every applicant for a license to receive, possess and use radioactive material in conjunction with uranium or thorium milling, or byproduct material at sites formerly associated with such milling, is required by the provisions of U.4 to include in a license application proposed specifications relating to milling operations and the disposition of tailings or wastes resulting from such milling activities. This appendix establishes technical, ownership, and long-term site surveillance criteria relating to the siting, construction, operation, decontamination, decommissioning, financial assurance, and reclamation of mills and tailings or waste systems and sites at which such mills and systems are located.

As used in this appendix, the term "as low as is reasonably achievable" has the same meaning as in Part A.2. of these regulations.

In many cases, flexibility is provided in the criteria to allow achieving an optimum tailings disposal program on a site-specific basis. However, in such cases the objectives, technical alternatives and concerns which must be taken into account in developing a tailings program are identified. As provided by the provisions of U.4, applications for licenses must clearly demonstrate how the criteria have been addressed.

The specifications shall be developed considering the expected full capacity of tailings or waste systems and the lifetime of mill operations. Where later expansions of systems or operations may be likely (for example, where large quantities of ore now marginally uneconomical may be stockpiled), the amenability of the disposal system to accommodate increased capacities without degradation in long-term stability and other performance factors shall be evaluated.

Licensees or applicants may propose to the Agency alternatives to meet the specific requirements in this Appendix. The alternative proposals may take into account local or regional conditions, including geology, topography, hydrology, and meteorology. The Agency may find that the proposed alternatives meet the Agency's requirements if the alternatives will achieve a level of stabilization and containment of the sites concerned and a level of protection for public health, safety, and the environment from radiological and non-radiological hazards associated with the site, which is equivalent to, to the extent practicable, or more stringent than the level which would be achieved by the requirements of this Appendix and the standards promulgated by the Environmental Protection Agency in 40 CFR Part 192, Subparts D and E. Proposed alternatives to specific regulations in this Part U require notice and opportunity for hearing before the U. S. Nuclear Regulatory Commission.

All site-specific licensing decisions based on the criteria in this Appendix or alternatives proposed by licensees or applicants will take into account the risk to the public health and safety and the environment with due consideration to the economic costs involved and any other factors the Agency determines to be appropriate. In implementing this Appendix, the Agency will consider "practicable" and "reasonably achievable" as equivalent terms. Decisions involving these terms will take into account the state of

technology, and the economics of improvements in relation to benefits to the public health and safety, and other societal and socioeconomic considerations, and in relation to the utilization of atomic energy in the public interest.

Criterion 1.

Criterion 1A. The general goal or broad objective in siting and design decisions is permanent isolation of tailings and associated contaminants by minimizing disturbance and dispersion by natural forces, and to do so without ongoing maintenance. For practical reasons, specific siting decisions and design standards must involve finite times (e.g., the longevity design standard in Criterion 6). The following site features which will contribute to such a goal or objective must be considered in selecting among alternative tailings disposal sites or judging the adequacy of existing tailings sites:

(1) Remoteness from populated areas;

(2) Hydrologic and other natural conditions as they contribute to continued immobilization and isolation of contaminants from ground-water sources; and

(3) Potential for minimizing erosion, disturbance, and dispersion by natural forces over the long term.

Criterion 1B. The site selection process must be an optimization to the maximum extent reasonably achievable in terms of the features in Criterion 1A.

Criterion 1C. In the selection of disposal sites, primary emphasis must be given to isolation of tailings or wastes, a matter having long-term impacts, as opposed to consideration only of short-term convenience or benefits, such as minimization of transportation or land acquisition costs. While isolation of tailings will be a function of both site and engineering design, overriding consideration must be given to siting features given the long-term nature of the tailings hazards.

Criterion 1D. Tailings should be disposed of in a manner that no active maintenance is required to preserve conditions of the site.

Criterion 2. To avoid proliferation of small waste disposal sites and thereby reduce perpetual surveillance obligations, byproduct material from *in situ* extraction operations, such as residues from solution evaporation or contaminated control processes, and wastes from small remote above ground extraction operations shall be disposed of at existing large mill tailings sites; unless considering the nature of the wastes, such as their volume and specific activity, and the costs and environmental impacts of transporting the wastes to a large disposal site, such off-site disposal is demonstrated to be impracticable or the advantages of onsite burial clearly outweigh the benefits of reducing the perpetual surveillance obligations.

Criterion 3. The "prime option" for disposal of tailings is placement below grade, either in mines or specially excavated pits (that is, where the need for any specially constructed retention structure is eliminated). The evaluation of alternative sites and disposal methods performed by mill operators in support of their proposed tailings disposal program (provided in applicants' environmental reports) must reflect serious consideration of this disposal mode. In some instances, below grade disposal may not be the most environmentally sound approach, such as might be the case if a ground-water formation is relatively close to the surface or not very well isolated by overlying soils and rock. Also, geologic and topographic conditions might make full below grade burial impracticable. For example, bedrock may be

sufficiently near the surface that blasting would be required to excavate a disposal pit at excessive cost, and more suitable alternative sites are not available. Where full below grade burial is not practicable, the size of retention structures, and size and steepness of slopes associated with exposed embankments must be minimized by excavation to the maximum extent reasonably achievable or appropriate given the geologic and hydrologic conditions at a site. In these cases, it must be demonstrated that an above grade disposal program will provide reasonably equivalent isolation of the tailings from natural erosional forces.

Criterion 4. The following site and design criteria must be adhered to whether tailings or wastes are disposed of above or below grade.

Criterion 4A. Upstream rainfall catchment areas must be minimized to decrease erosion potential and the size of the floods which could erode or wash out sections of the tailings disposal area.

Criterion 4B. Topographic features should provide good wind protection.

Criterion 4C. Embankment and cover slopes must be relatively flat after final stabilization to minimize erosion potential and to provide conservative factors of safety assuring long-term stability. The broad objective should be to contour final slopes to grades which are as close as possible to those which would be provided if tailings were disposed of below grade: this could, for example, lead to slopes of about 10 horizontal to 1 vertical (10h:1v) or less steep. In general, slopes should not be steeper than about 5h:1v. Where steeper slopes are proposed, reasons why a slope less steep than 5h:1v would be impracticable should be provided and compensating factors and conditions which make such slopes acceptable should be identified.

Criterion 4D. A full self-sustaining vegetative cover must be established or rock cover employed to reduce wind and water erosion to negligible levels.

(1) Where a full vegetative cover is not likely to be self-sustaining due to climatic or other conditions, such as in semi-arid and arid regions, rock cover must be employed on slopes of the impoundment system. The Agency will consider relaxing this requirement for extremely gentle slopes such as those which may exist on the top of the pile.

(2) The following factors must be considered in establishing the final rock cover design to avoid displacement of rock particles by human and animal traffic or by natural process, and to preclude undercutting and piping:

   (a) Shape, size, composition, and gradation of rock particles (excepting bedding material average particles size must be at least cobble size or greater);

   (b) Rock cover thickness and zoning of particles by size; and

   (c) Steepness of underlying slopes.

(3) Individual rock fragments must be dense, sound, and resistant to abrasion, and must be free from cracks, seams, and other defects that would tend to unduly increase their destruction by water and frost actions. Weak, friable, or laminated aggregate may not be used.

(4) Rock covering of slopes may be unnecessary where top covers are very thick (on the order of 10m or greater); impoundment slopes are very gentle (on the order of 10h:1v or less); bulk cover materials have inherently favorable erosion resistance characteristics; and, there is negligible

drainage catchment area upstream of the pile and good wind protection as described in Criteria 4A and 4B.

(5) Furthermore, all impoundment surfaces must be contoured to avoid areas of concentrated surface runoff or abrupt or sharp changes in slope gradient. In addition to rock cover on slopes, areas toward which surface runoff might be directed must be well protected with substantial rock cover (rip rap). In addition to providing for stability of the impoundment system itself, overall stability, erosion potential, and geomorphology of surrounding terrain must be evaluated to assure that there are not ongoing or potential processes, such as gully erosion, which would lead to impoundment instability.

Criterion 4E. The impoundment may not be located near a capable fault that could cause a maximum credible earthquake larger than that which the impoundment could reasonably be expected to withstand. As used in this criterion, the term "capable fault" has the same meaning as defined in section III(g) of Appendix A of 10 CFR Part 100. The term "maximum credible earthquake" means that earthquake which would cause the maximum vibratory ground motion based upon an evaluation of earthquake potential considering the regional and local geology and seismology and specific characteristics of local subsurface material.

Criterion 4F. The impoundment, where feasible, should be designed to incorporate features which will promote deposition. For example, design features which promote deposition of sediment suspended in any runoff which flows into the impoundment area might be utilized; the object of such a design feature would be to enhance the thickness of cover over time.

Criterion 5. Criteria 5A-5D and Criterion 13 incorporate the basic ground water protection standards imposed by the Environmental Protection Agency in 40 CFR Part 192, Subparts D and E (48 FR 45926; October 7, 1983) which apply during operations and prior to the end of closure. Groundwater monitoring to comply with these standards is required by Criterion 7A.

Criterion 5A.

(1) The primary ground water protection standard is a design standard for surface impoundments used to manage uranium and thorium radioactive material. Unless exempted under paragraph 5A(3) of this criterion, surface impoundments (except for an existing portion) shall have a liner that is designed, constructed, and installed to prevent any migration of wastes out of the impoundment to the adjacent subsurface soil, ground water, or surface water at any time during the active life (including the closure period) of the impoundment. The liner may be constructed of materials that may allow wastes to migrate into the liner (but not into the adjacent subsurface soil, ground water, or surface water) during the active life of the facility, provided that impoundment closure includes removal or decontamination of all waste residues, contaminated containment system components (liners, etc.), contaminated subsoils, and structures and equipment contaminated with waste and leachate. For impoundments that will be closed with the liner material left in place, the liner must be constructed of materials that can prevent wastes from migrating into the liner during the active life of the facility.

