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APR 17 2001

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Mail Stop T8-A33
Washington, D.C. 20555-0001

Subject: *Guidance for Implementing the Long-Term Surveillance Program for UMTRCA Title I and Title II Disposal Sites*

Reference: Letter, P. Ting, NRC, to A. Kleinrath, DOE, providing comments on the draft guidance for implementing the Long-Term Surveillance Program, dated December 29, 2000.

Dear Mr. Gillen:

Four copies of the *Guidance for Implementing the Long-Term Surveillance Program for UMTRCA Title I and Title II Disposal Sites* are enclosed. The comments provided by the NRC in the reference letter have been addressed and are reflected in this submittal. This guidance document supercedes the February 1996 guidance document entitled *Guidance for Implementing the Long-Term Surveillance Program for UMTRA Project Title I Disposal Sites.*

The purpose of the new guidance document is to broaden the previous guidance to include the Title II disposal sites in addition to the Title I sites.

If NRC has questions about this document, please contact me at 970/248-6037.

Sincerely,

Art Kleinrath
Program Manager
Long-Term Surveillance and Maintenance

Enclosure

cc w/enclosure:
Project File LGPF 1.2 (A. Garcia)

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Guidance for Implementing the Long-Term Surveillance Program For UMTRCA Title I and Title II Disposal Sites

April 2001

U.S. Department of Energy

GRAND JUNCTION OFFICE

Work Performed Under DOE Contract No. DE-AC13-96GJ87335 for the U.S. Department of Energy
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GJO–2001–215–TAR
LGPF 1.2

Long-Term Surveillance and Maintenance Program

Guidance for Implementing The Long-Term Surveillance Program For UMTRCA Title I and Title II Disposal Sites

April 2001

Prepared by
U.S. Department of Energy
Grand Junction Office
Grand Junction, Colorado

Work Performed Under DOE Contract Number DE-AC13-96GJ87335
Task Order Number MAC 01-06
Document Number S00336

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Attachment 2—Samples of Permanent Site Surveillance Features

Attachment 3—Sample Inspection Checklist

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Acronyms and Initialisms

AEA	Atomic Energy Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
DOE	U.S. Department of Energy
EM	Environmental Management
EPA	U.S. Environmental Protection Agency
LTS	Long-Term Stewardship
LTSP	long-term surveillance plan
NARA	National Archives and Records Administration
NEPA	National Environmental Policy Act
NRC	U.S. Nuclear Regulatory Commission
RCRA	Resource Conservation and Recovery Act
ROD	Record of Decision
SDWA	Safe Drinking Water Act
TSCA	Toxic Substances Control Act
UMTRCA	Uranium Mill Tailings Radiation Control Act

1.0 Purpose and Scope

This document provides guidance for preparation of site-specific long-term surveillance plans (LTSP) for Title I and Title II sites established by the Uranium Mill Tailings Radiation Control Act (UMTRCA) (42 USC §7901 *et seq.*). This guidance may by used to prepare LTSPs (or site operation plans) for other types of disposal sites under DOE custody as well.

Requirements for long-term surveillance, monitoring, and maintenance of UMTRCA Title I and Title II sites, to protect public health and safety and the environment, are provided in U.S. Nuclear Regulatory Commission (NRC) regulations 10 CFR Part 40, specifically §40.27, §40.28, and Appendix A (Attachment 1).

End of current text

2.0 Long-Term Surveillance Plan

The NRC regulations require that each LTSP include descriptions of the disposal site and disposal cell, final disposal site conditions, the surveillance program, and criteria for follow-up inspections and site maintenance.

LTSPs may reference information in documents previously submitted to the NRC, (10 CFR §40.27(b), §40.28(b)).

2.1 Purpose and Scope of Site-Specific LTSPs

An LTSP must state its purpose and scope. Its purpose is first, to comply with NRC regulatory requirements and second, to facilitate the long-term care of the disposal site. The LTSP also describes baseline conditions for comparisons over time. LTSPs are site-specific.

2.2 Legal Site Description

The LTSP must include a legal description of the disposal site (10 CFR §40.27(b)(1), §40.28(b)(1)).

The site description contains the number of acres included in the site. It also includes the type of real estate instruments associated with conveying the site from the affected state or licensee to the United States or the negotiation of a custodial agreement between the U.S. Department of Energy (DOE) and tribes.

Documents containing information associated with the land transaction (e.g., book, page, county, state, and date for deeds; *Federal Register* number and date for Public Land Order transfers of jurisdiction; and tribal custody and access agreements) should be listed in the LTSP, with the following statement:

Real estate correspondence and instruments are maintained and filed by the Property Management Branch and Administrative Services Property Division, Albuquerque Operations Office.

The LTSP will also state that copies of all real estate documents will be maintained in the permanent site file.

A surveyor's description of the property as recorded and filed at the county seat (or equivalent office) is attached to the LTSP. It includes the township, range, and section (nearest quarter section) or equivalent system (e.g., metes and bounds).

2.3 Final Disposal Site Conditions

An LTSP summarizes final disposal site conditions, as a baseline for comparisons over time. The comparisons are made during site inspections described in Section 2.4 below. The site-specific remedial action plan (RAP) or reclamation plan, as-builts, and completion report should be summarized and referenced for more details.

The LTSP also summarizes the final disposal site description, ground water conditions; and for Title I sites, planned ground water protection activities as required by 10 CFR §40.27(b)(2). This description (in the LTSP or a referenced document) must be detailed enough that inspectors can determine changes from baseline conditions and determine when these changes require maintenance or repairs.

2.3.1 Processing History and Associated Contaminants

The LTSP also summarizes historical information related to surface and ground water (e.g., years of operation, processes, and volume of material processed), and references other site documents for more processing details so the quantity and quality of the tailings stabilized in the cell are understood by the regulators and inspectors.

2.3.1.1 Hazardous Constituents In Stabilized Tailings

An LTSP identifies constituents with established maximum concentration limits (MCL), other hazardous constituents listed in Appendix I of 40 CFR Part 192 or Appendix A Criterion 13 of 10 CFR Part 40, for Title I or Title II sites, respectively, and hazardous constituents of concern that are present in or reasonably derived from the tailings stabilized in the disposal cell.

For most sites, hazardous constituents are identified (in the site RAP or reclamation plan) by sampling and analyzing tailings pore water and by subsequent ground water characterization. In addition to chemical analysis of tailings pore fluids, the LTSP summarizes other factors that could result in constituents being added to or removed from the list of hazardous constituents proposed in the RAP or reclamation plan. These factors include, but are not limited to the following:

- The chemical composition of the raw ore.
- Chemical agents used for uranium extraction.
- Chemical analysis data from sampling collection ponds, subsurface soils, or contaminated ground water at the processing site.
- The chemical properties of Appendix I (40 CFR Part 192) or Appendix A, Criterion 13 (10 CFR Part 40) compounds when they come into contact with water (e.g., stability and solubility).

The LTSP also discusses other water quality parameters of the disposal site environment that may explain or predict potential contaminant migration. Pore water data and other data used to characterize the disposal material may be summarized in a table that also summarizes background and/or on-site contaminant concentrations.

2.3.2 Description and Location of the Disposal Site Area

The as-built and current descriptions of the disposal site area in the LTSP should include the following information:

- A figure locating the disposal site within the region (e.g., state, county, nearby towns, highways, major waterways).
- A road log or figure with instructions for traveling to the site.
- Land use, surface and ground water use, and land ownership of the surrounding areas.
- Surface features of the disposal site including topography, drainage patterns, natural or cultural resources, surface waters, and physiographic setting.
- Vegetation on and around the cell at completion as well as a description and assessment of anticipated volunteer plant growth (see section 2.3.3).
- Subsurface features including ground water characterization.
- Climate including average annual precipitation, temperature and evaporation, prominent wind direction, and vegetation.

For Title I sites, if ground water monitoring is required, the LTSP summarizes Uranium Mill Tailings Remedial Action (UMTRA) Project ground water monitor well data if the wells (1) are specifically referenced in the text; (2) will be used in future ground water protection activities at the disposal site; or (3) are not planned for sampling but will remain at the disposal site after licensing.

For Title II sites, the ground water corrective action program, or if appropriate, alternative concentration limit (ACL) application, must be completed prior to site transfer to the DOE. Therefore, most ground water monitor well data and other related information will be incorporated into the LTSP by reference.

For all sites, a table that lists the monitoring locations and that provides relevant information for each location, such as formation of completion and depth of screened interval, is desirable. Springs or seeps that are used for monitoring should be identified. A site map should show monitoring locations used for background characterization.

In the context of the LTSP, background ground water quality represents the quality that would exist in the uppermost aquifer at the disposal site if neither the tailings disposal nor any previous uranium processing at the disposal site had occurred. For Title I sites, the LTSP summarizes and updates the RAP discussion on background ground water quality in the uppermost aquifer with respect to the basic properties of background ground water:

- Total dissolved solids.
- Major cations (e.g., sodium, magnesium, calcium) and anions (e.g., sulfate, chloride, bicarbonate).

- pH.
- Oxidation-reduction potential.
- Trace elements and constituents exceeding MCLs (Table 2-1).
- Range or variability in background water quality.
- Comparison to regional data, if available.

Table 2-1. Maximum Concentration of Constituents for Ground-Water Protection

Constituent	Maximum Concentration[a]
Arsenic	0.05
Barium	1.0
Cadmium	0.01
Chromium	0.05
Lead	0.05
Mercury	0.002
Selenium	0.01
Silver	0.05
Nitrate (as N)[c]	10
Molybdenum[c]	0.1
Combined radium-226 and radium-228	5 pCi/L
Combined uranium-234 and uranium-238[b,c]	30 pCi/L
Gross alpha-particle activity (excluding radon and uranium)	15 pCi/L
Endrin (1,2,3,4,10,10-hexachloro-6,7-exposy-1,4,4a,5,6,7,8,8a-octahydro-1,4-endo,endo-5,8-dimethanonaphthalene)	0.0002
Lindane (1,2,3,4,5,6-hexachlorocyclohexane, gamma insomer)	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-trichlorophenoxypropionic acid)	0.01

[a]Milligrams per liter, unless stated otherwise.
[b]Where secular equilibrium obtains, this criterion will be satisfied by a concentration of 0.044 milligrams per liter (mg/L). For conditions other than secular equilibrium, a corresponding value may be derived and applied, based on the measured site-specific ratio of the two isotopes of uranium.
[c]Title I sites only.
From Table 1 of 40 CFR Part 192, Subpart A and Table 5C of 10 CFR Part 40, Appendix A. pCi/L - picocuries per liter.

For Title II sites this information is included in the corrective action plan for sites undergoing ground water remediation or in the ACL application and supporting documents.

If the ground water protection strategy is based on a supplemental standard related to background ground water quality, the LTSP summarizes the basis for that determination.

An LTSP does not discuss potential changes in water quality due to failure of the disposal cell. An LTSP does summarize anticipated or reasonably possible changes in ground water conditions in the monitored aquifer at the disposal site and may discuss changes in ground water quality caused by the following:

- Impacts from disposal cell construction or drainage of the excess water from the disposal cell.

- Natural flushing or active remediation of existing ground water contamination at the site.

- Future land or water uses in the vicinity of the site.

- Short-term precipitation effects, cyclical seasonal variation, or long-term climatic influence.

2.3.3 Disposal Cell Design

The LTSP summarizes cell design and performance expectations and references appropriate sections of site-specific documents, including the RAP, reclamation plan, and completion report, for more information.

Title I and Title II disposal cells are designed to be effective for 1,000 years or at least 200 years, with no more than custodial maintenance (40 CFR §192.02(a)(d), 10 CFR Part 40, Appendix A, Criterion 6). An LTSP should summarize the following:

- Major constructed components of the disposal cell, including dimensions.

