March 31, 1997 SECY-97-046A

FOR: The Commissioners

FROM: L. Joseph Callan, Executive Director for Operations
/s/

SUBJECT: FINAL RULE ON RADIOLOGICAL CRITERIA FOR LICENSE TERMINATION

PURPOSE:

To obtain Commission approval to publish a final rule in the Federal Register on radiological criteria for license termination.

CATEGORY:

This paper covers issues requiring Commission consideration and decision.

SUMMARY:

The final rule would revise 10 CFR Part 20 to provide specific radiological criteria for the decommissioning of lands and structures. The final rule is intended to provide a clear and consistent regulatory basis for determining the extent to which lands and structures can be considered to be decommissioned. The final rule will result in more efficient and consistent licensing actions related to the numerous and complex site decommissioning activities anticipated in the future.

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BACKGROUND:

On April 23, 1996, the staff sent the Commission a paper (SECY-96-082) describing the current status of the rulemaking on radiological criteria for decommissioning and requested Commission direction on the appropriate schedule for preparation of the final rule. SECY-96-082 outlined the major considerations involved in making that decision, in particular the then imminent release by the Environmental Protection Agency (EPA) of a proposed rule on cleanup of nuclear facilities. This paper presented the following two options for issuing the final rule: (1) issue the NRC final rule before the EPA rule, and (2) issue the NRC final rule concurrently with EPA's final rule.

In a Staff Requirements Memorandum (SRM) dated December 9, 1996 (Enclosure 1), the Commission approved Option 1. In a memorandum from Mary Nichols, Assistant Administrator of EPA, to Sally Katzen of the Office of Management and Budget (OMB), dated December 19, 1996, the EPA indicated that it had decided to withdraw its proposed rule from consideration by OMB and indefinitely delay its issuance. Subsequently, in a letter to Chairman Jackson dated February 7, 1997, EPA Administrator Carol Browner reiterated that EPA still preferred that the unrestricted dose criterion be set at 15 mrem/y and that there be a separate groundwater standard in the final NRC rule. The letter from Administrator Browner further indicated that, if NRC revised its proposed rule to increase the dose criterion or to delete the separate groundwater standard, EPA would consider NRC's rule to be not protective under CERCLA and would be forced to reconsider its current policy
of exempting NRC sites from EPA's National Priorities List (NPL). This would result in potential additional EPA review of sites whose licenses have been terminated by the NRC. Neither of the EPA actions directly affect the conclusions of this paper regarding the requirements for radiological criteria for license termination developed in response to the Commission's SRM.

DISCUSSION:

On August 22, 1994 (59 FR 43228), the NRC published a proposed rule for comment in the Federal Register that would amend 10 CFR Part 20, "Standards for Protection Against Radiation," to include radiological criteria for license termination. The overall approach to license termination contained in the proposed rulemaking included a 15 mrem/y dose criterion for unrestricted use of sites after license termination, evaluation of ALARA levels below the dose criterion, provisions for license termination under restricted conditions, and acknowledgement that certain facilities may seek exemptions from the provisions of the rule. Other major provisions of the proposed rule included provisions for public involvement in the license termination process and requirements for cleanup of groundwater that were separate from the unrestricted dose criterion.

Over 100 organizations and individuals submitted comments on NRC's proposed rule. The nature of the comments was varied. For nearly every provision of the rule, there were viewpoints

expressed both in support and in disagreement. Particular areas of concern were: (1) the 15 mrem/y dose criterion for unrestricted use and the proposed requirement that licensees demonstrate, in addition to meeting the dose criterion, that residual radioactivity levels are ALARA; (2) issues related to restricted use including whether restricted use should be allowed, the requirement that licensees justify selecting restricted use, and the 100 mrem/y cap for restricted use; (3) if exemptions should be noted in the rule or if specific procedures and alternate criteria should be

included for these cases; (4) whether there should be separate groundwater provisions in the proposed rule; and (5) if the proposed requirements for site specific advisory boards (SSAB's) should be retained or if the rule should contain more flexible performance based criteria.