(2) The liner required by paragraph 5A(1) above shall be:

(a) Constructed of materials that have appropriate chemical properties and sufficient strength and thickness to prevent failure due to pressure gradients (including static head and external hydrogeologic forces), physical contact with the waste or leachate to which they

are exposed, climatic conditions, the stress of installation, and the stress of daily operation;

(b) Placed upon a foundation or base capable of providing support to the liner and resistance to pressure gradients above and below the liner to prevent failure of the liner due to settlement, compression, or uplift; and

(c) Installed to cover all surrounding earth likely to be in contact with the wastes or leachate.

(3) The applicant or licensee will be exempted from the requirements of paragraph 5A(1) of this criterion if the Agency finds, based on a demonstration by the applicant or licensee, that alternate design and operating practices, including the closure plan, together with site characteristics, will prevent the migration of any hazardous constituents into ground water or surface water at any future time.

In deciding whether to grant an exemption, the Agency will consider:

(a) The nature and quantity of the wastes;

(b) The proposed alternate design and operation;

(c) The hydrogeologic setting of the facility, including the attenuative capacity and thickness of the liners and soils present between the impoundment and ground water or surface water; and

(d) All other factors which would influence the quality and mobility of the leachate produced and the potential for it to migrate to ground water or surface water.

(4) A surface impoundment must be designed, constructed, maintained, and operated to prevent overtopping resulting from normal or abnormal operations, overfilling, wind and wave actions, rainfall, or run-on; from malfunctions of level controllers, alarms, and other equipment; and from human error.

(5) When dikes are used to form the surface impoundment, the dikes must be designed, constructed, and maintained with sufficient structural integrity to prevent massive failure of the dikes. In ensuring structural integrity, it must not be presumed that the liner system will function without leakage during the active life of the impoundment.

Criterion 5B.

(1) Uranium and thorium byproduct material shall be managed to conform to the following secondary ground water protection standard: hazardous constituents entering the ground water from a licensed site must not exceed the specified concentration limits in the uppermost aquifer beyond the point of compliance during the compliance period. Hazardous constituents are those constituents identified by the Agency pursuant to paragraph 5B(2) of this criterion. Specified concentration limits are those limits established by the Agency as indicated in paragraph 5B(5) of this criterion. The Agency will also establish the point of compliance and compliance period on a site-specific basis through license conditions and orders. The objective in selecting the point of compliance is to provide the earliest practicable warning that the impoundment is releasing hazardous constituents to the ground water. The point of compliance must be selected to provide prompt indication of ground water contamination on the hydraulically down-gradient edge of the

disposal area. The Agency shall identify hazardous constituents, establish concentration limits, set the compliance period, and may adjust the point of compliance if needed to accord with developed data and site information as to the flow of ground water or contaminants, when the detection monitoring established under Criterion 7A indicates leakage of hazardous constituents from the disposal area.

(2) A constituent becomes a hazardous constituent subject to paragraph 5B(5) only when the constituent meets all three of the following tests:

(a) The constituent is reasonably expected to be in or derived from the uranium and thorium byproduct material in the disposal area;

(b) The constituent has been detected in the ground water in the uppermost aquifer; and

(c) The constituent is listed in Criterion 13 of this appendix.

(3) Even when constituents meet all three tests in paragraph 5B(2) of this criterion, the Agency may exclude a detected constituent from the set of hazardous constituents on a site-specific basis if it finds that the constituent is not capable of posing a substantial present or potential hazard to human health or the environment. In deciding whether to exclude constituents, the Agency will consider the following:

(a) Potential adverse effects on ground water quality, considering:

(i) The physical and chemical characteristics of the waste in the licensed site, including its potential for migration;

(ii) The hydrogeological characteristics of the facility and surrounding land;

(iii) The quantity of ground water and the direction of ground water flow;

(iv) The proximity and withdrawal rates of ground water users;

(v) The current and future uses of ground water in the area;

(vi) The existing quality of ground water, including other sources of contamination and their cumulative impact on the ground water quality;

(vii) The potential for health risks caused by human exposure to waste constituents;

(viii) The potential damage to wildlife, crops, vegetation, and physical structures caused by exposure to waste constituents;

(ix) The persistence and permanence of the potential adverse effects.

(b) Potential adverse effects on hydraulically-connected surface water quality, considering

(i) The volume and physical and chemical characteristics of the waste in the licensed site;

(ii) The hydrogeological characteristics of the facility and surrounding land;

(iii) The quantity and quality of ground water and the direction of ground water flow;

(iv) The patterns of rainfall in the region;

(v) The proximity of the licensed site to surface waters;

(vi) The current and future uses of surface waters in the area and any water quality standards established for those surface waters;

(vii) The existing quality of surface water, including other sources of contamination and the cumulative impact on surface water quality;

(viii) The potential for health risks caused by human exposure to waste constituents;

(ix) The potential damage to wildlife, crops, vegetation, and physical structures caused by exposure to waste constituents; and

(x) The persistence and permanence of the potential adverse effects.

(4) In making any determinations under paragraphs 5B(3) and 5B(6) of this criterion about the use of ground water in the area around the facility, the Agency will consider any identification of underground sources of drinking water and exempted aquifers made by the agency having jurisdiction.

(5) At the point of compliance, the concentration of a hazardous constituent must not exceed:

(a) The Agency-approved background concentration of that constituent in the ground water;

(b) The respective value given in the table in paragraph 5C if the constituent is listed in the table and if the background level of the constituent is below the value listed; or

(c) An alternate concentration limit established by the Agency.

(6) Conceptually, background concentrations pose no incremental hazards and the drinking water limits in Criterion 5C state acceptable hazards but these two options may not be practically achievable at a specific site. Alternate concentration limits that present no significant hazard may be proposed by licensees for Agency consideration. Licensees must provide the basis for any proposed limits including consideration of practicable corrective actions, that limits are as low as reasonably achievable, and information on the factors the Agency must consider. The Agency will establish a site-specific alternate concentration limit for a hazardous constituent as provided in paragraph 5B(5) of this criterion if it finds that the proposed limit is as low as reasonably achievable after considering practicable corrective actions, and that the constituent will not pose a substantial present or potential hazard to human health or the environment as long as the alternate concentration limit is not exceeded. In making the present and potential hazard finding, the Agency will consider the following factors:

(a) Potential adverse effects on ground water quality, considering:

(i) The physical and chemical characteristics of the waste in the licensed site including its potential for migration;

(ii) The hydrogeological characteristics of the facility and surrounding land;

(iii) The quantity of ground water and the direction of ground water flow;

(iv) The proximity and withdrawal rates of ground water users;

(v) The current and future uses of ground water in the area;

(vi) The existing quality of ground water, including other sources of contamination and their cumulative impact on the ground water quality;

(vii) The potential for health risks caused by human exposure to waste constituents;

(viii) The potential damage to wildlife, crops, vegetation, and physical structures caused by exposure to waste constituents;

(ix) The persistence and permanence of the potential adverse effects.

(b) Potential adverse effects on hydraulically-connected surface water quality, considering:

(i) The volume and physical and chemical characteristics of the waste in the licensed site;

(ii) The hydrogeological characteristics of the facility and surrounding land;

(iii) The quantity and quality of ground water, and the direction of ground water flow;

(iv) The patterns of rainfall in the region;

(v) The proximity of the licensed site to surface waters;

(vi) The current and future uses of surface waters in the area and any water quality standards established for those surface waters;

(vii) The existing quality of surface water including other sources of contamination and the cumulative impact on surface water quality;

(viii) The potential for health risks caused by human exposure to waste constituents;

(ix) The potential damage to wildlife, crops, vegetation, and physical structures caused by exposure to waste constituents; and

(x) The persistence and permanence of the potential adverse effects.

Criterion 5C. MAXIMUM VALUES FOR GROUND WATER PROTECTION

Constituent or property	Maximum Concentration Milligrams per liter:
Arsenic	0.05

Barium	1.0
Cadmium	0.01
Chromium	0.05
Lead	0.05
Mercury	0.002
Selenium	0.01
Silver	0.05
Endrin (1,2,3,4,10,10-hexachloro-1,7-expoxy-1,4,4a,5,6,7,8, 9a-octahydro-1, 4-endo, endo-5, 8-dimethano naphthalene)	0.0002
Lindane (1,2,3,4,5,6-hexachloro- cyclohexane, gamma isomer)	0.004
Methoxychlor (1,1,1-Trichloro-2,2-bis,p-methoxyphenylethane)	0.1
Toxaphene ($C_{10}H_{10}Cl_6$, Technical chlorinated camphene, 67-69 percent chlorine)	0.005
2,4-D (2,4-Dichlorophenoxyacetic acid)	0.1
2,4,5-TP Silvex (2,4,5-Trichloro-phenoxypropionic acid)	0.01
	Picocuries per liter:
Combined radium-226 and radium-228	5
Gross alpha-particle activity (excluding radon and uranium when producing uranium byproduct material or radon and thorium when producing thorium byproduct material)	15

Criterion 5D. If the ground water protection standards established under paragraph 5B(1) of this criterion are exceeded at a licensed site, a corrective action program must be put into operation as soon as is practicable, and in no event later than eighteen (18) months after the Agency finds that the standards have been exceeded. The licensee shall submit the proposed corrective action program and supporting rationale for Agency approval prior to putting the program into operation, unless otherwise directed by the Agency. The objective of the program is to return hazardous constituent concentration levels in ground water to the concentration limits set as standards. The licensee's proposed program shall address removing the hazardous constituents that have entered the ground water at the point of compliance or treating them in place. The program shall also address removing or treating in place any hazardous constituents that exceed concentration limits in ground water between the point of compliance and the down-gradient facility property boundary. The licensee shall continue corrective action measures to the extent necessary to achieve and maintain compliance with the ground water protection standard. The Agency will determine when the licensee may terminate corrective action measures based on data from the ground water monitoring program and other information that provide reasonable assurance that the ground water protection standard will not be exceeded.