- A plan view and cross sections of the disposal cell.

- The cover system (i.e., rock or vegetative) drainage controls, and other features that contribute to cell performance.

- Design elements necessary for ground water protection.

- Other performance features (e.g., compaction densities, frost protection, infiltration, and cover drainage).

- The locations, coordinates, types, numbers, and figures of permanent site surveillance features including survey monuments, boundary monuments, site markers, entrance and perimeter signs, settlement plates, etc. Examples are provided in Attachment 2.

Field observations show that rock covers on UMTRA Project disposal cells support volunteer plant growth (DOE, 1992; Burt, 1995). Although this plant growth was not planned, it was acknowledged early in the UMTRA Project that some limited plant growth likely would occur on the cells (DOE, 1985). The common plant species growing on many of the disposal cells are known and should be described or referenced in the LTSP. The LTSP also should summarize or specify the locations of the following information:

- Status of volunteer plant growth on the cell and the anticipated plant succession, with an assessment of the long-term impact of these plants on cover integrity.

- Information (including field data) regarding the rooting patterns of some of the common plants observed on the rock-covered disposal cells (DOE, 1992; Burt, 1995), and data from the literature pertaining to rooting patterns of some common species observed at the sites (DOE 1995).

- Vegetation control measures used at the site.
- Conditions that may dictate the initiation or continued use of vegetation control measures.

2.3.4 Disposal Site Drawings And Photographs

The LTSP states that drawings, maps, and photographs are archived in the permanent site files and are accessible for review prior to site inspections. This information illustrates baseline conditions against which future conditions at the disposal site can be compared and evaluated. As-built drawings, baseline photographs, and aerial photographs are included in the descriptions of disposal site as-built conditions at the completion of remedial action or reclamation. The permanent site file contains vicinity maps, a topographic map, a disposal site map, and photographs of the site. The permanent site file is updated and maintained in accordance with records management procedures established by DOE.

2.4 Long-Term Surveillance Program Description

The LTSP describes the long-term surveillance program: inspection frequency, reports to NRC, inspection personnel qualifications, inspection procedures, frequency and extent of ground water monitoring (if required), appropriate constituent concentration limits for ground water, record keeping, and quality assurance procedures (10 CFR §40.27(b)(3), §40.28(b)(3)). The LTSP refers to cooperative agreements between the DOE and tribes, states, or former licensees, for direction on notifying, reporting, or other actions as appropriate.

2.4.1 Site Inspections, Scope, and Frequency

The LTSP describes disposal site inspections. The objectives of the site inspection are to report on the condition of the disposal cell, note any changes or modifications to the disposal cell and disposal site over time, and identify potential problems. The LTSP should state that all activities will be conducted in compliance with DOE-approved personnel health and safety programs. The inspection detects and documents progressive changes over several years as a result of slow-acting, natural processes. Additionally, the inspection should detect the results of intrusive human actions that can lead to a degradation of institutional control. Comparing baseline conditions recorded in the completion report to inspection findings provides a basis for determining cell performance.

An inspection is conducted at least annually at each disposal site, as required by 10 CFR Part 40, Appendix A, Criterion 12.

2.4.1.1 Inspection Team

The LTSP recommends the requirements for the site inspection team, including the need for technical specialists on the team based on the disposal site design, specific site surveillance requirements, or conditions expected at the site. A minimum of two inspectors comprises an inspection team. Team members should have the technical background and/or experience needed to evaluate physical conditions at the site.

2.4.1.2 Preparing for and Conducting an Inspection

The LTSP refers to this guidance document for recommendations on inspection preparation and conduct. Prior to conducting inspections, inspectors should:

- Review the RAP or reclamation plan, completion report, as-builts, and other appropriate documents listed in the bibliography attached to the LTSP.
- Review the LTSP, the permanent site file, previous site inspection reports, site inspection maps, and any maintenance or emergency measures reports.
- Notify NRC of the inspection.
- Advise state and tribal agencies, if required, and obtain permission to enter adjacent property, if necessary.

During an inspection, site inspectors must:

- Observe the condition of permanent features and anomalous or unexpected features that may require closer inspection (e.g., erosion features such as gullies or rills, sediment accumulations, vandalism, animal intrusion, plant growth).
- Record observations as necessary, in field notebooks and on site maps.
- Take and record photographs as necessary, to document conditions at the disposal site and to provide a continuous record for monitoring changing conditions over time.

2.4.1.3 Disposal Site Access and Security

The LTSP describes or refers to (1) DOE agreements with area landowners, tribes, or state or local agencies for permanent access to the disposal site (road rights-of-way), and for access to and use of areas outside the disposal site boundary to conduct ground water monitoring, if needed; and (2) how the DOE inspects off-site features identified for long-term surveillance. If Privacy Act requirements preclude the inclusion of some of this information in an LTSP, the location of the information is referenced.

The LTSP also identifies the need for prior notification or permission to access the site from non-DOE property, and for special provisions that may be needed to access the disposal site (e.g., obtaining keys to locked gates).

2.4.1.4 Inspection Checklist

An inspection checklist (Attachment 3) that addresses site-specific conditions should be developed and updated for each site. Prior to annual inspections, the previous inspection checklist should be reviewed and updated as needed. The checklist addresses site-specific conditions and requirements, including:

- Specific features to be inspected and photographed. For example, the area within approximately 0.25 mile (mi) (0.40 kilometer [km]) of the boundary of the disposal site;

evidence of human, plant, or animal activity; or geomorphic features (e.g., stream channels or gullies) that could initiate significant erosion.

- Unique cell design criteria requiring monitoring.
- Data that need to be recorded.
- Volunteer plant growth requiring identification and measurement.
- High water marks, areas of active erosion and sedimentation, and changes in channel position.

The checklist should be revised as needed to include new information or to delete items that are no longer pertinent.

2.4.1.5 Disposal Site and Disposal Cell Inspection

The LTSP refers to Attachment 4 of this guidance document for minimal and prudent disposal site and disposal cell inspection procedures that should be considered during planning for site inspections.

2.4.1.6 Inspection Reporting Requirements

The regulations (10 CFR Part 40, Appendix A, Criterion 12) require the DOE to annually submit the results of all site inspections to the NRC within 90 days of the last site inspection for a given calendar year. Any site where unusual damage or disruption is discovered during the inspection, however, will require a preliminary site inspection report to be submitted within 60 days.

The NRC-Uranium Recovery Branch and the DOE-Grand Junction Office have agreed to implement the reporting requirements as follows: One annual report discussing inspection results for all sites licensed under 10 CFR 40.27 (Title I sites) will be submitted and a separate annual report discussing inspection results for all sites licensed under 10 CFR 40.28 (Title II sites) will be submitted. Each report being subject to the reporting time limits mentioned above.

A copy of all site inspection reports will be maintained in the permanent site file.

2.4.2 Follow-Up Inspections

The NRC regulations require that the criteria for follow-up inspections in response to observations from routine inspections and extreme natural events must be included in the LTSP (10 CFR §40.27(b)(4), §40.28(b)(4)). The NRC is notified prior to the follow-up inspection if the reported problem indicates the disposal cell has been compromised or that extensive repair or emergency measures could be needed. Follow-up inspections will be conducted by technical specialists in the disciplines appropriate to the problem that has been reported.

Follow-up inspection reports may include:

- A description of the problem that triggered the follow-up inspection.

- A preliminary assessment of the maintenance, repair, or emergency measures required.
- Conclusions and recommendations.
- Assessment data, including field and inspection data, and photographs.
- Inspectors' names, qualifications, and signatures.

2.4.3 Ground Water Monitoring

The NRC regulations require that each LTSP describe the proposed frequency and extent of ground water monitoring, and appropriate constituent concentration limits for ground water (10 CFR §40.27(b)(3), §40.28(b)(3)).

An LTSP does not describe compliance activities for preexisting ground water contamination associated with uranium milling activities unless these activities could impact the ground water protection strategy of the disposal cell or the ability to assess these strategies. If so, they are summarized in the LTSP.

2.4.3.1 Disposal Sites Not Requiring Ground Water Monitoring

If ground water monitoring is not necessary at a disposal site, the rationale for no monitoring is summarized in the LTSP. This summary consists of the minimum description of the ground water characteristics needed to support the summary. It references appropriate documents for more information on ground water characteristics and the justification for not performing ground water monitoring at or near the site.

2.4.3.2 Disposal Sites Requiring Ground Water Monitoring

The water sampling and analysis plan for each site should be summarized or referenced in the LTSP. Ground water samples will be collected in compliance with the most recent DOE-approved standard operating procedures. The LTSP will specify the frequency, extent, and locations of ground water sampling.

Ground water monitoring data should be analyzed to determine if the cell is functioning as designed.

2.4.4 Custodial Maintenance or Repair

The LTSP identifies routine or reasonably anticipated custodial activities, the timing and frequency with which they are performed, and the manner in which the work is authorized (10 CFR §40.27(b)(5), §40.28(b)(5)). The following examples of maintenance or repair may be specified.

- Planned maintenance: grass mowing, road maintenance, removal of weeds or debris, vegetation control, or replacement of signs.
- Unscheduled maintenance: removal of deep-rooted or other unwanted vegetation on the disposal cell.

- Repair: damage to disposal cell, fence, gate or locks, surveillance features, wells or roads.
- Repair: Deterioration of disposal site erosion protection materials.
- Repair: Mitigation of modifying processes that could eventually compromise disposal cell integrity.

Failure of planned vegetation to establish within a specified amount of time may warrant further analysis and action.

The LTSP describes custodial care certification and reporting requirements. At a minimum, the party that performs the work provides DOE with verification of the work. DOE inspects the work and certifies that it was completed in accordance with the specifications. Documentation of the custodial maintenance or repair is included in the annual report to the NRC.

A record of the custodial work documented and incorporated in the permanent site file includes:

- Summary of work required (statement of work).
- Procurement documents (drawings, specifications, subcontract).
- Documentation of completion of work.

2.4.5 Emergency Measures and Ground Water Corrective Actions

The difference between maintenance/repairs and emergency measures is determined by the cause and magnitude of the problem, the immediate threat to the public or the environment, and the need to comply with applicable standards.

The site inspectors evaluate the problem and make recommendations for the next step (e.g., immediate action or continued evaluation). Recommendations for the next step will be determined as follows: (1) DOE will assess the design bases governing the adequacy of the damaged site feature and the ability of the site design to control or accommodate the observed problems; (2) DOE will determine the extent of the damage or degradation and will compare existing conditions to design conditions; (3) as necessary, DOE will evaluate the existing conditions to determine if a design basis event can be withstood by the feature in its existing condition; and (4) DOE will provide to NRC (in either the annual report or a separate report) a clear and technically defensible basis for concluding that remedial measures are or are not necessary. After the NRC reviews the report and its recommendations, the DOE prepares a plan and submits it to the NRC. Emergency measures begin after the NRC has concurred with the plan.

NRC regulations do not specify a time frame for implementing emergency measures. However, the relative severity and imminence of threat to the public health and safety or the environment, will dictate how quickly action must be taken.

For ground water corrective actions, the EPA ground water standards require that a corrective action program must be in operation no later than 18 months after a finding of exceedance

(40 CFR §192.04, §192.33). Assessing the extent of the problem and developing a corrective action plan is not considered initiation of the corrective action program.

The following examples of disposal site conditions may require emergency measures:

- Surface rupture of the disposal cell, such as cracks, indications of differential settlement, or severe shrinkage of the cover materials.
- Subsidence, sliding, or slope instability on the disposal cell (caused by mass wasting, liquefaction, differential settlement, or other events).
- Development of rills or gullies considered an actual or potential breach to cell integrity.
- Deterioration to the point of imminent failure of the erosion protection rock on the disposal cell or in the drainage ditches.
- Seepage originating from the disposal cell.
- Development of gullies on or adjacent to disposal site property that could affect the integrity of the disposal cell.
- Rapid headward cutting of a nearby gully, arroyo, or ravine that threatens the stability of the disposal cell.
- Encroachment of stream channels onto the disposal site.
- Damage to the cell cover or disposal site property because of river encroachment, seismic events, flooding, catastrophic events, volunteer plant growth, or vandalism (removal of cell construction materials).
- Ground water quality degradation may require corrective action.