The issues associated with establishing radiological criteria in this final rule involve a number of complex technical and policy questions including those related to public health and environmental impacts, consistency with other standards, cost-effectiveness, and public participation in the decommissioning process. In evaluation of the rulemaking alternatives, the staff considered the public comments and: 1) convened a workshop on facilitating public involvement in the decommissioning process; 2) convened a workshop on issues related to implementing the dose criteria in the rule; 3) conducted field investigations and exercises related to the dose criteria at different types of nuclear facilities including a power reactor, a uranium fuel facility, and a thorium facility; 4) participated in an interagency task force to develop guidance on measurement methods, and continued research on measurement methods; 5) evaluated additional nuclear facility contamination data submitted by the commenters to assess the realism of the draft Generic Environmental Impact Statement (GEIS) assumptions and parameters; 6) performed analyses of groundwater contamination and associated potential doses to test reasonableness of proposed rule requirements; and 7) continued to work with EPA in development of data and in resolution of issues.

Based on the above efforts, the staff has reconsidered the bases of the proposed rule and has concluded that the overall license termination approach of this final rule should include: (1) an unrestricted use dose criterion, which has been modified to be 25 mrem/y, that would be applicable on a generic basis without site specific analysis; (2) continued provisions for ALARA below the dose criterion; (3) continued allowance of restricted use if certain provisions are met; and (4) modification of the rule to codify alternate site specific criteria in the rule to alleviate the need for exemptions in special circumstances. The staff has also modified the rule based on its conclusion that the separate groundwater requirement should be deleted, although ALARA would still be evaluated when considering groundwater sources of drinking water. In addition, the public participation requirements remain largely the same, although they have been modified to allow more flexibility in their use. The detailed rationale used in arriving at these conclusions is discussed in Enclosure 2 and the discussions there can be summarized as follows:

1) The dose criterion for release of a facility for unrestricted use has been modified in § 20.1402 of the rule to be 25 mrem/y Total Effective Dose Equivalent (TEDE) to the average member of the critical group. The proposed requirement that facilities demonstrate that they have also reduced the dose to ALARA levels below the dose criterion has been retained. The value of the dose criterion in the proposed rule was 15 mrem/y TEDE which, as noted in the preamble to the proposed rule (at 59 FR 43219), was selected to provide a substantial margin of safety below the public dose limit of 100 mrem/y in 10 CFR Part 20. This substantial margin was included to allow for the potential for exposure

to multiple sources and was stated there as being appropriate for decommissioned facilities. A large number of comments were provided on this question. A few of the commenters (including EPA) favored the 15 mrem/y, but most favored either reducing the criterion to a lower value, including return to a preexisting background, or increasing the dose criterion to suggested larger values such as 25, 30, or 100 mrem/y.

In its review of public comments, the staff reevaluated the principal basis for the 15 mrem/y criterion in the proposed rule based on its review of potential exposure scenarios; on health physics protection principles and recommendations contained in ICRP No. 60, NCRP No. 116, and the Draft Federal Radiation Protection Guidance (FRG); and recommendations from the Advisory Committee on Nuclear Waste (ACNW). Based on this reevaluation, the staff concludes that 25 mrem/y is a more appropriate criterion because it provides a sufficient and ample margin of safety in protection of public health and safety considering the low probability that a person may be exposed to more than a few potential sources over a lifetime.

With regard to ALARA, the analysis of the final GEIS finds a wide variation in cost-effectiveness of remediation to alternate dose levels among the various facilities covered by this rule. Therefore the site-specific ALARA requirement of the proposed rule has been retained, although the lessons of the Final GEIS will be used in regulatory guidance regarding how those ALARA analyses should be done.

The 25 mrem/y dose criterion is larger than the value of 15 mrem/y preferred by the EPA in their comments on the proposed rule. However, the staff, based on the reconsideration summarized above and discussed in detail in Enclosure 3, believes that the 25 mrem/y level is more appropriate. The staff also believes that the combination of the dose criterion with the ALARA requirement, as well as the nature of concrete and soil removal processes which generally remove large fractions of remaining radioactivity, will result in the actual dose from residual radioactivity at the sites being less than 15 mrem/y for the large majority of NRC-licensed sites.