Criterion 5E. In developing and conducting ground water protection programs, applicants and licensees shall also consider the following:

(1) Installation of bottom liners (Where synthetic liners are used, a leakage detection system must be installed immediately below the liner to ensure major failures are detected if they occur. This is in addition to the ground water monitoring program conducted as provided in Criterion 7. Where clay liners are proposed or relatively thin, *in situ* clay soils are to be relied upon for seepage control. Tests must be conducted with representative tailings solutions and clay materials to confirm that no significant deterioration of permeability or stability properties will occur with continuous exposure of clay to tailings solutions. Tests must be run for a sufficient period of

time to reveal any effects if they are going to occur (in some cases deterioration has been observed to occur rather rapidly after about nine months of exposure)).

(2) Mill process designs which provide the maximum practicable recycle of solutions and conservation of water to reduce the net input of liquid to the tailings impoundment.

(3) De-watering of tailings by process devices and/or *in situ* drainage systems (At new sites, tailings must be de-watered by a drainage system installed at the bottom of the impoundment to lower the phreatic surface and reduce the driving head of seepage, unless tests show tailings are not amenable to such a system. Where *in situ* de-watering is to be conducted, the impoundment bottom must be graded to assure that the drains are at a low point. The drains must be protected by suitable filter materials to assure that drains remain free running. The drainage system must also be adequately sized to assure good drainage).

(4) Neutralization to promote immobilization of hazardous constituents.

Criterion 5F. Where ground water impacts are occurring at an existing site due to seepage, action must be taken to alleviate conditions that lead to excessive seepage impacts and restore ground water quality. The specific seepage control and ground water protection method, or combination of methods, to be used must be worked out on a site-specific basis. Technical specifications must be prepared to control installation of seepage control systems. A quality assurance, testing, and inspection program, which includes supervision by a qualified engineer or scientist, must be established to assure the specifications are met.

Criterion 5G. In support of a tailings disposal system proposal, the applicant/operator shall supply information concerning the following:

(1) The chemical and radioactive characteristics of the waste solutions.

(2) The characteristics of the underlying soil and geologic formations particularly as they will control transport of contaminants and solutions. This includes detailed information concerning extent, thickness, uniformity, shape, and orientation of underlying strata. Hydraulic gradients and conductivities of the various formations must be determined. This information must be gathered from borings and field survey methods taken within the proposed impoundment area and in surrounding areas where contaminants might migrate to ground water. The information gathered on bore-holes must include both geological and geophysical logs in sufficient number and degree of sophistication to allow determining significant discontinuities, fractures, and channeled deposits of high hydraulic conductivity. If field survey methods are used, they should be in addition to, and calibrated with, bore-hole logging. Hydrologic parameters such as permeability may not be determined on the basis of laboratory analysis of samples alone; a sufficient amount of field testing (e.g., pump tests) must be conducted to assure actual field properties are adequately understood. Testing must be conducted to allow estimating chemi-sorption attenuation properties of underlying soil and rock.

(3) Location, extent, quality, capacity and current uses of any ground water at and near the site.

Criterion 5H. Steps must be taken during stockpiling of ore to minimize penetration of radionuclides into underlying soils; suitable methods include lining and/or compaction of ore storage areas.

Criterion 6.

(1) In disposing of waste byproduct material, licensees shall place an earthen cover (or approved alternative) over tailings or wastes at the end of milling operations and shall close the waste disposal area in accordance with a design[2/] which provides reasonable assurance of control of radiological hazards to (i) be effective for 1,000 years, to the extent reasonably achievable, and, in any case, for at least 200 years, and (ii) limit releases of radon-222 from uranium byproduct materials, and radon-220 from thorium byproduct materials, to the atmosphere so as not to exceed an average[3/] release rate of 0.74 becquerel per square meter per second (20 pCi/m^2s) to the extent practicable throughout the effective design life determined pursuant to (1)(i) of this criterion. In computing required tailings cover thicknesses, moisture in soils in excess of amounts found normally in similar soils in similar circumstances may not be considered. Direct gamma exposure from the tailings or wastes should be reduced to background levels. The effects of any thin synthetic layer may not be taken into account in determining the calculated radon exhalation level. If non-soil materials are proposed as cover materials, it must be demonstrated that these materials will not crack or degrade by differential settlement, weathering, or other mechanism, over long-term intervals.

(2) As soon as reasonably achievable after emplacement of the final cover to limit releases of radon-222 from uranium byproduct material and prior to placement of erosion protection barriers or other features necessary for long-term control of the tailings, the licensee shall verify through appropriate testing and analysis that the design and construction of the final radon barrier is effective in limiting releases of radon-222 to a level not exceeding 0.74 becquerel per meter square per second (20 pCi/m^2s) averaged over the entire pile or impoundment using the procedures described in 40 CFR Part 6, Appendix B, Method 115, or another method of verification approved by the Agency as being at least as effective in demonstrating the effectiveness of the final radon barrier.

(3) When phased emplacement of the final radon barrier is included in the applicable reclamation plan, the verification of radon-222 release rates required in paragraph (2) of this Criterion must be conducted for each portion of the pile or impoundment as the final radon barrier for that portion is emplaced.

(4) Within ninety days of the completion of all testing and analysis relevant to the required verification in paragraphs (2) and (3) of this Criterion, the uranium mill licensee shall report to the Agency the results detailing the actions taken to verify that levels of release of radon-222 do not exceed 0.74 becquerel per meter square per second (20 pCi/m^2s) when averaged over the entire pile or impoundment. The licensee shall maintain records until termination of the license documenting the source of input parameters including the results of all measurements on which they are based, the calculations and/or analytical methods used to derive values for input parameters, and the procedure used to determine compliance. These records shall be kept in a form suitable for transfer to the custodial agency at the time of transfer of the site to the U.S. Department of Energy or a state for long-term care if requested.

(5) Near surface cover materials (i.e., within the top three meters) may not include waste or rock that contains elevated levels of radium; soils used for near surface cover must be essentially the

---

[2/] *In the case of thorium byproduct materials, the standard applies only to design. Monitoring for radon emissions from thorium byproduct materials after installation of an appropriately designed cover is not required.*

[3/] *This average applies to the entire surface of each disposal area over a period of a least one year, but a period short compared to 100 years. Radon will come from both byproduct materials and from covering materials. Radon emissions from covering materials should be estimated as part of developing a closure plan for each site. The standard, however, applies only the emissions from byproduct materials to the atmosphere.*

same, as far as radioactivity is concerned, as that of surrounding surface soils. This is to ensure that surface radon exhalation is not significantly above background because of the cover material itself.

(6) The design requirements in this Criterion for longevity and control of radon releases apply to any portion of a licensed and/or disposal site unless such portion contains a concentration of radium in land, averaged over areas of 100 square meters, which as a result of byproduct material, does not exceed the background level by more than: (i) 0.18 becquerel per gram (5 pCi/g) of radium-226, or, in the case of thorium byproduct material, radium-228, averaged over the first 15 centimeters (cm) below the surface, and (ii) 0.56 becquerel per gram (15 pCi/g) of radium-226, or, in the case of thorium byproduct material, radium-228, averaged over 15-cm thick layers more than 15 cm below the surface.

Byproduct material containing concentrations of radionuclides other than radium in soil, and surface activity on remaining structures, must not result in a total effective dose equivalent (TEDE) exceeding the dose from cleanup of radium contaminated soil to the above standard (benchmark dose), and must be at levels which are as low is reasonably achievable. If more than one residual radionuclide is present in the same 100 square-meter area, the sum of the ratios for each radionuclide of concentration present to the concentration limit will not exceed "1" (unity). A calculation of the potential peak annual TEDE within 1000 years to the average member of the critical group that would result from applying the radium standard (not including radon) on the site must be submitted for approval. The use of decommissioning plans with benchmark doses which exceed 1 millisievert per year (100 mrem/yr), before application of ALARA, requires the approval of the Agency. This requirement for dose criteria does not apply to sites that have decommissioning plans for soil and structures approved before [insert effective date].

(7) The licensee shall also address the non-radiological hazards associated with the wastes in planning and implementing closure. The licensee shall ensure that disposal areas are closed in a manner that minimizes the need for further maintenance. To the extent necessary to prevent threats to human health and the environment, the licensee shall control, minimize, or eliminate post-closure escape of non-radiological hazardous constituents, leachate, contaminated rainwater, or waste decomposition products to the ground or surface waters or to the atmosphere.

Criterion 6A.

(1) For impoundments containing uranium byproduct materials, the final radon barrier must be completed as expeditiously as practicable considering technological feasibility after the pile or impoundment ceases operation in accordance with a written, Agency-approved reclamation plan. (The term as expeditiously as practicable considering technological feasibility as specifically defined in U.3 includes factors beyond the control of the licensee). Deadlines for completion of the final radon barrier and, if applicable, the following interim milestones must be established as a condition of the individual license: windblown tailings retrieval and placement on the pile and interim stabilization including dewatering or the removal of freestanding liquids and recontouring. The placement of erosion protection barriers or other feature necessary for long-term control of the tailings must also be completed in a timely manner in accordance with a written, Agency-approved reclamation plan.