The LTSP discusses certification of emergency measures or corrective actions and the reporting requirements for the progress of the actions. The NRC reviews the progress reports, which may be appended to the site inspection and/or annual report. After the action is completed, all work is certified by the DOE in accordance with the design specifications. The NRC reviews the certification that the emergency repair or corrective action is acceptable. All reports, data, and documentation generated during the emergency measures or corrective action, including a copy of the certification statement, are retained in the permanent site file.

2.4.6 Record Keeping

The LTSP identifies and summarizes the DOE-approved record keeping requirements that apply to LTSP documentation. DOE updates and maintains the following documents:

- The DOE's annual report to the NRC documenting the results of the inspections as required by 10 CFR §40.27(b)(3) and 10 CFR §40.28(b)(3) for Titles I and II, respectively.
- Files and original deeds, custody agreements, and other property documents.

- Surveillance and maintenance documentation.
- Emergency measures records.
- Ground water corrective action records.
- Other documents deemed important by DOE.

Records, including the permanent site file, will be managed and maintained in accordance with schedules and procedures established by the National Archives and Records Administration (NARA) and DOE Order 1324.5B, *Records Management*.

2.4.7 Emergency Notification and Reporting

An LTSP includes copies of agency agreements and emergency and reporting procedures (e.g., the DOE agreement with the U.S. Geological Survey National Earthquake Information Service to notify the DOE in the event of an earthquake in the disposal site area). Attachment 5 provides the criteria for earthquake reporting requirements.

The LTSP states that if a site-related emergency requires public notification, the DOE takes appropriate action to notify individuals who may be affected and advise them of precautions that should be taken. Local law enforcement officials, news media, DOE and NRC representatives, and tribal or state representatives are included in this process. Nothing in the LTSP may negate or override DOE occurrence reporting requirements.

The designated facility contact telephone number also is posted on the site entrance sign (DOE 24-hour number), allowing area residents to contact the DOE when problems are discovered.

2.4.8 Quality Assurance

The LTSP refers to DOE quality assurance requirements that must be followed during implementation of the surveillance and maintenance program, including DOE Order 414.1A, *Quality Assurance*.

3.0 References

Burt, C., 1995. Jacobs Engineering Group Inc., personal communication with S. Cox, Jacobs Engineering Group Inc., UPDCC File Location No. 5.15.1.1, Albuquerque, New Mexico, 5 October 1995.

DOE (U.S. Department of Energy), 1995. *UMTRA Project Disposal Cell Cover Biointrusion Sensitivity Assessment*, DOE/AL/62350-200, Rev. 1, prepared for the U.S. Department of Energy, Environmental Restoration Division, UMTRA Project Team, Albuquerque, New Mexico.

DOE (U.S. Department of Energy), 1992. *Vegetation Growth Patterns on Six Rock-Covered UMTRA Project Disposal Cells*, DOE/AL-400677.0000, prepared for the U.S. Department of Energy, UMTRA Project Office, Albuquerque Operations Office, Albuquerque, New Mexico.

DOE (U.S. Department of Energy), 1985. *Technical Summary of the UMTRA Project Technology Development Program (1980-1984)*, UMTRA-DOE/AL-200125.0000, prepared for the U.S. Department of Energy, UMTRA Project Office, Albuquerque Operations Office, Albuquerque, New Mexico.

EPA (U.S. Environmental Protection Agency), 1992. *Addendum to Interim Final Guidance, Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities*, Office of Solid Waste Management Division, U.S. Environmental Protection Agency, Washington, D.C.

Code Of Federal Regulations

10 CFR Part 40, *Domestic Licensing of Source Material*, U.S. Nuclear Regulatory Commission.

40 CFR Part 192, *Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings,* U.S. Environmental Protection Agency.

DOE Orders

Order 414.1A, *Quality Assurance*, September 29, 1999, U.S. Department of Energy, Washington, D.C.

Order 1324.5B, Records Management, July 19, 1996, U.S. Department of Energy, Washington, D.C.

United States Code

42 USC Section 7901 *et seq.*, *Uranium Mill Tailings Radiation Control Act of 1978*, November 8, 1978.

End of current text

Attachment 1

U.S. Nuclear Regulatory Commission Regulations
(10 CFR §40.27, §40.28, and §40 Appendix A)

§ 40.26 General license for possession and storage of byproduct material as defined in this part.

(a) A general license is hereby issued to receive title to, own, or possess byproduct material as defined in this part without regard to form or quantity.

(b) The general license in paragraph (a) of this section applies only: In the case of licensees of the Commission, where activities that result in the production of byproduct material are authorized under a specific license issued by the Commission pursuant to this part, to byproduct material possessed or stored at an authorized disposal containment area or transported incident to such authorized activity: *Provided*, That authority to receive title to, own, or possess byproduct material under this general license shall terminate when the specific license for source material expires, is renewed, or is amended to include a specific license for byproduct material as defined in this part.

(c) The general license in paragraph (a) of this section is subject to:

(1) The provisions of parts 19, 20, 21, and §§ 40.1, 40.2a, 40.3, 40.4, 40.5, 40.6, 40.41, 40.46, 40.60, 40.61, 40.62, 40.63, 40.65, 40.71, and 40.81 of part 40 of this chapter; and

(2) The documentation of daily inspections of tailings or waste retention systems and the immediate notification of the appropriate NRC regional office as indicated in appendix D to 10 CFR part 20 of this chapter, or the Director, Office of Nuclear Material Safety and Safeguards, U.S. Nuclear Regulatory Commission, Washington, DC 20555, of any failure in a tailings or waste retention system that results in a release of tailings or waste into unrestricted areas, or of any unusual conditions (conditions not contemplated in the design of the retention system) that if not corrected could lead to failure of the system and result in a release of tailings or waste into unrestricted areas; and any additional requirements the Commission may by order deem necessary. The licensee shall retain this documentation of each daily inspection as a record for three years after each inspection is documented.

(d) The general license in paragraph (a) of this section shall expire nine months from the effective date of this subparagraph unless an applicable licensee has submitted, pursuant to the provisions of § 40.31 of this part, an application for license renewal or amendment which includes a detailed program for meeting the technical and financial criteria contained in appendix A of this part.

[44 FR 50014, Aug. 24, 1979, as amended at 45 FR 12377, Feb. 26, 1980; 45 FR 65531, Oct. 3, 1980; 53 FR 19248, May 27, 1988; 56 FR 40768, Aug. 16, 1991]

§ 40.27 General license for custody and long-term care of residual radioactive material disposal sites.

(a) A general license is issued for the custody of and long-term care, including monitoring, maintenance, and emergency measures necessary to protect public health and safety and other actions necessary to comply with the standards promulgated under section 275(a) of the Atomic Energy Act of 1954, as amended, for disposal sites under title I of the Uranium Mill Tailings Radiation Control Act of 1978, as amended. The license is available only to the Department of Energy, or another Federal agency designated by the President to provide long-term care. The purpose of this general license is to ensure that uranium mill tailings disposal sites will be cared for in such a manner as to protect the public health, safety, and the environment after remedial action has been completed.

(b) The general license in paragraph (a) of this section becomes effective when the Commission accepts a site Long-Term Surveillance Plan (LTSP) that meets the requirements of this section, and when the Commission concurs with the Department of Energy's determination of completion of remedial action at each disposal site. There is no termination of this general license. The LTSP may incorporate by reference information contained in documents previously submitted to the Commission if the references to the individual incorporated documents are clear and specific. Each LTSP must include—

(1) A legal description of the disposal site to be licensed, including documentation on whether land and interests are owned by the United States or an Indian tribe. If the site is on Indian land, then, as specified in the Uranium Mill Tailings Radiation Control Act of 1978, as amended, the Indian tribe and any person holding any interest in the land shall execute a waiver releasing the United States of any liability or claim by the Tribe or person concerning or arising from the remedial action and holding the United States harmless against any claim arising out of the performance of the remedial action;

(2) A detailed description, which can be in the form of a reference, of the final disposal site conditions, including existing ground water characterization and any necessary ground water protection activities or strategies. This description must be detailed enough so that future inspectors will have a baseline to determine changes to the site and when these changes are serious enough to require maintenance or repairs. If the disposal site has continuing aquifer restoration requirements, then the licensing process will be completed in two steps. The first step includes all items other than ground water restoration. Ground water monitoring, which would be addressed in the LTSP, may still be required in this first step to assess performance of the tailings disposal units. When the Commission concurs with the completion of ground water restoration, the licensee shall assess the need to modify the LTSP and report results to the Commission. If the proposed modifications meet the requirements of this section, the LTSP will be considered suitable to accommodate the second step.

(3) A description of the long-term surveillance program, including proposed inspection frequency and reporting to the Commission (as specified in appendix A, criterion 12 of this part), frequency and extent of ground water monitoring if required, appropriate constituent concentration limits for ground water, inspection personnel qualifications, inspection procedures, recordkeeping and quality assurance procedures;

(4) The criteria for follow-up inspections in response to observations from routine inspections or extreme natural events; and

(5) The criteria for instituting maintenance or emergency measures.

(c) The long-term care agency under the general license established by paragraph (a) of this section shall—

(1) Implement the LTSP as described in paragraph (b) of this section;

(2) Care for the disposal site in accordance with the provisions of the LTSP;

(3) Notify the Commission of any changes to the LTSP; the changes may not conflict with the requirements of this section;

(4) Guarantee permanent right-of-entry to Commission representatives for the purpose of periodic site inspections; and

(5) Notify the Commission prior to undertaking any significant construction, actions, or repairs related to the disposal site, even if the action is required by a State or another Federal agency.

(d) As specified in the Uranium Mill Tailings Radiation Control Act of 1978, as amended, the Secretary of the Interior, with the concurrence of the Secretary of Energy and the Commission, may sell or lease any subsurface mineral rights associated with land on which residual radioactive materials are disposed. In such cases, the Commission shall grant a license permitting use of the land if it finds that the use will not disturb the residual radioactive materials or that the residual radioactive materials will be restored to a safe and environmentally sound condition if they are disturbed by the use.

(e) The general license in paragraph (a) of this section is exempt from parts 19, 20, and 21 of this chapter, unless significant construction, actions, or repairs are required. If these types of actions are to be undertaken, the licensee shall explain to the Commission which requirements from these parts apply for the actions and comply with the appropriate requirements.

[55 FR 45598, Oct. 30, 1990]

§ 40.28 General license for custody and long-term care of uranium or thorium byproduct materials disposal sites.

(a) A general license is issued for the custody of and long-term care, including monitoring, maintenance, and emergency measures necessary to protect the public health and safety and other actions necessary to comply with the standards in this part for uranium or thorium mill tailings sites closed under title II of the Uranium Mill Tailings Radiation Control Act of 1978, as amended. The licensee will be the Department of Energy, another Federal agency designated by the President, or a State where the disposal site is located. The purpose of this general license is to ensure that uranium and thorium mill tailings disposal sites will be cared for in such a manner as to protect the public health, safety, and the environment after closure.