The discussion in the preamble to the final rule (Enclosure 2) notes that the dose criterion has been established based on Commission judgment regarding the appropriate fraction of the public dose limits of 10 CFR Part 20 and that further ALARA requirements have been set based on cost considerations. It should be further noted that the dose criterion of 25 mrem/y is established as a sufficient and ample, but not necessary, margin below the 100 mrem/y public dose limits given the uncertainties involved in potential multiple sources. This provides additional flexibility in the rule for the staff to deal with special circumstances rather than having to rely on an exemption process. This is discussed further in item No. 3, below.

The staff notes that the radiological criteria for decommissioning proposed in this paper

address the potential for exposures to sources of man-made radiation other than those associated with the decommissioned site, whereas the public dose limits of 10 CFR Part 20 only apply to exposure to radioactive material released by or controlled by the licensee. Because the two sets of circumstances are quite different the staff does not believe that any immediate reconsideration of 10 CFR Part 20 is warranted. However, when the Draft FRG being developed by EPA in concert with other cognizant agencies is published in final form, the staff will consider the implications of the guidance for all the Commission's regulations.

2) Restricted use has been retained as an option in the final rule (§ 20.1403). The final rule continues to note that unrestricted use is preferable because it results in sites that generally have lower levels of contamination than at restricted sites. However, based on the analyses in the Final GEIS and on staff experience with actual sites, restricted use, when properly designed in accordance with the rule's provisions, can provide a more cost-effective alternative than unrestricted use for some facilities. Thus, the level of justification has been modified from a showing that remediation to unrestricted levels is prohibitively expensive to an ALARA consideration. No change has been made to the financial assurance provisions presented in the proposed rule.

   With regard to the "cap" if institutional controls fail, the value of the cap has been retained at 100 mrem/y consistent with the rationale of the proposed rule that it be set at the level of the public dose limit of 10 CFR Part 20. However, the rule has been modified to be more flexible in addressing a wide variety of circumstances while still assuring protection of public health. This modification will allow sites with unusual circumstances to be treated under the general provisions of the rule, rather than as exemptions as the proposed rulemaking had envisioned, by allowing for exceedence of the 100 mrem/y cap up to a value of 500 mrem/y in site specific situations and under specific provisions. It is anticipated that such situations will have an extremely low probability of occurrence. The specific provisions include a recheck of the institutional controls every 5 years to ensure that the controls are in place so that, if the controls fail, no one would receive the 500-mrem exposure for more than 5 years. The use of this supplementary 500 mrem/y cap in special circumstances with the rechecks is consistent with 10 CFR Part 20 and the draft FRG.

3) The final rule has also included a provision in § 20.1404 codifying alternate site specific criteria to alleviate the need for exemptions. This provides additional flexibility for dealing with special
site-specific circumstances.

   The preamble to the proposed rule recognized that there would likely be facilities which would seek exemptions from the proposed rule. As discussed in Enclosure 2, because it is preferable to deal with those facilities under the aegis of a rule rather than as

exemptions and

because the 25 mrem/y dose criterion is established as providing a sufficient and ample, rather than necessary, margin below the public dose limit, the staff has included a provision for alternate criteria in the final rule. In allowing such a provision, it is nonetheless the staff's judgement that: (1) it is in general preferable for sites to reduce doses to 25 mrem/y due to the uncertainty over the number of sources where nuclides may be present for a long time-frame; (2) the large majority of sites can reduce doses to less than 25 mrem/y through restricting site use; and (3) permitting large numbers of licensees to propose alternate criteria is not advisable because it would be contrary to one of the goals of this rulemaking which is to achieve more efficient and consistent licensing actions. Therefore, the staff has limited the conditions under which a licensee could apply to the Commission for alternate criteria to special circumstances. A licensee proposing to terminate a license at a site-specific level above 25 mrem/y would be required to: (1) provide assurance by means of a comprehensive analysis of possible sources of exposure that it is unlikely the total dose from all sources would exceed 100 mrem/y; (2) employ, to the extent practical, restrictions on site use for minimizing exposures at the site using the provisions of restricted use in § 20.1403 of the rule; and (3) reduce doses to ALARA levels. If a licensee could still not decommission its site even with the provisions of alternate criteria, continued licensing of the site may be necessary.