(2) The Agency may approve a licensee's request to extend the time for performance of milestones related to emplacement of the final radon barrier if, after providing an opportunity for public participation, the Agency finds that the licensee has adequately demonstrated in the manner required in paragraph (2) of Criterion 6 that releases of radon-222 do not exceed an average of

0.74 becquerel per meter square per second (20 pCi/m^2s). If the delay is approved on the basis that the radon releases do not exceed 0.74 becquerel per meter square per second (20 pCi/m^2s), a verification of radon levels, as required by paragraph (2) of Criterion 6, must be made annually during the period of delay. In addition, once the Agency has established the date in the reclamation plan for the milestone for completion of the final radon barrier, the Agency may extend that date based on cost if after providing an opportunity for public participation, the Agency finds that the licensee is making good faith efforts to emplace the final radon barrier, the delay is consistent with the definition of available technology, and the radon releases caused by the delay will not result in a significant incremental risk to the public health.

(3) The Agency may authorize by license amendment, upon licensee report, a portion of the impoundment to accept uranium byproduct material or such materials that are similar in physical, chemical, and radiological characteristics to the uranium mill tailings and associated wastes already in the pile or impoundment from other sources, during the closure process. No such authorization will be made if it results in a delay or impediment to emplacement of the final radon barrier over the remainder of the impoundment in a manner that will achieve levels of radon-222 releases not exceeding 0.74 becquerel per meter square per second (20 pCi/m^2s) averaged over the entire impoundment. The verification required in paragraph (2) of Criterion 6 may be completed with a portion of the impoundment being used for further disposal if the Agency makes a final finding that the impoundment will continue to achieve a level of radon-222 release not exceeding 0.74 becquerel per meter square per second (20 pCi/m^2s) averaged over the entire impoundment. In this case, after the final radon barrier is complete except for the continuing disposal area, (a) only byproduct material will be authorized for disposal, (b) the disposal will be limited to the specified existing disposal area, and (c) this authorization will only be made after providing opportunity for public participation. Reclamation of the disposal area, as appropriate, must be completed in a timely manner after disposal operations cease in accordance with paragraph (1) of Criterion 6; however, these actions are not required to be complete as part of meeting the deadline for final radon barrier construction.

Criterion 7. The licensee shall establish a detection monitoring program needed for the Agency to set the site-specific ground water protection standards in paragraph 5B(1) of this appendix. For all monitoring under this paragraph, the licensee or applicant will propose for Agency approval as license conditions which constituents are to be monitored on a site-specific basis. A detection monitoring program has two purposes. The initial purpose of the program is to detect leakage of hazardous constituents from the disposal area so that the need to set ground water protection standards is monitored. If leakage is detected, the second purpose of the program is to generate data and information needed for the Agency to establish the standards under Criterion 5B. The data and information must provide a sufficient basis to identify those hazardous constituents which require concentration limit standards and to enable the Agency to set the limits for those constituents and the compliance period. They may also need to provide the basis for adjustments to the point of compliance. The detection monitoring programs must be in place when specified by the Agency in orders or license conditions. Once ground water protection standards have been established pursuant to paragraph 5B(1), the licensee shall establish and implement a compliance monitoring program. The purpose of the compliance monitoring program is to determine that the hazardous constituent concentrations in ground water continue to comply with the standards set by the Agency. In conjunction with a corrective action program, the licensee shall establish and implement a corrective action monitoring program. The purpose of the corrective action monitoring program is to demonstrate the effectiveness of the corrective actions. Any monitoring program required by this paragraph may be based on existing monitoring programs to the extent the existing programs can meet the stated objective for the program.

Criterion 8. Milling operations must be conducted so that all airborne effluent releases are reduced to levels as low as is reasonably achievable. The primary means of accomplishing this must be by means of emission controls. Institutional controls, such as extending the site boundary and exclusion area, may be employed to ensure that offsite exposure limits are met, but only after all practicable measures have been taken to control emissions at the source. Notwithstanding the existence of individual dose standards, strict control of emissions is necessary to assure that population exposures are reduced to the maximum extent reasonably achievable and to avoid site contamination. The greatest potential sources of offsite radiation exposure (aside from radon exposure) are dusting from dry surfaces of the tailings disposal area not covered by tailings solution and emissions from yellowcake drying and packaging operations. During operations and prior to closure, radiation doses from radon emissions from surface impoundments of uranium or thorium byproduct materials must be kept as low as is reasonably achievable.

Checks must be made and logged hourly for all parameters (e.g., differential pressures and scrubber water flow rates) that determine the efficiency of yellowcake stack emission control equipment operation. The licensee shall retain each log as a record for three years after the last entry in the log is made. It must be determined whether or not conditions are within a range prescribed to ensure that the equipment is operating consistently near peak efficiency; corrective action must be taken when performance is outside of prescribed ranges. Effluent control devices must be operative at all times during drying and packaging operations and whenever air is exhausting from the yellowcake stack. Drying and packaging operations must terminate when controls are inoperative. When checks indicate the equipment is not operating within the range prescribed for peak efficiency, actions must be taken to restore parameters to the prescribed range. When this cannot be done without shutdown and repairs, drying and packaging operations must cease as soon as practicable. Operations may not be restarted after cessation due to off-normal performance until needed corrective actions have been identified and implemented. All these cessations, corrective actions, and restarts must be reported to the Agency as indicated in Criterion 8A, in writing, within ten days of the subsequent restart.

To control dusting from tailings, that portion not covered by standing liquids must be wetted or chemically stabilized to prevent or minimize blowing and dusting to the maximum extent reasonably achievable. This requirement may be relaxed if tailings are effectively sheltered from wind, such as may be the case where they are disposed of below grade and the tailings surface is not exposed to wind. Consideration must be given in planning tailings disposal programs to methods which would allow phased covering and reclamation of tailings impoundments because this will help in controlling particulate and radon emissions during operation. To control dusting from diffuse sources, such as tailings and ore pads where automatic controls do not apply, operators shall develop written operating procedures specifying the methods of control which will be utilized.

Milling operations producing or involving uranium and thorium byproduct materials must be conducted in such a manner as to provide reasonable assurance that the annual dose equivalent does not exceed 0.25 millisievert (25 mrem) to the whole body, 0.75 millisievert (75 mrem) to the thyroid, and 0.25 millisievert (25 mrem) to any other organ of any member of the public as a result of exposures to the planned discharge of radioactive material, radon and its progeny excepted, to the general environment.

Uranium and thorium byproduct materials must be managed so as to conform to the applicable provisions of Title 40 of the Code of Federal Regulations, Part 440, "Ore Mining and Dressing Point Source Category: Effluent Limitations Guidelines and New Source Performance Standards, Subpart C, Uranium, Radium, and Vanadium Ores Subcategory", as codified on January 1, 1983.

Criterion 8A. Inspections of tailings or waste retention systems must be conducted daily during operations, or at an alternate frequency approved by the Agency for other conditions. Such inspections

shall be conducted by, or under the supervision of, a qualified engineer or scientist, and documented. The licensee shall retain the documentation for each inspection as a record for three years after the documentation is made. The Agency must be immediately notified of any failure in a tailings or waste retention system that results in a release of tailings or waste into unrestricted areas, or any unusual conditions (conditions not contemplated in the design of the retention system) that if not corrected could indicate the potential or lead to failure of the system and result in a release of tailings or waste into unrestricted areas.

Criterion 9 Financial surety arrangements must be established by each mill operator prior to the commencement of operations to assure that sufficient funds will be available to carry out the decontamination and decommissioning of the mill and site and for the reclamation of any tailings or waste disposal areas. The amount of funds to be ensured by such surety arrangements must be based on Agency-approved cost estimates in an Agency-approved plan for (1) decontamination and decommissioning of mill buildings and the milling site to levels which allow unrestricted use of these areas upon decommissioning, and (2) the reclamation of tailings and/or waste areas in accordance with technical criteria delineated in this Appendix. The licensee shall submit this plan in conjunction with an environmental report that addresses the expected environmental impacts of the milling operation, decommissioning and tailings reclamation, and evaluates alternatives for mitigating these impacts. The surety must also cover the payment of the charge for long-term surveillance and control required by Criterion 10**.** In establishing specific surety arrangements the licensee's cost estimates must take into account total costs that would be incurred if an independent contractor were hired to perform the decommissioning and reclamation work. In order to avoid unnecessary duplication and expense, the Agency may accept financial sureties that have been consolidated with financial or surety arrangements established to meet requirements of other Federal or state agencies and/or local governing bodies for such decommissioning, decontamination, reclamation, and long-term site surveillance and control, provided such arrangements are considered adequate to satisfy these requirements and that the portion of the surety which covers the decommissioning and reclamation of the mill, mill tailings site and associated areas, and the long-term funding charge is clearly identified and committed for use in accomplishing these activities. The licensee's surety mechanism will be reviewed annually by the Agency to assure that sufficient funds would be available for completion of the reclamation plan if the work had to be performed by an independent contractor. The amount of surety liability should be adjusted to recognize any increases or decreases resulting from inflation, changes in engineering plans, activities performed, and any other conditions affecting costs. Regardless of whether reclamation is phased through the life of the operation or takes place at the end of operations, an appropriate portion of surety liability must be retained until final compliance with the reclamation plan is determined.

This will yield a surety that is at least sufficient at all times to cover the costs of decommissioning and reclamation of the areas that are expected to be disturbed before the next license renewal. The term of the surety mechanism must be open ended, unless it can be demonstrated that another arrangement would provide an equal level of assurance. This assurance would be provided with a surety instrument which is written for a specified period of time (e.g. 5 years) yet which must be automatically renewed unless the surety notifies the beneficiary (the Agency) and the principal (the licensee) some reasonable time (e.g. 90 days) prior to the renewal date of their intention not to renew. In such a situation the surety requirement still exists and the licensee would be required to submit an acceptable replacement surety within a brief period of time to allow at least 60 days for the Agency to collect.