(b) The general license in paragraph (a) of this section becomes effective when the Commission terminates, or concurs in an Agreement State's termination of, the current specific license and a site Long-Term Surveillance Plan (LTSP) meeting the requirements of this section has been accepted by the Commission. There is no termination of this general license. If the LTSP has not been formally received by the NRC prior to termination of the current specific license, the Commission may issue a specific order to the intended custodial agency to ensure continued control and surveillance of the disposal site to protect the public health, safety, and the environment. The Commission will not unnecessarily delay the termination of the specific license solely on the basis that an acceptable LTSP has not been received. The LTSP may incorporate by reference information contained in documents previously submitted to the Commission if the references to the individual incorporated documents are clear and specific. Each LTSP must include—

(1) A legal description of the disposal site to be transferred (unless transfer is exempted under provisions of the Atomic Energy Act, § 83(b)(1)(A)) and licensed;

(2) A detailed description, which can be in the form of a reference of the final disposal site conditions, including existing ground water characterization. This description must be detailed enough so that future inspectors will have a baseline to determine changes to the site and when these changes are serious enough to require maintenance or repairs;

(3) A description of the long-term surveillance program, including proposed inspection frequency and reporting to the Commission (as specified in appendix A, Criterion 12 of this part), frequency and extent of ground water monitoring if required, appropriate constituent concentration limits for ground water, inspection personnel qualifications, inspection procedures, recordkeeping and quality assurance procedures;

(4) The criteria for follow-up inspections in response to observations from routine inspections or extreme natural events; and

(5) The criteria for instituting maintenance or emergency measures.

(c) The long-term care agency who has a general license established by paragraph (a) of this section shall—

(1) Implement the LTSP as described in paragraph (b) of this section;

(2) Care for the disposal site in accordance with the provisions of the LTSP;

(3) Notify the Commission of any changes to the LTSP; the changes may not conflict with the requirements of this section;

(4) Guarantee permanent right-of-entry to Commission representatives for the purpose of periodic site inspections; and

(5) Notify the Commission prior to undertaking any significant construction, actions, or repairs related to the disposal site, even if the action is required by a State or another Federal agency.

(d) Upon application, the Commission may issue a specific license, as specified in the Uranium Mill Tailings Radiation Control Act of 1978, as amended, permitting the use of surface and/or subsurface estates transferred to the United States or a State. Although an application may be received from any person, if permission is granted, the person who transferred the land to DOE or the State shall receive the

right of first refusal with respect to this use of the land. The application must demonstrate that—

(1) The proposed action does not endanger the public health, safety, welfare, or the environment;

(2) Whether the proposed action is of a temporary or permanent nature, the site would be maintained and/or restored to meet requirements in appendix A of this part for closed sites; and

(3) Adequate financial arrangements are in place to ensure that the byproduct materials will not be disturbed, or if disturbed that the applicant is able to restore the site to a safe and environmentally sound condition.

(e) The general license in paragraph (a) of this section is exempt from parts 19, 20, and 21 of this chapter, unless significant construction, actions, or repairs are required. If these types of actions are to be undertaken, the licensee shall explain to the Commission which requirements from these parts apply for the actions and comply with the appropriate requirements.

(f) In cases where the Commission determines that transfer of title of land used for disposal of any byproduct materials to the United States or any appropriate State is not necessary to protect the public health, safety or welfare or to minimize or eliminate danger to life or property (Atomic Energy Act, §83(b)(1)(A)), the Commission will consider specific modifications of the custodial agency's LTSP provisions on a case-by-case basis.

[55 FR 45599, Oct. 30, 1990]

LICENSE APPLICATIONS

§ 40.31 Application for specific licenses.

(a) A person may file an application for specific license in duplicate on NRC Form 313, "Application for Material License," in accordance with the instructions in § 40.5 of this chapter. Information contained in previous applications, statements or reports filed with the Commission may be incorporated by reference provided that the reference is clear and specific.

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

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

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

(e) Each application for a source material license, other than a license exempted from part 170 of this chapter, shall be accompanied by the fee prescribed in § 170.31 of this chapter. No fee will be required to accompany an application for renewal or amendment of a license, except as provided in § 170.31 of this chapter.

(f) An application for a license to possess and use source material for uranium milling, production of uranium hexafluoride, or for the conduct of any other activity which the Commission has determined pursuant to subpart A of part 51 of this chapter will significantly affect the quality of the environment shall be filed at least 9 months prior to commencement of construction of the plant or facility in which the activity will be conducted and shall be accompanied by any Environmental Report required pursuant to subpart A of part 51 of this chapter.

(g) In response to a written request by the Commission, an applicant for a license to possess and use source material in a uranium hexafluoride production plant or a fuel fabrication plant and any other applicant for a license to possess and use more than one effective kilogram of source material (except for ore processing, as defined in § 75.4(o) of

under sections 161b, 161i, or 161o of the Act. For purposes of section 223, all the regulations in part 40 are issued under one or more of sections 161b, 161i, or 161o, except for the sections listed in paragraph (b) of this section.

(b) The regulations in part 40 that are not issued under sections 161b, 161i, or 161o for the purposes of section 223 are as follows: §§40.1, 40.2, 40.2a, 40.4, 40.5, 40.6, 40.8, 40.11, 40.12, 40.13, 40.14, 40.20, 40.21, 40.31, 40.32, 40.34, 40.43, 40.44, 40.45, 40.71, 40.81, and 40.82.

[57 FR 55075, Nov. 24, 1992]

APPENDIX A TO PART 40—CRITERIA RELATING TO THE OPERATION OF URANIUM MILLS AND THE DISPOSITION OF TAILINGS OR WASTES PRODUCED BY THE EXTRACTION OR CONCENTRATION OF SOURCE MATERIAL FROM ORES PROCESSED PRIMARILY FOR THEIR SOURCE MATERIAL CONTENT

Introduction. Every applicant for a license to possess and use source material in conjunction with uranium or thorium milling, or byproduct material at sites formerly associated with such milling, is required by the provisions of §40.31(h) 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, financial, ownership, and long-term site surveillance criteria relating to the siting, operation, decontamination, decommissioning, 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 §20.1003 of this chapter.

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 §40.31(h) applications for licenses must clearly demonstrate how the criteria have been addressed.

The specifications must 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 must be evaluated.

Licensees or applicants may propose alternatives to the specific requirements in this appendix. The alternative proposals may take into account local or regional conditions, including geology, topography, hydrology, and meterology. The Commission may find that the proposed alternatives meet the Commission'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 nonradiological hazards associated with the sites, 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.

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 Commission determines to be appropriate. In implementing this Appendix, the Commission will consider "practicable" and "reasonably achievable" as equivalent terms. Decisions involved 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.

The following definitions apply to the specified terms as used in this appendix:

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 recovery 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 this appendix.

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 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.

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 Commission approved plan to accomplish closure.

Compliance period begins when the Commission 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.

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 apply.

Existing portion means that land surface area of an existing surface impoundment on which significant quantities of uranium or thorium byproduct materials 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. 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

(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 this appendix (excluding erosion protection features).

Ground water means water below the land surface in a zone of saturation. For purposes of this appendix, 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 byproduct material.

Licensed site means the area contained within the boundary of a location under the control of persons generating or storing byproduct materials under a Commission 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.

Milestone means an action or event that is required to occur by an enforceable date.

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.

Reclamation plan, for the purposes of Criterion 6A, means the plan detailing activities to accomplish reclamation of the tailings or waste disposal area in accordance with the technical criteria of this appendix. 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 dewatering or the removal of freestanding liquids and recontouring), 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.)

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.

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.

I. Technical Criteria

Criterion 1—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:

Remoteness from populated areas;

Hydrologic and other natural conditions as they contribute to continued immobilization and isolation of contaminants from groundwater sources; and

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

The site selection process must be an optimization to the maximum extent reasonably achievable in terms of these features.

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.

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 must be disposed of at existing large mill tailings disposal 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 offsite 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 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.

(a) 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.

(b) Topographic features should provide good wind protection.

(c) 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.

(d) A full self-sustaining vegetative cover must be established or rock cover employed to reduce wind and water erosion to negligible levels.

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 NRC will consider relaxing this requirement for extremely gentle slopes such as those which may exist on the top of the pile.

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:

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

Rock cover thickness and zoning of particles by size; and

Steepness of underlying slopes.

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.

Rock covering of slopes may be unnecessary where top covers are very thick (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 points (a) and (b) of this Criterion.

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.

(e) 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.

(f) 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 new 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. Ground-water monitoring to comply with these standards is required by Criterion 7A.

5A(1)—The primary ground-water protection standard is a design standard for surface impoundments used to manage uranium and thorium byproduct material. Unless exempted under paragraph 5A(3) of this criterion, surface impoundments (except for an existing portion) must 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.

5A(2)—The liner required by paragraph 5A(1) above must 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;

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.

(d) A full self-sustaining vegetative cover must be established or rock cover employed to reduce wind and water erosion to negligible levels.

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 NRC will consider relaxing this requirement for extremely gentle slopes such as those which may exist on the top of the pile.

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:

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

Rock cover thickness and zoning of particles by size; and

Steepness of underlying slopes.

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.

Rock covering of slopes may be unnecessary where top covers are very thick (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 points (a) and (b) of this Criterion.

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.

(e) 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.

(f) 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 new 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. Ground-water monitoring to comply with these standards is required by Criterion 7A.

5A(1)—The primary ground-water protection standard is a design standard for surface impoundments used to manage uranium and thorium byproduct material. Unless exempted under paragraph 5A(3) of this criterion, surface impoundments (except for an existing portion) must 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.

5A(2)—The liner required by paragraph 5A(1) above must 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.

5A(3)—The applicant or licensee will be exempted from the requirements of paragraph 5A(1) of this criterion if the Commission 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 Commission 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.

5A(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.

5A(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.

5B(1)—Uranium and thorium byproduct materials must 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 Commission pursuant to paragraph 5B(2) of this criterion. Specified concentration limits are those limits established by the Commission as indicated in paragraph 5B(5) of this criterion. The Commission 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 downgradient edge of the disposal area. The Commission 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.

5B(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 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.

5B(3)—Even when constituents meet all three tests in paragraph 5B(2) of this criterion, the Commission 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 Commission will consider the following:

(a) Potential adverse effects on groundwater 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 groundwater 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.

5B(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 Commission will consider any identification of underground sources of drinking water and exempted aquifers made by the Environmental Protection Agency.

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

(a) The Commission 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 Commission.

5B(6)—Conceptually, background concentrations pose no incremental hazards and the drinking water limits in paragraph 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 Commission 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 Commission must consider. The Commission 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 Commission will consider the following factors:

(a) Potential adverse effects on groundwater 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 groundwater 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.

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-hexachlorocyclohexane, gamma isomer)	0.004
Methoxychlor (1,1,1-Trichloro-2,2-bis (p-methoxyphenylethane)	0.1
Toxaphene (C_{10} H_{10} Cl_8, 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-Trichlorophenoxypropionic 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

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 Commission finds that the standards have been exceeded. The licensee shall submit the proposed corrective action program and supporting rationale for Commission approval prior to putting the program into operation, unless otherwise directed by the Commission. 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 must address removing the hazardous constituents that have entered the ground water at the point of compliance or treating them in place. The program must also address removing or treating in place any hazardous constituents that exceed concentration limits in ground water between the point of compliance and the downgradient 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 Commission 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.

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) Dewatering of tailings by process devices and/or in-situ drainage systems (At new sites, tailings must be dewatered 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 dewatering 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.

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.

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 boreholes must include both geologic 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 borehole 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.

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[1] 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[2] release rate of 20 picocuries per square meter per second (pCi/m^2 s) 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 20 pCi/m^{2}s averaged over the entire pile or impoundment using the procedures described in 40 CFR part 61, appendix B, Method 115, or another method of verification approved by the Commission 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 Commission the results detailing the actions taken to verify that levels of release of radon-222 do not exceed 20 pCi/m^{2}s 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

[1] 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.

[2] 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 to emissions from byproduct materials to the atmosphere.

the site to DOE 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 covermust be essentially the 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) 5 picocuries per gram (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) 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.

(7) The licensee shall also address the nonradiological 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 postclosure escape of nonradiological 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, Commission-approved reclamation plan. (The term *as expeditiously as practicable considering technological feasibility* as specifically defined in the Introduction of this appendix 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 features necessary for long-term control of the tailings must also be completed in a timely manner in accordance with a written, Commission-approved reclamation plan.

(2) The Commission 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 Commission 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 20 pCi/m²s. If the delay is approved on the basis that the radon releases do not exceed 20 pCi/m²s, 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 Commission has established the date in the reclamation plan for the milestone for completion of the final radon barrier, the Commission may extend that date based on cost if, after providing an opportunity for public participation, the Commission 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 Commission may authorize by license amendment, upon licensee request, 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 20 pCi/m²s 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 Commission makes a final finding that the impoundment will continue to achieve a level of radon-222 releases not exceeding 20 pCi/m² s 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— At least one full year prior to any major site construction, a preoperational monitoring program must be

conducted to provide complete baseline data on a milling site and its environs. Throughout the construction and operating phases of the mill, an operational monitoring program must be conducted 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.

7A—The licensee shall establish a detection monitoring program needed for the Commission 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 Commission 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 Commission 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 Commission 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. For licenses in effect September 30, 1983, the detection monitoring programs must have been in place by October 1, 1984. For licenses issued after September 30, 1983, the detection monitoring programs must be in place when specified by the Commission 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 Commission. 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 of 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 appropriate NRC regional office 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 thorium byproduct material must be conducted in such a manner as to provide reasonable assurance that the annual dose equivalent does not exceed 25 millirems to the whole body, 75 millirems to the thyroid, and 25 millirems to any other organ of any member of the public as a result of exposures to the planned discharge of radioactive materials, radon-220 and its daughters 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—Daily inspections of tailings or waste retention systems must be conducted by a qualified engineer or scientist and documented. The licensee shall retain the documentation for each daily inspection as a record for three years after the documentation is made. The appropriate NRC regional office as indicated in Appendix D to 10 CFR Part 20 of this chapter, or the Director, Office of Nuclear Material Safety and Safeguards, U.S. Nuclear Regulatory Commission, Washington, DC, 20555, 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 of any unusual conditions (conditions not contemplated in the design of the retention system) that is 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.

II. Financial Criteria

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 Commission-approved cost estimates in a Commission-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 Section I of 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 Commission 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 licensees's surety mechanism will be reviewed annually by the Commission 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 equivalent 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 Commission or the State regulatory 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 regulatory 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 Commission are:

(a) Surety bonds;

(b) Cash deposits;

(c) Certificates of deposits;

(d) Deposits of government securities;

(e) Irrevocable letters or lines of credit; and

(f) Combinations of the above or such other types of arrangements as may be approved by the Commission. However, self insurance, or any arrangement which essentially constitutes self insurance (e.g., a contract with a State or Federal agency), will not satisfy the surety requirement since this provides no additional assurance other than that which already exists through license requirements.

Criterion 10—A minimum charge of $250,000 (1978 dollars) to cover the costs of long-term surveillance must 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 be significantly greater than those specified in Criterion 12 (e.g., if fencing is determined to be necessary), variance in funding requirements may be specified by the Commission. In any case, the total charge to cover the costs of long-term surveillance must be such that, with an assumed 1 percent annual real interest rate, the collected funds will yield interest in an amount sufficient to cover the annual costs of site surveillance. The total charge will be adjusted annually prior to actual payment to recognize inflation. The inflation rate to be used is that indicated by the change in the Consumer Price Index published by the U.S. Department of Labor, Bureau of Labor Statistics.

III. Site and Byproduct Material Ownership

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

B. Any uranium or thorium milling license or tailings license must contain such terms and conditions as the Commission determines 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.

C. Title to the byproduct material licensed under this Part 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 an NRC 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. For licenses issued before November 8, 1981, the 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.

D. If the 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 Commission may permit the use of the surface or subsurface estates, or both, of such land in a manner consistent with the provisions provided in these criteria. If the 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.

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

F. 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 byproduct material, as defined in this Part, the licensee shall enter into arrangements with the Commission as may be appropriate to assure the long-term surveillance of such lands by the United States.

IV. Long-Term Site Surveillance

Criterion 12—The final disposition of tailings, residual radioactive material, or wastes at milling sites should be such that ongoing active maintenance is not necessary to preserve isolation. As a minimum, annual site inspections must be conducted by the government agency responsible for long-term care of the disposal site to confirm its integrity and to determine the need, if any, for maintenance and/or monitoring. Results of the inspections for all the sites under the licensee's jurisdiction will be reported to the Commission annually within 90 days of the last site inspection in that calendar year. Any site where unusual damage or disruption is discovered during the inspection, however, will require a preliminary site inspection report to be submitted within 60 days. On the basis of a site specific evaluation, the Commission may require more frequent site inspections if necessary due to the features of a particular disposal site. In this case, a preliminary inspection report is required to be submitted within 60 days following each inspection.

V. Hazardous Constituents

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 Commission will also set a limit for gross alpha activity. The Commission 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-methylcarbamate 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-[((aminocabonyl)oxy)methyl]-1,1a,2,8,8a,8b-hexahydro-8a methoxy-5-methy-)
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]
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-])

[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,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-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]
Cyanogen (Ethanedinitrile)
Cyanogen bromide (Bromine cyanide)
Cyanogen chloride (Chlorine cyanide)
Cycasin (beta-D-Glucopyranoside, (methyl-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,O-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]-)
Diisopropylfluorophosphate (DFP) (Phosphorofluoridic acid, bis(1-methylethyl) ester)
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-Benzanthracene, 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 (Thioimidodicarbonic diamide)
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 (Hexachlorohexahydro-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-0)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-[(methylcarbamoyl)oxy]thio-, methyl ester)
Methoxychlor (Ethane, 1,1,1-trichloro-2,2'-bis(p-methoxyphenyl)-)
2-Methylaziridine (1,2-Propylenimine)
3-Methylcholanthrene (Benz[j]aceanthrylene, 1,2-dihydro-3-methyl-)
Methyl chlorocarbonate (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-(4-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)-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-)
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 cyanide
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)
Safrole (Benzene, 1,2-methylenedioxy-4-allyl-)
Selenious acid (Selenium dioxide)
Selenium and compounds, N.O.S.[3]
Selenium sulfide (Sulfur selenide)
Selenourea (Carbamimidoselenoic acid)
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-)
Tetrachloroethane (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)
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'-biphenyl)- 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)
Vanadium pentoxide (Vanadium (V) oxide)
Vinyl chloride (Ethene, chloro-)
Zinc cyanide
Zinc phosphide

[50 FR 41862, Oct. 16, 1985, as amended at 52 FR 31611, Aug. 21, 1987; 52 FR 43562, Nov. 13, 1987; 53 FR 19248, May 27, 1988; 55 FR 45600, Oct. 30, 1990; 56 FR 23473, May 21, 1991; 58 FR 67661, Dec. 22, 1993; 59 FR 28229, June 1, 1994]

PART 50—DOMESTIC LICENSING OF PRODUCTION AND UTILIZATION FACILITIES

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Attachment 2

Samples of Permanent Site Surveillance Features

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Table A2.1. Example Locations of Disposal Site Permanent Surveillance Features

Feature	Location Coordinates[a]
Site Markers	
SMK-1	N 14,678; E 12,600
SMK-2	N 15,539; E 12,974
Survey/Boundary Monuments	
SM-1/BM-1	N 15,002; E 14,326
SM-2/BM-2	N 16,648; E 14,321
SM-3/BM-3	N 16,663; E 12,500
Boundary Monuments	
BM-4	N 16,394; E 11,660
BM-5	N 15,828; E 11,662
BM-6	N 15,343; E 11,996
BM-7	N 15,009; E 11,998
BM-8	N 14,685; E 11,999
BM-9	N 14,684; E 12,326
BM-10	N 14,679; E 13,632
BM-11	N 14,897; E 14,327
Background Well	
GUN08-0716	N 17499; E 13,216
POC Wells	
POC-1	N 15,500; E 12,375[b]
POC-2	N 16,125; E 12,625[b]
POC-3	N 16,375; E 13,250[b]
POC-4	N 15,750; E 13,675[b]
POC-5	N 15,500; E 13,500[b]
POC-6	N 15,000; E 13,375[b]

[a]Coordinates in feet based on Project Survey Control Point (N 15,000; E 15,000 - modified Colorado State Plane Coordinate System).
[b]Estimated coordinates based on tentative well locations.

From MK-ECE, 1995.

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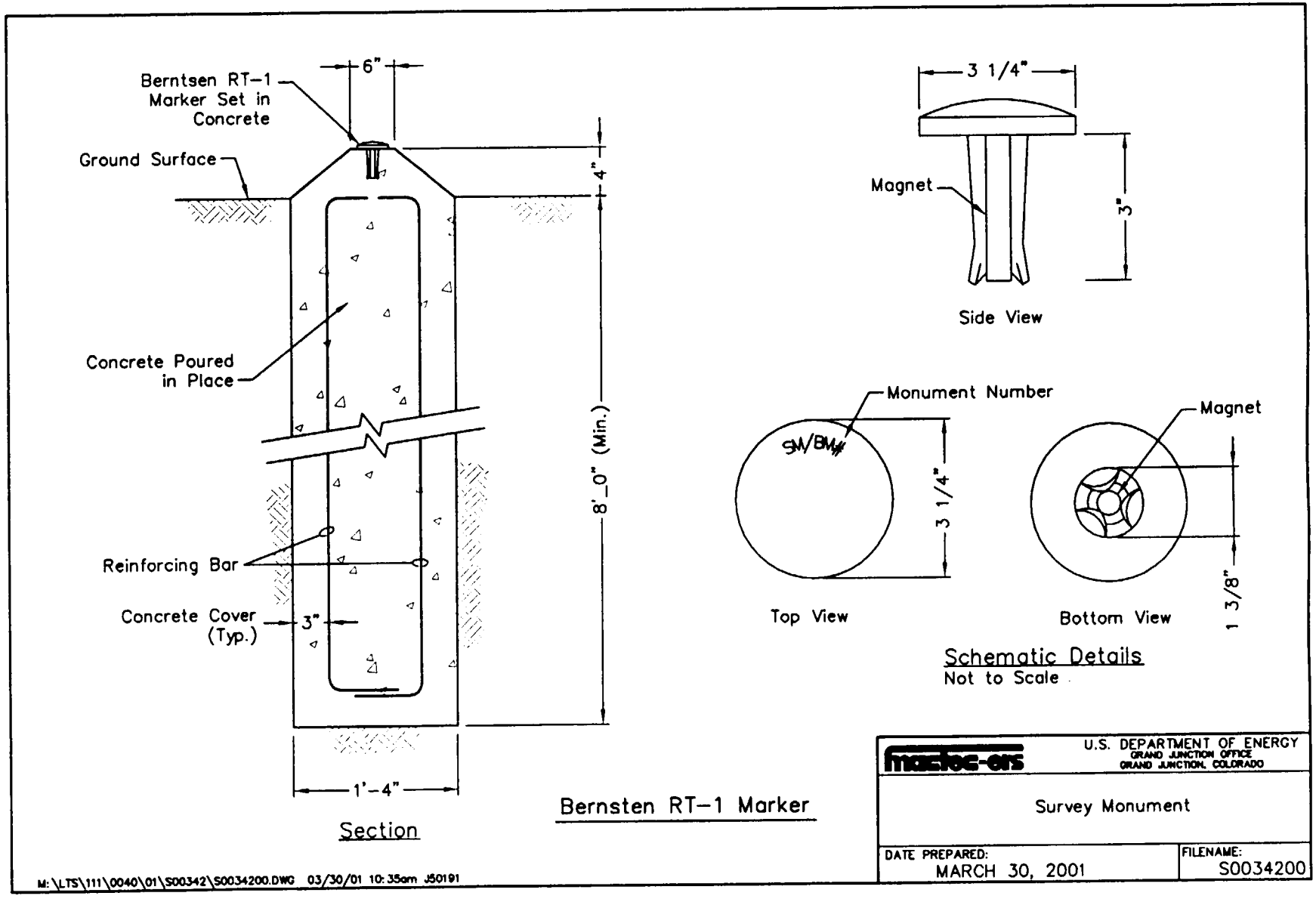