Proof of forfeiture must not be necessary to collect the surety so that in the event that the licensee could not provide an acceptable replacement surety within the required time, the surety shall be automatically collected prior to its expiration. The conditions described above would have to be clearly stated on any surety instrument which is not open-ended, and must be agreed to by all parties. Financial surety arrangements generally acceptable to the Agency are:

(1) Surety bonds;

(2) Cash deposits;

(3) Certificates of deposits;

(4) Deposits of government securities;

(5) Irrevocable letters or lines of credit; and

(6) Combinations of the above or such other types of arrangements as may be approved by the Agency. However, self insurance, or any arrangement which essentially constitutes self insurance will not satisfy the surety requirement since this provides no additional assurance other than that which already exists through licensing requirements.

[A licensee who uses either a surety bond guaranteeing payment or performance, or a letter of credit must establish a standby trust. Under the terms of the mechanism, all payments made thereunder will be deposited by the issuer directly into the standby trust fund in accordance with instructions from the Director of the Agency.

Criterion 10 A minimum charge of $250,000 (1978 dollars) to cover the costs of long-term surveillance shall be paid by each mill operator to the general treasury of the United States or to an appropriate State agency prior to the termination of a uranium or thorium mill license.

If site surveillance or control requirements at a particular site are determined, on the basis of a site specific evaluation, to require funding significantly greater than specified in this Criteria (e.g., if fencing is determined to be necessary), variance in funding requirements may be specified by the Agency. The total charge to cover the costs of long-term surveillance shall be such that, with an assumed one percent annual real interest rate, the collected funds will yield interest in an amount sufficient to cover the annual costs of site surveillance. The charge will be adjusted annually prior to actual payments to recognize inflation. The inflation rate to be used is that indicated by the change in the consumer price index published by the United States Department of Labor, Bureau of Labor Statistics.

Criterion 11.

Criterion 11A. These criteria relating to ownership of tailings and their disposal sites became effective on November 8, 1981, and apply to all licenses terminated, issued, or renewed after that date.

Criterion 11B**.** Any uranium or thorium milling license or tailings license must contain such terms and conditions as the U.S. Nuclear Regulatory Commission and Agency determine necessary to assure that prior to termination of the license, the licensee will comply with ownership requirements of this criterion for sites used for tailings disposal.

Criterion 11C. Title to the byproduct material licensed under this Part U and land, including any interests therein (other than land owned by the United States or by a State), which is used for the disposal of any such byproduct material, or is essential to ensure the long-term stability of such disposal site, must be transferred to the United States or the State in which such land is located, at the option of such State. In view of the fact that physical isolation must be the primary means of long-term control, and Government land ownership is a desirable supplementary measure, ownership of certain severable subsurface interests (for example, mineral rights) may be determined to be unnecessary to protect the

public health and safety and the environment. In any case, however, the applicant/operator must demonstrate a serious effort to obtain such subsurface rights, and must in the event that certain rights cannot be obtained, provide notification in local public land records of the fact that the land is being used for the disposal of radioactive material and is subject to either a U.S. Nuclear Regulatory Commission general or specific license prohibiting the disruption and disturbance of the tailings. In some rare cases, such as may occur with deep burial where no ongoing site surveillance will be required, surface land ownership transfer requirements may be waived with the approval of the U.S. Nuclear Regulatory Commission. For licenses issued before November 8, 1981, the U.S. Nuclear Regulatory Commission may take into account the status of the ownership of such land, and interests therein, and the ability of a licensee to transfer title and custody thereof to the United States or a State.

Criterion 11D. If the U.S. Nuclear Regulatory Commission , subsequent to title transfer determines that use of the surface or subsurface estates, or both, of the land transferred to the United States or to a State will not endanger the public health, safety, welfare, or environment, the U.S. Nuclear Regulatory Commission may permit the use of the surface or subsurface estates, or both, of such and in a manner consistent with the provisions provided in these criteria. If the U.S. Nuclear Regulatory Commission, permits such use of such land, it will provide the person who transferred such land with the right of first refusal with respect to such use of such land.

Criterion 11E. Material and land transferred to the United States or the State in accordance with this Criterion must be transferred to the United States or the State without cost other than administrative or legal costs incurred in carrying out such transfer.

Criterion 11F. The provisions of this Part respecting transfer of title and custody to land and tailings and wastes do not apply in the case of lands held in trust by the United States for any Indian tribe or lands owned by such Indian tribe subject to a restriction against alienation imposed by the United States. In the case of such lands which are used for the disposal of uranium or thorium byproduct material the licensee shall enter into arrangements with the U.S. Nuclear Regulatory Commission as may be appropriate to assure the long-term surveillance of such lands by the United States.

Criterion 12 Reserved

Criterion 13. Secondary ground water protection standards required by Criterion 5 of this Appendix are concentration limits for individual hazardous constituents. The following list of constituents identifies the constituents for which standards must be set and complied with if the specific constituent is reasonably expected to be in or derived from the byproduct material and has been detected in ground water. For purposes of this Appendix, the property of gross alpha activity will be treated as if it is a hazardous constituent. Thus, when setting standards under paragraph 5B(5) of Criterion 5, the Agency will also set a limit for gross alpha activity. The Agency does not consider the following list imposed by 40 CFR Part 192 to be exhaustive and may determine other constituents to be hazardous on a case-by-case basis, independent of those specified by the U.S. Environmental Protection Agency in Part 192.

HAZARDOUS CONSTITUENTS

- Acetonitrile (Ethanenitrile)
- Acetophenone (Ethanone, 1-phenyl)
- 3-(alpha-Acetonylbenzyl)-4-hydroxycoumarin and salts (Warfarin)
- 2-Acetylaminofluorene (Acetamide, N-(9H-fluoren-2-yl)-)
- Acetyl chloride (Ethanoyl chloride)
- 1-Acetyl-2-thiourea (Acetamide, N-(aminothioxomethyl)-)
- Acrolein (2-Propenal)
- Acrylamide (2-Propenamide)
- Acrylonitrile (2-Propenenitrile)
- Aflatoxins
- Aldrin (1,2,3,4,10,10-Hexachloro-1,4,4a,5,8,8a,8b-hexahydro-endo,exo-1,4:5,8-Dimethanonaphthalene)
- Allyl alcohol (2-Propen-1-ol)
- Aluminum phosphide
- 4-Aminobiphenyl ([1,1-Biphenyl])-4-amine)
- 6-Amino-1,1a,2,8,8a,8b-hexahydro-8-(hydroxymethyl)-8a-methoxy-5-methyl-carbamate azirino(2,3:3,4)pyrrolo(1,2-a]indole-4,7-dione,(ester) (Mitomycin C) (Azirino[2,3:3,4]pyrrolo(1,2-a)indole-4,7-dione,6-amino-8-[((amino-cabonyl)oxy)methyl)-1,1a,2,8,8a,8b-hexahydro-8a methoxy-5-methyl-)
- 5-(Aminomethyl)-3-isoxazolol (3(2H)-Isoxazolone, 5-(aminomethyl)-)4-Aminopyridine (4-Pyridinamine)
- Amitrole (1H-1,2,4-Triazol-3-amine)
- Aniline (Benzenamine)
- Antimony and compounds, N.O.S.[3/]
- Aramite (Sulfurous acid,2-chloroethyl-,2-(4-(1,1-dimethylethyl)phenoxy)-1-methylethyl ester)
- Arsenic and compounds, N.O.S.[3/]
- Arsenic acid (Orthoarsenic acid)
- Arsenic pentoxide (Arsenic (V) oxide)
- Arsenic trioxide (Arsenic (III) oxide)
- Auramine (Benzenamine,4,4-carbonimidoylbis (N,N-Dimethyl-, monohydrochloride)
- Azaserine (L-Serine, diazoacetate (ester))
- Barium and compounds, N.O.S.[3/]

[3/] *The abbreviation N.O.S. (not otherwise specified) signifies those members of the general class not specifically listed by name in this list*

[3/] *The abbreviation N.O.S. (not otherwise specified) signifies those members of the general class not specifically listed by name in this list*

- Barium cyanide
- Benz(c)acridine (3.4-Benzacridine)
- Benz(a)anthracene (1,2-Benzanthracene)
- Benzene (Cyclohexatriene)
- Benzenearsonic acid (Arsonic acid, phenyl-)
- Benzene, dichloromethyl-(Benzal chloride)
- Benzenethiol (Thiophenol)
- Benzidine ([1,1-Biphenyl]-4,4 diamine)
- Benzo(b)fluoranthene (2,3-Benzofluoranthene)
- Benzo(j)fluoranthene (7,8-Benzofluoranthene)
- Benzo(a)pyrene (3,4-Benzopyrene)
- p-Benzoquinone (1,4-Cyclohexadienedione)
- Benzotrichloride (Benzene, Trichloromethyl)
- Benzyl chloride (Benzene, (chloromethyl)-)
- Beryllium and compounds, N.O.S.[3/]
- Bis(2-chloroethoxy)methane (Ethane,1,1-(methylenebis(oxy)]bis[2-chloro-])
- Bis(2-chloroethyl) ether (Ethane, 1,1-oxybis (2-chloro-))
- N,N-Bis(2-chloroethyl)-2-naphthylamine (Chlornaphazine)
- Bis(2-Chloroisopropyl) ether (Propane, 2,2-oxybis[2-chloro-])
- Bis(chloromethyl) ether (methane, oxybis[chloro-])
- Bis(2-ethylhexyl) phthalate (1,2-Benzenedicarboxylic acid, bis(2-ethylhexyl) ester)
- Bromoacetone (2-Propanone, 1-bromo-)
- Bromomethane (Methyl bromide)
- 4-Bromophenyl phenyl ether (Benzene, 1-bromo-4-phenoxy-)
- Brucine (Strychnidin-10-one, 2,3-dimethoxy-)
- 2-Butanone peroxide (Methyl ethyl ketone, peroxide)
- Butyl benzyl phthalate (1,2-Benzenedicarboxylic acid, butyl phenylmethyl ester)
- 2-sec-Butyl-4,6-dinitrophenol (DNBP) (Phenol, 2,4-dinitro-6-(1-methylpropyl)-)
- Cadmium and compounds, N.O.S.[3/]
- Calcium chromate (Chromic acid, calcium salt)
- Calcium cyanide
- Carbon disulfide (Carbon bisulfide)
- Carbon oxyfluoride (Carbonyl fluoride)
- Chloral (Acetaldehyde, trichloro-)
- Chlorambucil (Butanoic acid, 4-(bis(2-