Figure A2.1 Example Disposal Site Survey Monument

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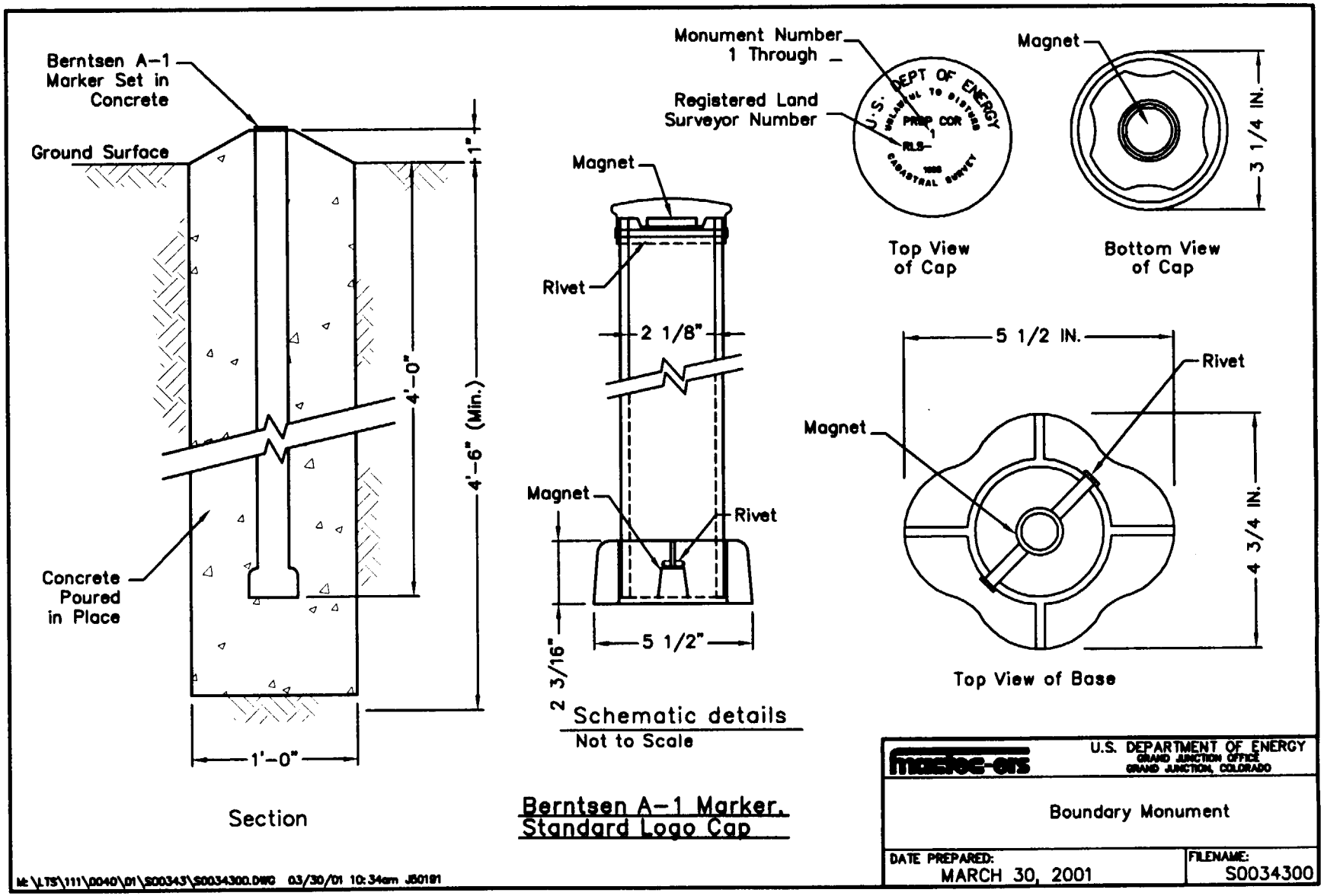

Figure A2.2 Example Disposal Site Boundary Monument

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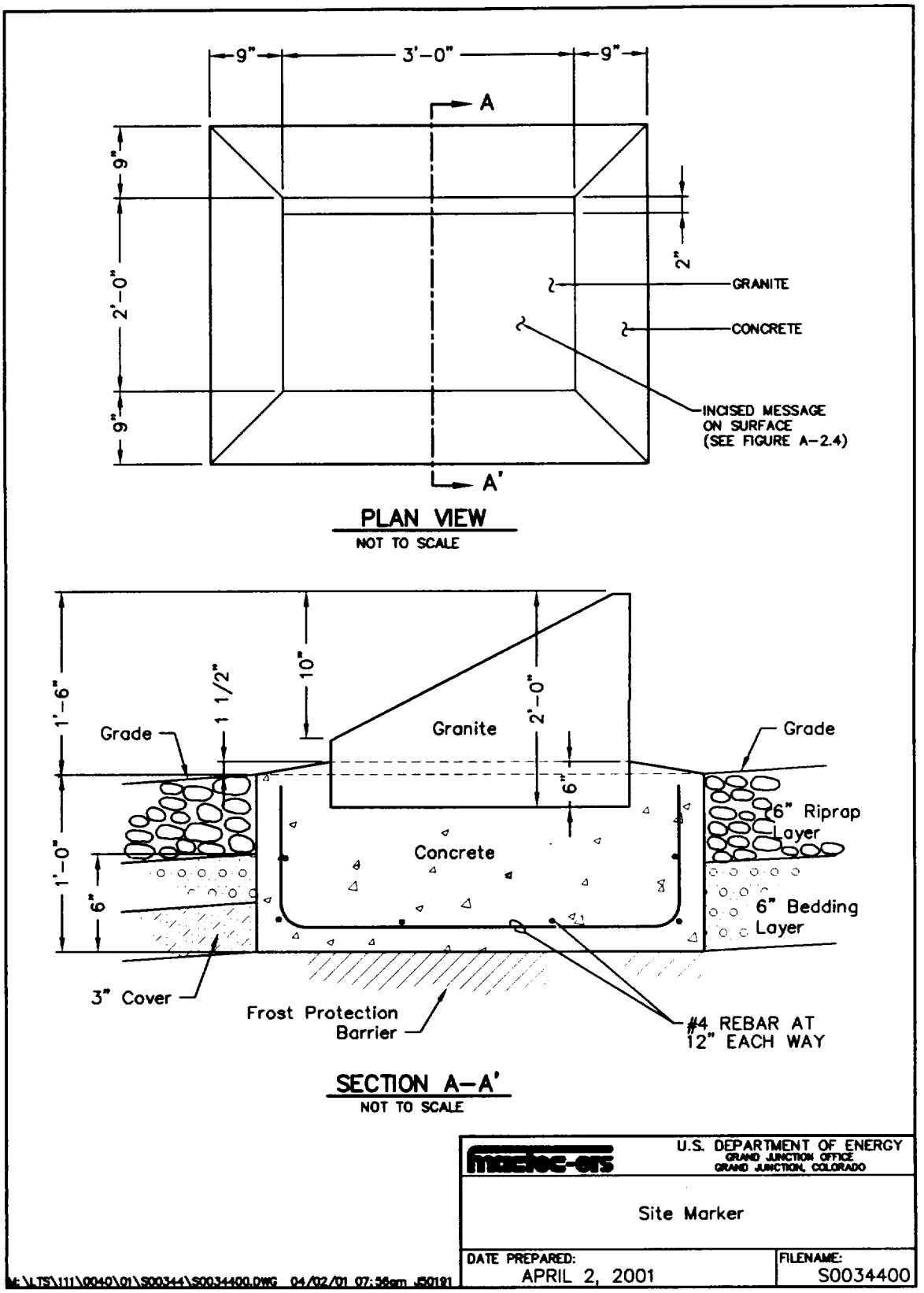

Figure A2.3 Example Disposal Site Marker

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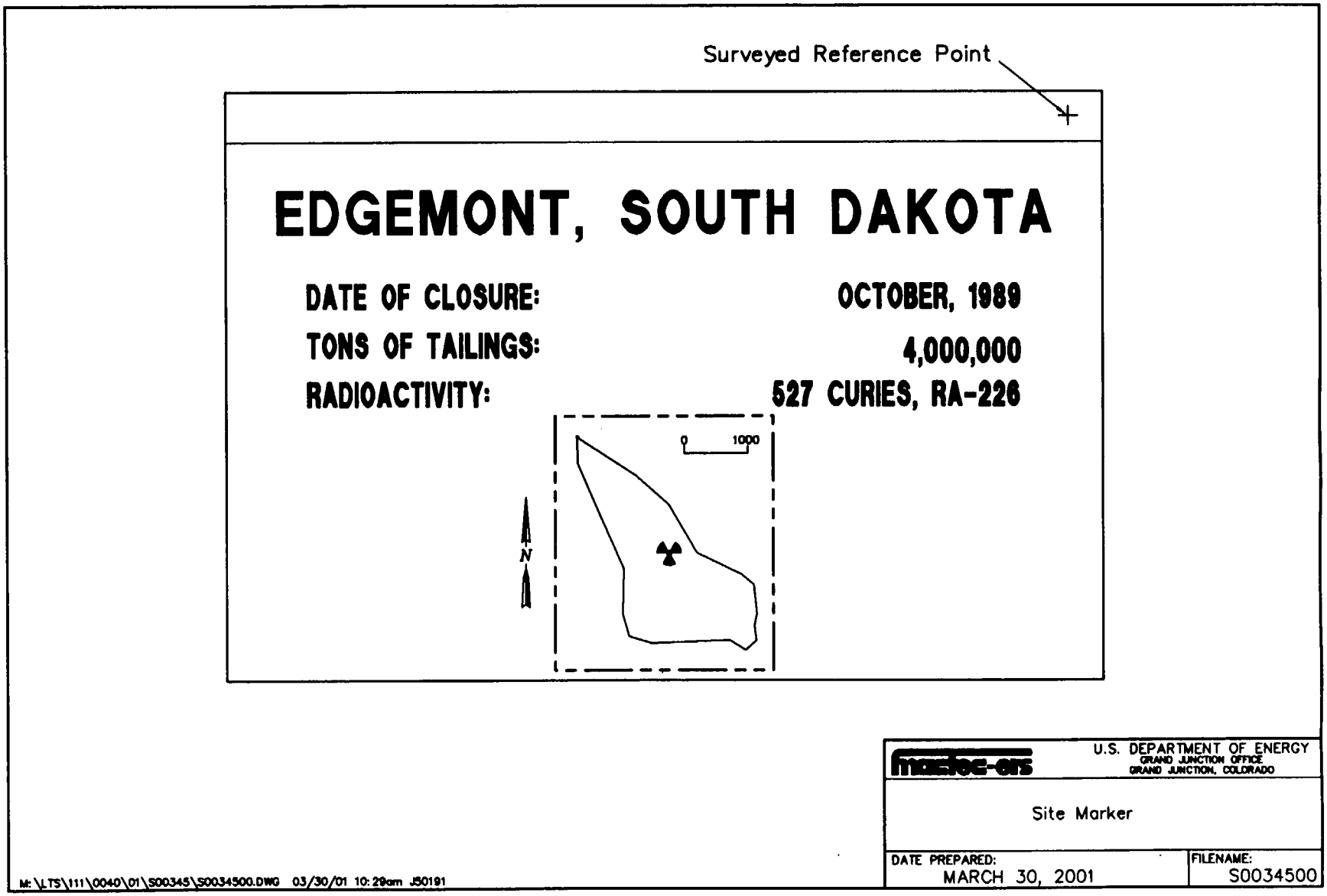

Figure A2.4 Example Disposal Site Marker Message

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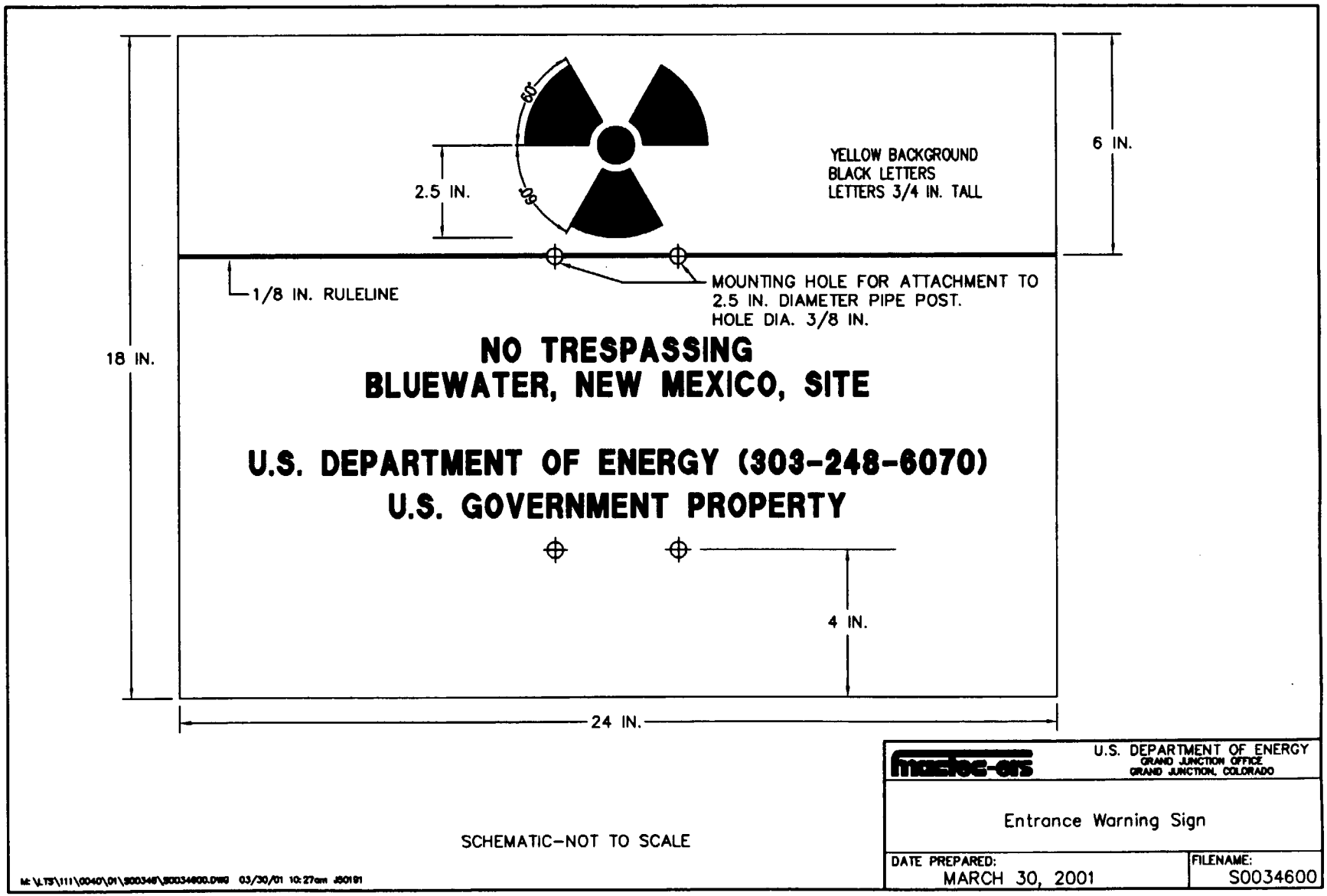

Figure A2.5 Example Disposal Site Warning Sign

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Attachment 3

Sample Inspection Checklist

SITE STATUS REPORT (CHECKLIST) AND JOB SAFETY ANALYSIS

RIFLE

Status of Site Inspections

Last Update of This Status Report:	August 3, 1998
Last Annual Inspection:	August 13-14, 1998
Inspectors	M. Plessinger (Chief) and J. Waugh
Next Annual Inspection:	Week of August 3, 1998
Last Follow-Up Inspection	May 14, 1998 to investigate cattle inside the fence

Issues and Issue Resolution

The 1997 inspection was the V&O inspection. Review the 1997 inspection report for baseline information.

1. Fencing

   ERD-UMTRA relied on topography and inadequate fencing to keep cattle from adjoining grazing lease off the site. Rancher reported in May that he was unable to keep his cattle out. GJO paid for materials and the rancher, as subcontractor, installed a new section of fence from about P11 due north into the edge of the riprap.

   Resolution: Evaluate adequacy of fencing to keep cattle off revegetated areas of the site. There may be a problem along the southwest edge of the site where the fence ends at a gully.

2. Survey Monuments

   Three survey monuments were not found during the V&O inspection.

   Resolution: Survey monuments are not as important as boundary monuments. Nevertheless, attempt to locate the missing survey monuments at approximate locations shown on Plate 1.

3. Boundary monuments

Corners:	20
Boundary monuments:	15, according to the LTSP
Found in 1997:	13 monuments

Boundary monuments, BM-3 and BM-18 were not found during the V&O inspection.

Resolution: Attempt to locate the two missing boundary monuments at approximate locations shown on Plate 1.

4. Erosion

Erosion at the base of the toe drain outlet is anticipated in the design. The outlet should self-armor as erosion removes finer materials down to the base of the large riprap.

Resolution: Evaluate.

5. Reseeded Areas

Graded and disturbed areas south of the disposal cell were reseeded.

In 1997, revegetated areas south of the disposal cell were in excellent condition. Areas surrounding the disposal cell, SMK-1, and the area south of the site boundary, where materials were stockpiled, were not reseeded until the spring of 1997, and plants were too immature to evaluate.

Resolution: Reinspect.

6. South Drainage Gully

In 1997, Inspectors recommended that a riprap-armored drainage gully south of the site should be added to Plate 1 in the LTSP. Needless to say, this did not happen.

Resolution: Re-evaluate. If the need still exists, include a sketch of the gully in relation to the site in the trip report.

7. Noxious Weeds

Spotted knapweed (noxious) and musk thistle (undesirable) may be present.

Resolution: Report if present. Consider collecting specimens in large zip-lock bags for positive identification.

8. Emergency Services

We don't have information on these services for the Rifle area.

Resolution: Inspectors should please obtain telephone numbers for the JSA when in the Rifle area.

Specific Site Surveillance Features: RIFLE

Identifier	Feature		Comment
—	Entrance Gate		
—	Entrance Sign	1	
P1, P2, etc.	Perimeter Signs	26	
SMK	Site Markers	2	
SM	Survey Monuments	3	Not found in 1997
BM	Boundary Monuments	15(?)	BM-3 and BM-18 not found in 1997
—	BLM witness corner		Not a specific site surveillance feature
???	Standpipes	3	Labeled as MW's on 1997 inspection drawing, symbol: o. Add symbol to legend.
MW	Monitor Wells	9	All to be abandoned. Inspect as time permits. Report new wells if encountered
—	Settlement Plates	?	Not a specific site surveillance feature

LTSM Job Safety Analysis

Site Rifle, Colorado		**JSA Number** RFL-98-1	
Task Annual Prelicensing Site Inspection			
Prepared by C. A. Jones	**Date** 08/03/98	**Reviewed by**	**Date**

Site Hazards
-Large area of rough, irregular riprap
-Rapid changes in weather conditions. Electrical storms. Precipitation possible. Consult forecast.
-Wood (and Lyme?) ticks, other bugs possible

Protective Clothing Required/Suggested
-Sturdy boots with ankle support are recommended
-Personnel clothing appropriate to changeable spring weather

Protective Equipment Required/Suggested
-Drinking water
-Personal items such as sunscreen, sunglasses, insect repellant
-First-aid kit

Medical & Emergency Service Information	
Police	911
Ambulance	911
Sheriff	911
Fire	911
Clagett Memorial Hospital 710 East 5th Rifle	911 or 970-625-1510

End of current text

Attachment 4

Disposal Site and Disposal Cell Inspection Techniques

Disposal Site and Disposal Cell Inspection Techniques

An effective way to initiate inspection of the disposal site area and disposal cell is with a series of well-planned traverses around the perimeter of the disposal site, and along the base, sideslopes, and crest of the disposal cell and diversion channels. The number of traverses along the sideslopes is determined by the height of the disposal cell. Sideslope traverses generally should be spaced at 50-yard (46-meter [m]) intervals. Traverses across the disposal cell crest should be diagonal to its long axis. At a minimum, the site perimeter and site area traverses should be selected to observe damage or disturbance to the following features:

- Site perimeter roads.
- Fences, gates, and locks.
- Permanent site-surveillance features.
- Ground water monitor wells and other monitoring points.
- Other instrumentation or surveillance features.
- Site area vegetation or volunteer plant growth.
- Sedimentation or erosion.
- Lateral stream cutting or channel migration.

Traverses along the engineered component (diversion ditches, cell sideslopes, cell crest, and cover) should be walked along their complete length and examined for evidence of the following:

- Structural instability caused by differential settlement, subsidence, cracking, sliding, or creep.
- Erosion evidenced by the development of rills or gullies.
- Sedimentation or debris.
- Rapid deterioration of rock caused by weathering or erosion.
- Removal of rock or other disposal cell material.
- Seepage.
- Intrusion (inadvertent or deliberate) by humans or animals (burrowing).
- Vandalism.

- Development of trails from human or animal activity.

- Volunteer plant growth, especially on the disposal cell or in the diversion channels.

- Erosion of vegetation if the site area or disposal cell cover is vegetated.

Modifications due to natural processes are most likely to occur on the lower portion of the sideslopes of the disposal cell. These modifications include gullying and headward erosion, cracking, landslides, creep, piping, sheet erosion, sedimentation or deflation, animal and plant intrusion, and extreme natural events (e.g., tornadoes or earthquakes). The site inspectors should know how to recognize, quantify, and record these processes for future evaluation. If any modifying features are observed during the inspection, the following data should be recorded briefly on the inspection checklist and fully discussed in the inspection report:

- Extent of area affected, stability, and nature of movement (e.g., planar or rotational).

- Number of features, spacing, length, depth, and width.

- Related erosional features.

- Patterns of occurrence.

- Species present (if plants or animals are found on the site).

- Location and density of volunteer plant growth.

Inadvertent or casual intrusion by humans or animals is not of great concern, but evidence of removal of the cover, extensive vandalism to signs and monuments, or the presence of well-established trails should be described in detail. Continuing vandalism may require more active measures to control access to the site.

If new conditions requiring continuing observation, monitoring, or immediate action are discovered during the inspection, a description of the problem and recommended follow-up actions, if required, should be included in the inspection report.

Some disposal cells have vegetated rather than rock covers. A plant specialist should participate in the inspection if circumstances warrant. If timing of the inspection conflicts with the overall schedule for other site inspections, a plant specialist or other qualified person may conduct a separate inspection at a more optimum time of year. The condition of expected plant growth could affect the timing of the aerial photography. The areas around the disposal cells are recontoured and seeded at the end of remedial action. The LTSP discusses the seed mix needed to revegetate the recontoured area.