[3/] *The abbreviation N.O.S. (not otherwise specified) signifies those members of the general class not specifically listed by name in this list*

chloroethyl)amino)benzene-)
- Chlordane (alpha and gamma isomers)4,7-Methanoindan, 1,2,4,5,6,7,8,8-octachloro-3,4,7,7a-tetrahydro-) (alpha and gamma isomers)
- Chlorinated benzenes, N.O.S.[3/]
- Chlorinated ethane, N.O.S.[3/]
- Chlorinated fluorocarbons, N.O.S.[3/]
- Chlorinated naphthalene, N.O.S.[3/]
- Chlorinated phenol, N.O.S.[3/]
- Chloroacetaldehyde (Acetaldehyde, chloro-)
- Chloroalkyl ethers N.O.S.[3/]
- p-Chloroaniline (Benzenamine, 4-chloro-)
- Chlorobenzene (Benzene, chloro-)
- Chlorobenzilate (Benzeneacetic acid, 4-chloro-alpha-(4-chlorophenyl)-alpha-hydroxy-,ethyl ester)
- p-Chloro-m-cresol (Phenol, 4-chloro-3-methyl)
- 1-Chloro-2,3-epoxypropane (Oxirane, 2-(chloromethyl)-)
- 2-Chloroethyl vinyl ether (Ethene, (2-chloroethoxy)-)
- Chloroform (Methane, trichloro-)
- Chloromethane (Methyl chloride)
- Chloromethyl methyl ether (Methane, chloromethoxy-)
- 2-Chloronaphthalene (Naphthalene, betachloro-)
- 2-Chlorophenol (Phenol, o-chloro-)
- 1-(o-Chlorophenyl)thiourea(Thiourea,(2-chlorophenyl)-)
- 3-Chloropropionitrile (Propanenitrile, 3-chloro-)
- Chromium and compounds, N.O.S. [3/]
- Chrysene (1,2-Benzphenanthrene)
- Citrus red No. 2 (2-Naphthol, 1-((2,5-dimethoxyphenyl)azo)-)
- Coal tars
- Copper cyanide
- Creosote (Creosote, wood)
- Cresols (Cresylic acid) (Phenol, methyl-)
- Crotonaldehyde (2-Butenal)
- Cyanides (soluble salts and complexes), N.O.S.[3]3/
- Cyanogen (Ethanedinitrile)
- Cyanogen bromide (Bromine cyanide)
- Cyanogen chloride (Chlorine cyanide)
- Cycasin (beta-D-Glucopyranoside, (methyl-

[3/] *The abbreviation N.O.S. (not otherwise specified) signifies those members of the general class not specifically listed by name in this list*

ONN-azoxy)methyl-)
- 2-Cyclohexyl-4,6-dinitrophenol (phenol, 2-cyclohexyl-4,6-dinitro-)
- Cyclophosphamide (2H-1,3,2-Oxazaphosphorine (bis(2-chloroethyl) amino)-tetrahydro-,2-oxide)
- Daunomycin (5,12-Naphthacenedione, (8S-cis)-8-acetyl-10-((3-amino-2,3,6-trideoxy)-alpha-L-lyxo-hexopyranosyl)oxy)7,8,9,10-tetrahydro-6,8,11-trihydroxy-1-methoxy-)
- DDD (Dichlorodiphenyldichloroethane) (Ethane, 1,1-dichloro-2,2-bis(p-chlorophenyl)-)
- DDE (Ethylene, 1,1-dichloro-2,2-bis(4-chlorophenyl)-)
- DDT (Dichlorodiphenyltrichloroethane) (Ethane, 1,1,1-trichloro-2,2-bis (p-chlorophenyl)-)
- Diallate (S-(2,3-dichloroallyl) diisopropylthiocarbamate
- Dibenz(a,h)acridine(1,2,5,6-Dibenzacridine)
- Dibenz(a,j)acridine(1,2,7,8-Dibenzacridine)
- Dibenz(a,h)anthracene (1,2,5,6-Dibenzanthracene
- 7H-Dibenzo(c,g)carbazole (3,4,5,6-Dibenzcarbazole)
- Dibenzo(a,e)pyrene(1,2,4,5-Dibenzpyrene)
- Dibenzo(a,h)pyrene(1,2,5,6-Dibenzpyrene)
- Dibenzo(a,i)pyrene(1,2,7,8-Dibenzpyrene)
- 1,2-Dibromo-3-chloropropane (Propane, 1,2-dibromo-3-chloro-)
- 1,2 Dibromoethane (Ethylene dibromide)
- Dibromomethane (Methylene bromide)
- Di-n-butyl phthalate (1,2-Benzenedicarboxylic acid, dibutyl ester)
- o-Dichlorobenzene (Benzene, 1,2-dichloro-)
- m-Dichlorobenzene (Benzene, 1,3-dichloro-)
- p-Dichlorobenzene (Benzene, 1,4-dichlor-)
- Dichlorobenzene, N.O.S.[3/] (Benzene, dichloro-, N.O.S.[3/])
- 3,3-Dichlorobenzidine ([1,1, Biphenyl]-4,4-diamine, 3,3-dichloro-)
- 1,4-Dichloro-2-butene (2-Butene, 1,4-dichloro-)
- Dichlorodifluoromethane (Methane, dichlorodifluoro-)
- 1,1 Dichloroethane (Ethylidene dichloride)
- 1,2 Dichloroethane (Ethylene dichloride)
- trans-1,2-Dichloroethene (1,2-Dichloroethylene)

- Dichloroethylene, N.O.S.[3/] (Ethene, dichloro-N.O.S.[3/]
- 1,1-Dichloroethylene (Ethene, 1,1-dichloro-)
- Dichloromethane (Methylene chloride)
- 2,4-Dichlorophenol (Phenol, 2,4-dichloro-)
- 2,6-Dichlorophenol (Phenol, 2,6-dichloro-)
- 2,4-Dichlorophenoxyacetic acid (2,4-D), salts and esters (Acetic acid, 2,4-dichlorophenoxy-, salts and esters)
- Dichlorophenylarsine (Phenyl dichloroarsine)
- Dichloropropane, N.O.S.[3/] (Propane, dichloro-N.O.S.[3/]
- 1,2-Dichloropropane (Propylene dichloride)
- Dichloropropanol, N.O.S.[3/] (Propanol, dichloro-N.O.S.) [3/]
- Dichloropropene, N.O.S.[3/] (Propene, dichloro-N.O.S.[3/]
- 1,3-Dichloropropene (1-Propene, 1,3-dichloro-)
- Dieldin (1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octa-hydro-endo,exo-1,4:5,8-Dimethanonaphthalene)
- 1,2:3,4-Diepoxybutane (2,2,-Bioxirane)
- Diethylarsine (Arsine, diethyl-)
- N,N-Diethylhydrazine (Hydrazine, 1,2-diethyl)
- O,O-Diethyl S-methyl ester of phosphorodithioic acid (Phosphorodithioic acid, O,O-diethyl S-methyl ester)
- O,O-Diethylphosphoric acid, O-p-nitrophenyl ester (Phosphoric acid, diethyl p-nitrophenyl ester)
- Diethyl phthalate (1,2-Benzenedicarboxylic acid, diethyl ester)
- O,O-Diethyl O-2-pyrazinyl phosphorothioate (Phosphorothioic acid, O,0-diethyl O-pyrazinyl ester)
- Diethylstilbesterol (4,4-Stilbenediol,alpha,alpha-diethyl, bis(dihydrogen phosphate, (E)-)
- Dihydrosafrole (Benzene, 1,2-methylenedioxy-4-propyl-)
- 3,4-Dihydroxy-alpha-(methylamino)methyl benzyl alcohol (1,2-Benzenediol, 4-(1-hydroxy-2 (methylamino)ethyl))
- Dilsopropylfluorophosphate (DFP) (Phosphorofluoridic acid, bis(1-methylethyl) ester)

[3/] *The abbreviation N.O.S. (not otherwise specified) signifies those members of the general class not specifically listed by name in this list*

- Dimethoate (Phosphorodithioic acid, O,O-dimethyl S-(2-(methylamino)-2-oxoethyl) ester)
- 3,3,-Dimethoxybenzidine ((1,1,-Biphenyl)-4,4,-diamine, 3-3,-dimethoxy-)
- p-Dimethylaminoazobenzene (Benzenamine, N,N-dimethyl-4-(phenylazo)-)
- 7,12-Dimethylbenz(a)anthracene(1,2-Benzathracene, 7,12-dimethyl-)
- 3,3-Dimethylbenzidine (1,1-Biphenyl)-4,4, diamine, 3,3-dimethyl-)
- Dimethylcarbamoyl chloride (Carbamoyl chloride, dimethyl)
- 1,1 Dimethylhydrazine (Hydrazine, 1,1-dimethyl-)
- 1,2-Dimethylhydrazine (Hydrazine, 1,2-dimethyl-)
- 3,3-Dimethyl-1-(methylthio)-2-butanone, O-[(methylamino) carbonyl] oxime (Thiofanox)
- alpha,alpha-Dimethylphenethylamine (Ethanamine, 1,1-dimethyl-2-phenyl-)
- 2,4-Dimethylphenol (Phenol, 2,4-dimethyl-)
- Dimethyl phthalate (1,2-Benzenedicarboxylic acid, dimethyl ester)
- Dimethyl sulfate (Sulfuric acid, dimethyl ester)
- Dinitrobenzene, N.O.S.[3/](Benzene, dinitro-N.O.S.[3/])
- 4,6-Dinitro-o-cresol and salts (Phenol, 2,4-dinitro-6-methyl-, and salts)
- 2,4-Dinitrophenol (Phenol, 2,4-dinitro-)
- 2,4-Dinitrotoluene (Benzene, 1-methyl-2,4-dinitro-)
- 2,6-Dinitrotoluene (Benzene, 1-methyl 2,6-dinitro-)
- Di-n-octyl phthalate (1,2-Benzenedicarboxylic acid, dioctyl ester)
- 1,4-Dioxane (1,4-Diethylene oxide)
- Diphenylamine (Benzenamine, N-phenyl-)
- 1,2-Diphenylhydrazine (Hydrazine, 1,2-diphenyl-)
- Di-n-propylnitrosamine (N-Nitroso-di-n-propylamine)
- Disulfoton (O,O-diethyl S-(2-(ethylthio)ethyl) phosphorodithioate)
- 2,4-Dithiobiuret (Thiomidodicarbonic diamide)

[3/] *The abbreviation N.O.S. (not otherwise specified) signifies those members of the general class not specifically listed by name in this list*

- Endosulfan (5-Norbornene, 2,3-dimethanol, 1,4,5,6,7,7-hexachloro-cyclic sulfite)
- Endrin and metabolites (1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-endo, endo-1,4,5,8-dimethanonaphthalene, and metabolites)
- Ethyl carbamate (Urethan) (Carbamic acid, ethyl ester)
- Ethyl cyanide (Propanenitrile)
- Ethylenebisdithiocarbamic acid, salts, and esters (1,2-Ethanediyl-biscarbamodithioic acid, salts and esters)
- Ethyleneimine (Aziridine)
- Ethylene oxide (Oxirane)
- Ethylenethiourea (2-Imidazolidinethione)
- Ethyl methacrylate (2-Propenoic acid, 2-methyl-, ethyl ester)
- Ethyl methanesulfonate (Methanesulfonic acid, ethyl ester)
- Fluoranthene (Benzo[j,k]fluorene)
- Fluorine
- 2-Fluoroacetamide (Acetamide, 2-fluoro-)
- Fluoroacetic acid, sodium salt (Acetic acid, fluoro-sodium salt)
- Formaldehyde (Methylene oxide)
- Formic acid (Methanoic acid)
- Glycidylaldehyde (1-Propanol-2,3 epoxy)
- Halomethane, N.O.S.[3/]
- Heptachlor (4,7-Methano-1H-indene. 1,4,5,6,7,8,8-heptachloro-3a,4,7,7a-tetrahydro-)
- Heptachlor epoxide (alpha, beta, and gamma isomers) (4,7-Methano-1H-indene, 1,4,5,6,7,8,8-heptachloro-2,3-epoxy-3a,4,7,7-tetrahydro-,alpha, beta, and gamma isomers)
- Hexachlorobenzene (Benzene, hexachloro-)
- Hexachlorobutadiene (1,3-Butadiene, 1,1,2,3,4,4-hexachloro-)
- Hexachlorocyclohexane (all isomers) (Lindane and isomers)
- Hexachlorocyclopentadiene (1,3-Cyclopentadiene, 1,2,3,4,5,5-hexachloro-)
- Hexachloroethane (Ethane, 1,1,1,2,2,2-hexachloro-)
- 1,2,3,4,10,10-Hexachloro-1,4,4a,5,8,8a-hexahydro-1,4,5,8-endo,endo-dimethanonaphthalene (Hexachlorohexa-

[3/] *The abbreviation N.O.S. (not otherwise specified) signifies those members of the general class not specifically listed by name in this list*

hydro-endo,endo-dimethanonaphthalene)
- Hexachlorophene (2,2,-Methylenebis(3,4,6-trichlorophenol)
- Hexachloropropene(1-Propene, 1,1,2,3,3,3-hexachloro-)
- Hexaethyl tetraphosphate (Tetraphosphoric acid, hexaethyl ester)
- Hydrazine (Diamine)
- Hydrocyanic acid (Hydrogen cyanide)
- Hydrofluoric acid (Hydrogen fluoride)
- Hydrogen sulfide (Sulfur hydride)
- Hydroxydimethylarsine oxide (Cacodylic acid)
- Indeno (1,2,3-cd)pyrene(1,10-(1,2-phenylene)pyrene)
- Iodomethane (Methyl iodide)
- Iron dextran (Ferric dextran)
- Isocyanic acid, methyl ester (Methyl isocyanate)
- Isobutyl alcohol (1-Propanol, 2-methyl-)
- Isosafrole (Benzene, 1,2-methylenedioxy-4-allyl-)
- Kepone (decachlorooctahydro-1,3,4-Methano-2H-cyclobuta[cd]pentalen-2-one)
- Lasiocarpine (2-Butenoic acid, 2-methyl-,7-[(2,3-dihydroxy-2-(1-methoxyethyl)-3-methyl-1-oxobutoxy)methyl]2,3,5,7a-tetrahydro-1H-pyrrolizin-1-yl-ester)
- Lead and compounds, N.O.S.[3/]
- Lead acetate (Acetic acid, lead salt)
- Lead phosphate (Phosphoric acid, lead salt)
- Lead subacetate (Lead, bis(acetato-O)tetrahydroxytri-)
- Maleic anhydride (2,5-Furandione)
- Maleic hydrazide (1,2-Dihydro-3,6-pyridazinedione)
- Malononitrile (Propanedinitrile)
- Melphalan (Alanine, 3-(p-bis(2-chloroethyl)amino)phenyl-L-)
- Mercury fulminate (Fulminic acid, mercury salt)
- Mercury and compounds, N.O.S.[3/]
- Methacrylonitrile (2-Propenenitrile, 2-methyl-)
- Methanethiol (Thiomethanol)
- Methapyrilene (Pyridine, 2-[(2-dimethylamino)ethyl)]-2-thenylamino-)
- Metholmyl (Acetimidic acid, N-

[3/] *The abbreviation N.O.S. (not otherwise specified) signifies those members of the general class not specifically listed by name in this list*

[(methylcarbamoyl)oxy]thio-,methyl ester)
- Methoxychlor (Ethane, 1,1,1-trichloro-2,2,-bis(p-methoxyphenyl)-)
- 2-Methylaziridine (1,2-Propylenimine)
- 3-Methlycholanthrene (Benz[j]aceanthrylene, 1,2-dihydro-3-methyl-)
- Methyl chlorcarbonate (Carbonochloridic acid, methyl ester)
- 4,4-Methylenebis(2-chloroaniline) Benzenamine, 4,4-methylenebis-(2-chloro-)
- Methyl ethyl ketone (MEK) (2-Butanone)
- Methyl hydrazine (Hydrazine methyl-)
- 2-Methyllactonitrile (Propanenitrile 2-hydroxy-2-methyl-)
- Methyl methacrylate (2-Propenoic acid, 2-methyl-, methyl ester)
- Methyl methanesulfonate Methanesulfonic acid, methyl ester)
- 2-Methyl-2-(methylthio)propionaldehyde-o-(methylcarbonyl) oxime (Propanal,2-methyl-2(methylthio-0-[(methylamino)carbonyl]oxime)
- N-Methyl-N,-nitro-N-nitrosoguanidine (Guanidine, N-nitroso-N-methyl-N,-nitro-)
- Methyl parathion (0,0-dimethyl 0-(40 nitrophenyl) phosphorothioate)
- Methylthiouracil (4-IH-Pyrimidinone, 2,3-dihydro-6-methyl-2-thioxo-)
- Molybdenum and compounds, N.O.S.[3/]
- Mustard gas (Sulfide, bis(2-chloroethyl)-)
- Naphthalene
- 1,4-Naphthoquinone (1,4-Naphthalenedione)
- 1-Naphthylamine (alpha-Naphthylamine)
- 2-Naphthylamine (beta-Naphthylamine)
- 1-Naphthyl-2-thiourea (Thiourea,1-naphthalenyl-)
- Nickel and compounds, N.O.S.[3/]
- Nickel carbonyl (Nickel tetracarbonyl)
- Nickel cyanide (Nickel (II) cyanide)
- Nicotine and salts (Pyridine, (S)-3-(1-methyl-2-pyrrolidinyl)-, and salts)
- Nitric oxide (Nitrogen (II) oxide)
- p-Nitroaniline (Benzenamine, 4-nitro-)
- Nitrobenzine (Benzene, nitro-)
- Nitrogen dioxide (Nitrogen (IV) oxide)
- Nitrogen mustard and hydrochloride salt (Ethanamine, 2-chloro-,N-(2-chloroethyl)-

[3/] *The abbreviation N.O.S. (not otherwise specified) signifies those members of the general class not specifically listed by name in this list*