At disposal cells with rock covers, volunteer plant growth may be observed during the inspection. If an unknown plant species is encountered by a qualified inspection team member, biologists from the Soil Conservation Service or Bureau of Land Management or botanists from a local college or university could be contacted. Also, samples of the plant species in question may be collected and taken into the office for identification.

The inspection team's determination of plant density on the disposal cell likely will be subjective. The inspection team should determine if there are areas of moderate-to-dense vegetation growth on the disposal cell. At the Shiprock disposal cell, coverage of 10 to 25 plants per 100 square feet (ft^2) (9 square meter [m^2]) is considered moderate and coverage of more than 25 plants per 100 ft^2 (9 m^2) is considered densely vegetated (DOE, 1992). If moderately to densely vegetated areas are noted, further study may be warranted.

The need for further study also is dictated by site conditions. For example, if there is a 7 ft (2 m) frost protection layer above the infiltration/radon barrier and the plant species growing on the disposal cell likely would not grow that deep, further investigation may not be warranted. However, if there is 1 to 3 ft (0.3 to 1 m) of cover above the infiltration/radon barrier layer, further study may be required. Further study could include a more detailed analysis of the rooting patterns of the species in question based on an analysis of existing information.

The concept of using the ratio of rooting depth to shoot height to determine the rooting depth of species observed in the field is discussed in the disposal cell cover biointrusion sensitivity assessment (DOE, 1995). This report provides the rooting depth to shoot height for some common species observed on the disposal cells. This ratio used with knowledge of the cover characteristics may help field inspectors determine if vegetation control measures are required. This ratio should be used with caution to determine site-specific vegetation control measures because rooting depth for some of the common species growing on the disposal cells may be density-dependent. Vegetation control measures based on the root-to-shoot ratio should be determined by individuals familiar with this concept and its limitations.

Field studies show that plant growth on some rock disposal cells is sparse (e.g., the Green River and Clive, Utah, cells) while plant growth on other rock-covered cells is more extensive (e.g., Shiprock, New Mexico; Burrell, Pennsylvania; and Cheney, Colorado). These studies also show that plant roots have grown into the infiltration/radon barrier layer at some of the disposal cells (DOE, 1992; Burt, 1995). The impacts of plant root growth into this layer have not been determined although studies on the UMTRA Project and elsewhere indicate that such plant root growth could result in an increase in radon emanation from the disposal cell (DOE, 1995; Morris and Fraley, 1989). Other potential impacts from plant biointrusion into the disposal cell include increased water infiltration into the cell, breakdown of the engineered cover system, and transport of other contaminants out of the cell.

Because the rooting patterns of a given plant species may vary with ecological conditions and from species to species, the analysis of plant growth on the cells must be addressed on a site-by-site basis. A species that altered its rooting pattern based on varying conditions is the summer cypress at the Cheney disposal cell. A 4.5-ft (1.4-m) tall summer cypress was excavated from a sparsely vegetated area (plants at least 10 ft [3 m] apart); its rooting depth was 14 inches (36 centimeters [cm]). A 32-inch (81 cm) tall summer cypress excavated in a densely vegetated area had extended roots 25 inches (64 cm) into the cover (the depth of the excavation); small roots continued down into the cover for an additional undetermined depth (Burt, 1995). The rooting depth-to-shoot height ratio of summer cypress was determined to be 1 to 1 although rooting depth can be highly variable (DOE, 1995). The summer cypress from the sparsely vegetated area had a root depth-to-shoot height ratio of 0.3 to 1 while this same ratio in the densely vegetated area was probably about 1 to 1. Although in this example a root-to-shoot ratio

of 1 to 1 would be conservative, data indicate that rooting depth appears to increase with plant density.

References

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Attachment 5

Earthquake Reporting Criteria

List of Acronyms

Acronym	Definition
DOE	U.S. Department of Energy
NEIC	National Earthquake Information Center
UMTRA	Uranium Mill Tailings Remedial Action
USGS	U.S. Geological Survey

Earthquake Reporting Criteria

The U.S. Geological Survey (USGS) National Earthquake Information Center (NEIC) will notify the U.S. Department of Energy (DOE) when an earthquake of a specified magnitude is reported within a specified radius of a Uranium Mill Tailings Remedial Action (UMTRA) Project disposal site.

In determining a specific magnitude of earthquake or a site radial distance significant to a specific site, the following limitations of these parameters should be understood:

- Ground conditions resulting from severe weather (such as recent heavy rains) may cause variations in ground response at the site.
- The accuracy of the distance and attenuation relationships may vary due to local structure and stratigraphy.
- The accuracy of the reported magnitude and epicentral distance depends on the number and proximity of the reporting seismic stations, and quality of the data.
- The significance of regional earthquakes may depend on the orientation of the structure associated with an earthquake relative to the site. An earthquake on a fault that trends near the disposal site has implications for possible focusing of the ground response and migration of future aftershocks closer to the site.

The variability of the potential ground response and the need to review the significance of regional earthquakes relative to known or unknown structures suggest the minimum acceleration of 0.10 gravitational acceleration for long-term and short-term design should be used to define the significant radial distance from the site for a seismic event notification. The distance acceleration relationship of Campbell (1981) is recommended in the technical approach document (DOE, 1989) for the western United States, and the relationship applicable to the central United States is taken from Nuttli and Hermann (1978).

Figure A-5.1 identifies the radius relative to the magnitude of earthquakes that would trigger the NEIC notification process to DOE. These radii and magnitudes are applicable to all disposal sites, regardless of seismic design of specific sites. Table A5.1 provides the design magnitude and peak acceleration for each site used to develop the notification criteria identified in Figure A-5.1.

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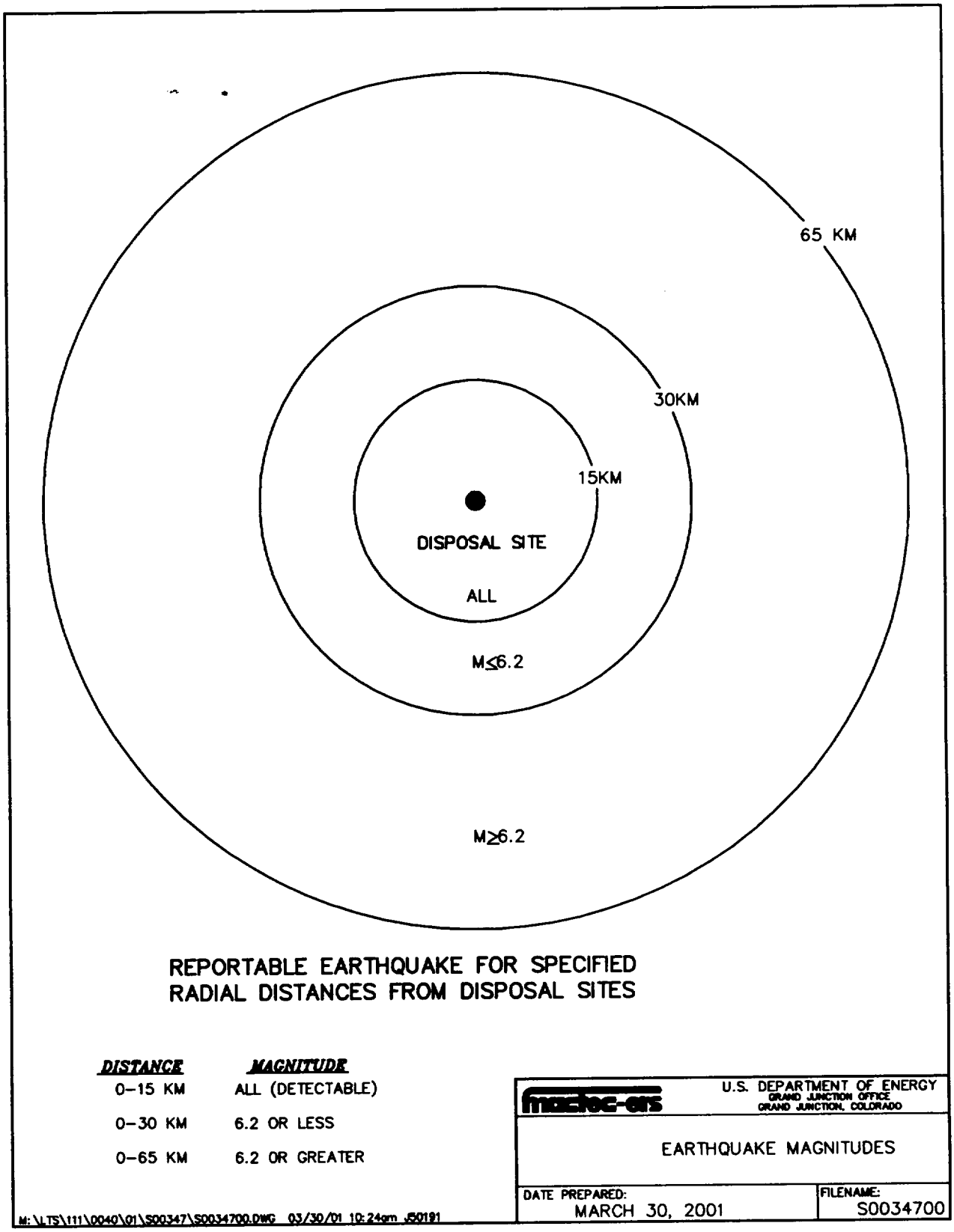

Figure A-5.1. Reportable Earthquake Magnitudes for Specified Radial Distances From an UMTRA Project Disposal Site

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Table A-5.1 Earthquake Data for the UMTRA Project Disposal Sites

Disposal Site	Latitude	Longitude	Design earthquake (M_L)	Peak acceleration(g)
ARIZONA				
Tuba City	N36.15	W111.10	6.2	0.21
COLORADO				
Durango (Bodo Canyon)	N37.15	W107.90	a	0.16
Grand Junction (Cheney)	N38.91	W108.32	6.0	0.34
Gunnison (Landfill)	N38.51	W106.85	6.2	0.21
Maybell	N40.55	W107.99	6.2	0.21
Naturita (Dry Flats)	N38.21	W108.60	7.1	0.25
Rifle (Estes Gulch)	N39.60	W107.82	6.2	0.21
Slick Rock (Burro Canyon)	N38.05	W108.87	6.2	0.21
IDAHO				
Lowman	N44.16	W115.61	7.0	0.34
NEW MEXICO				
Ambrosia Lake	N35.41	W107.80	6.2	0.21
Shiprock	N36.80	W108.65	5.75	0.13
NORTH DAKOTA				
Bowman	N46.23	W103.55	6.0	0.15
OREGON				
Lakeview (Collins Ranch)	N42.2	W120.3	7.5	0.52
PENNSYLVANIA				
Canonsburg	N40.26	W80.25	a	0.10
Burrell VP	N40.62	W79.65		0.10
TEXAS				
Falls City	N28.91	W98.13		0.10
UTAH				
Green River	N39.0	W110.1	6.2	0.21
Mexican Hat	N37.10	W109.85	6.2	0.21
Salt Lake City (Clive)	N40.69	W113.11	7.1	0.31
WYOMING				
Spook	N43.23	W105.63	6.2	0.21

[a]The seismic design for the Canonsburg, Burrell, and Durango disposal sites was based on a probabilistic approach of potential acceleration and did not assign a design magnitude.

Notes:
1. The specific locations of the disposal cells are in parentheses.
2. The Belfield and Monument Valley tailings are codisposed at the Bowman and Mexican Hat sites, respectively.
3. The Riverton tailings were removed to a Title II site in Wyoming.

VP - vicinity property
.g - gravitational acceleration 32.2 feet per second per second.
M_L - local magnitude.

References

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