N-methyl-, and hydrochloride salt)
- Nitrogen mustard N-Oxide and hydrochloride salt (Ethanamine, 2-chloro,N-(2-chloroethyl)-N-methyl-and hydrochloride salt)
- Nitroglycerine (1,2,3-Propanetriol, trinitrate)
- 4-Nitrophenol (Phenol, 4-nitro)
- 4-Nitroquinoline-1-oxide (Quinoline,4-nitro-1-oxide-)
- Nitrosamine, N.O.S.[3/]
- N-Nitrosodi-n-butylamine (1-Butanamine,N-butyl-N-nitroso-)
- N-Nitrosodiethanolamine (Ethanol, 2,2-(nitrosoimino)bis-)
- N-Nitrosodiethylamine (Ethanamine, N-ethyl-N-nitroso-)
- N-Nitrosodimethylamine (Dimethylnitrosamine)
- N-Nitroso-N-ethylurea (Carbamide, N-ethyl-N-nitroso-)
- N-Nitrosomethylethylamine (Ethanamine, N-methyl-N-nitroso-)
- N-Nitroso-N-methylurea (Carbamide, N-methyl-N-nitroso-)
- N-Nitroso-N-methylurethane (Carbamic acid, methylnitroso-, ethyl ester)
- N-Nitrosomethylvinylamine (Ethenamine,N-methyl-N-nitroso-)
- N-Nitrosomorpholine (Morpholine,-N-nitroso-)
- N-Nitrosonornicotine (Nornicotine,-N-nitroso-)
- N-Nitrosopiperidine (Pyridine, hexahydro-,N-nitroso-)
- Nitrosopyrrolidine (Pyrrole, tetrahydro-N-nitroso-)
- N-Nitrososarcosine (Sarcosine,-N-nitroso-)
- 5-Nitro-o-toluidine (Benzenamine, 2-methyl-5-nitro-)
- Octamethylpyrophosphoramide (Diphosphoramide, octamethyl-)
- Osmium tetroxide (Osmium(VIII)oxide)
- 7-Oxabicyclo(2,2,1)heptane-2,3-dicarboxylic acid (Endothal)
- Paraldehyde (1,3,5-Trioxane, 2,4,6-trimethyl-)
- Parathion (Phosphorothioic acid O,O-diethyl O-(p-nitrophenyl)ester)
- Pentachlorobenzene (Benzene, pentachloro-)
- Pentachloroethane (Ethane, pentachloro-)

[3/] *The abbreviation N.O.S. (not otherwise specified) signifies those members of the general class not specifically listed by name in this list*

- Pentachloronitrobenzene (PCNB) (Benzene, Pentachloronitro-)
- Pentachlorophenol (Phenol, pentachloro-)
- Phenacetin (Acetamide, N-(4-ethoxyphenyl)-)
- Phenol (Benzene, hydroxy-)
- Phenylenediamine (Benzenediamine)
- Phenylmercury acetate (Mercury acetatophenyl-)
- N-Phenylthiourea (Thiourea, phenyl-)
- Phosgene (Carbonyl chloride)
- Phosphine (Hydrogen phosphide)
- Phosphorodithioic acid, O,O-diethyl S-[(ethylthio)methyl]ester (Phorate)
- Phosphorothioic acid, O,O-dimethyl O-(p-[(dimethylamino)sulfonyl)phenyl]ester (Famphur)
- Phthalic acid esters, N.O.S.[3/] (Benzene, 1,2-dicarboxylic acid, esters, N.O.S.[3/])
- Phthalic anhydride (1,2-Benzenedicarboxylic acid anhydride)
- 2-Picoline (Pyridine, 2-methyl-)
- Polychlorinated biphenyl, N.O.S.[3/]
- Potassium cynanide
- Potassium silver cyanide (Argentate(1-), dicyano-,potassium)
- Pronamide (3,5-Dichloro-N-(1,1-dimethyl-2-propynyl)benzamide)
- 1,3 Propane sultone (1,2-Oxathiolane, 2,2-dioxide)
- n-Propylamine (1-Propanamine)
- Propylthiouracil (Undecamethylenediamine, N,N-bis(2-chlorobenzyl-),dihydrochloride)
- 2-Propyn-1-ol(Propargyl alcohol)
- Pyridine
- Radium-226 and -228
- Reserpine (Yohimban-16-carboxylic acid, 11,17-dimethoxy-18-[3,4,5-trimethoxybenzoyl)oxy]-,methyl ester)
- Resorcinol (1,3-Benzenediol)
- Saccharin and salts (1,2-Benzoisothiazolin-3-one, 1,1-dioxide, and salts)
- Safrele (Benzene, 1,2-methylenedioxy-4-allyl-)
- Selenious acid (Selenium dioxide)
- Selenium and compounds, N.O.S.[3/]
- Selenium sulfide (Sulfur selenide)
- Selenourea (Carbamimidoselenoic acid)

[3/] *The abbreviation N.O.S. (not otherwise specified) signifies those members of the general class not specifically listed by name in this list*

- Silver and compounds, N.O.S.[3/]
- Silver cyanide
- Sodium cyanide
- Streptozotocin (D-Glucopyranose, 2-deoxy-2-(3-methyl-3-nitrosoureido)-)
- Strontium sulfide
- Strychnine and salts (Strychnidin-10-one, and salts)
- 1,2,4,5-Tetrachlorobenzene (Benzene,1,2,4,5-tetrachloro-)
- 2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD) (Dibenzo-p-dioxin, 2,3,7,8-tetrachloro-)
- Tetrachloroethane, N.O.S.[3/] (Ethane, tetrachloro-N.O.S.[3/]
- 1,1,1,2-Tetrachlorethane (Ethane, 1,1,1,2-tetrachloro-)
- 1,1,2,2-Tetrachlorethane (Ethane 1,1,2,2-tetrachloro-)
- Tetrachlorethane (Ethene, 1,1,2,2-tetrachloro-)
- Tetrachloromethane (Carbon tetrachloride)
- 2,3,4,6-Tetrachlorophenol (Phenol 2,3,4,6-tetrachloro-)
- Tetraethyldithiopyrophosphate (Dithiopyrophosphoric acid, tetraethyl-ester)
- Tetraethyl lead (Plumbane, tetraethyl-)
- Tetraethylpyrophosphate (Pyrophosphoric acide, tetraethyl ester)
- Tetranitromethane (Methane, tetranitro-)
- Thallium and compounds, N.O.S.[3/]
- Thallic oxide (Thallium (III) oxide)
- Thallium (I) acetate (Acetic acid, thallium (I) salt)
- Thallium (I) carbonate (Carbonic acid dithallium (I) salt)
- Thallium (I) chloride
- Thallium (I) nitrate (Nitric acid, thallium (I) salt)
- Thallium selenite
- Thallium (I) sulfate (Sulfuric acid, thallium (I) salt)
- Thioacetamide (Ethanethioamide)
- Thiosemicarbazide (Hydrazinecarbothioamide)
- Thiourea (Carbamide thio-)
- Thiuram (Bis(dimethylthiocarbamoyl) disulfide)

[4/]*The abbreviation N.O.S. (not otherwise specified) signifies those members of the general class not specifically listed by name in this*

- Thorium and compounds, N.O.S.[3/] when producing thorium byproduct material
- Toluene (Benzene, methyl-)
- Toluenediamine (Diaminotoluene)
- o-Toluidine hydrochloride (Benzenamine, 2-methyl-,hydrochloride)
- Tolylene diisocyanate (Benzene, 1,3-diisocyanatomethyl-)
- Toxaphene (Camphene, octachloro-)
- Tribromomethane (Bromoform)
- 1,2,4-Trichlorobenzene (Benzene, 1,2,4-trichloro-)
- 1,1,1-Trichloroethane (Methyl chloroform)
- 1,1,2-Trichloroethane (Ethane, 1,1,2-trichloro-)
- Trichloroethene (Trichloroethylene)
- Trichloromethanethiol (Methanethiol, trichloro-)
- Trichloromonofluoromethane (Methane, trichlorofluoro-)
- 2,4,5-Trichlorophenol (Phenol, 2,4,5-trichloro-)
- 2,4,6-Trichlorophenol (Phenol, 2,4,6-trichloro-)
- 2,4,5-Trichlorophenoxyacetic acid (2,4,5-T) (Acetic acid, 2,4,5-trichlorophenoxy-)
- 2,4,5-Trichlorophenoxypropionic acid (2,4,5-TP) (Silvex) (Propionoic acid, 2-(2,4,5-trichlorophenoxy)-)
- Trichloropropane, N.O.S.[3/] (Propane, trichloro-, N.O.S.[3/])
- 1,2,3-Trichloropropane (Propane, 1,2,3-trichloro-)
- O,O,O-Triethyl phosphorothioate (Phosphorothioic acid, O,O,O-triethyl ester)
- sym-Trinitrobenzene (Benzene, 1,3,5-trinitro-)
- Tris(1-azridinyl) phosphine sulfide (Phosphine sulfide, tris(1-aziridinyl-)
- Tris(2,3-dibromopropyl) phosphate (1-Propanol, 2,3-dibromo-, phosphate)
- Trypan blue (2,7-Naphthalenedisulfonic acid, 3,3,-((3,3,-dimethyl (1,1,-bi.henyl)-4,4,-diyl)bis(azo))bis(5-amino-4-hydroxy-tetrasodium salt)
- Uracil mustard (Uracil-5-[bis(2-chloroethyl]amino)-)
- Uranium and compounds, N.O.S[3/]
- Vanadic acid, ammonium salt (ammonium vanadate)

[3/] *The abbreviation N.O.S. (not otherwise specified) signifies those memebers of the general class not specifically listed by name in this list*

[3/] *The abbreviation N.O.S. (not otherwise specified) signifies those members of the general class not specifically listed by name in this list*

- Vanadium pentoxide (Vanadium (V) oxide)
- Vinyl chloride (Ethene, chloro-)
- Zinc cyanide
- Zinc phosphide