4) The final rule has deleted the requirement that a separate groundwater requirement be met. The proposed rule indicated that, in addition to meeting the 15 mrem/y TEDE dose criterion, any contamination in groundwater must be reduced to levels less than the values in 40 CFR 141. A number of commenters disagreed with the inclusion of a separate groundwater requirement, stating that it was unnecessary in the presence of an all-pathway standard and that it was not cost-effective. Other commenters, including the EPA, favored the inclusion of a separate groundwater standard as being consistent with the EPA standard.

The rationale for dropping this provision in the final rule is that such a requirement is unnecessary and inappropriate for protection of public health and safety with the promulgation of the all-pathways standard in this rule; i.e., there is no reason from the standpoint of protection of public health and safety to have a separate, lower criterion for a single pathway as long as, when combined, the contributions from all pathways do not exceed the total dose standard established in the rule. Although the separate requirement has been deleted, the rule does acknowledge the importance of this pathway as part of the 25 mrem/y dose criterion in § 20.1402, and, in addition, the ALARA requirements of § 20.1402 would apply to all pathways, including those involving cleanup of drinking water. This is consistent with the Final GEIS analysis which indicates that there can be cases where a site specific analysis would identify the need to consider reducing the dose below the unrestricted use dose criterion (e.g., a population deriving its drinking water from a supply using a downstream plume). It is also consistent with the position taken in

the letter from Chairman Jackson to Sally Katzen of OMB, dated November 15, 1996, and referred to in the SRM. In a letter from Larry Weinstock of EPA to Bill Morris, NRC, the EPA questioned some of the assumptions used by the NRC as part of its analyses in the Final GEIS. Responses to those questions are contained as part of Enclosure 3.

5) The final rule has retained the requirement in § 20.1403 to seek advice from affected parties and to document how this advice was sought, specifically when a licensee proposes restricted use, but has modified this requirement to make it more flexible. The final rule still requires the licensee to seek advice from the public but has deleted the specific requirement for an SSAB. The public comments in this area varied with some supporting the proposed rule. Other commenters stated that the proposed notice requirements are more than what is required by the Administrative Procedures Act (APA) and that no health and safety need exists.

   The reasons for the requirement to seek such advice is that it is reasonable, particularly when a licensee is proposing a restricted use, to obtain advice from those in the community who will be affected by the restrictions placed on land use and will have knowledge of whether the proposed institutional controls perform the intended function of keeping the dose below the criteria of the rule. Broad performance criteria, rather than a requirement of an SSAB, appear appropriate for obtaining this advice because it allows a licensee to seek and obtain advice from the local community in a manner most appropriate for the specific site. It is expected that this requirement will, in many cases, result in convening such a board (and, in fact, such boards or similar bodies have already been convened at various sites). Regulatory guidance to be prepared in support of the rule will include a discussion on the use of such boards as one way to meet this requirement.

The final rule also addresses a number of other major issues raised in the public comments. Specifically, the final rule retains the following provisions of the proposed rule: (1) the criteria would not apply to sites already covered by Commission approved decommissioning plans, and rereview of sites decommissioned in accordance with the rule criteria would be limited to situations where there could be significant public risk (§ 20.1401); (2) financial assurance for maintenance of institutional controls in § 20.1403; (3) general public participation and notification requirements in § 20.1405; and (4) requirements for minimization of contamination in § 20.1406.

In its evaluation of institutional controls in the SRM, the Commission specifically requested that the staff determine ways to mitigate potential long-term cost increases. In response, it is anticipated that the financial assurance requirements contained in the rule are appropriate for requiring licensees to obtain appropriate financial instruments so that inflation will not erode the

ability to maintain the controls. The staff believes investment

vehicles are available which licensees can use so future revenue requirements would be reasonably protected against inflation. For example, The U.S. Treasury will be issuing inflation-adjusted Treasury Bonds for the first time beginning January 17, 1997. The index used to measure inflation will be the Consumer Price Index for All Urban Users (CPI-U). In addition, the staff believes that investment houses already offer inflation adjusted annuities that could provide the necessary assurance. Finally, monies placed in short-term interest accounts such as money market funds should effectively provide inflation protection.

The Commission also requested in the SRM that the staff determine the effect that institutional controls might have on other NRC regulations and policies and the role that DOE may have in providing long-term oversight of these sites. The staff response to these issues is contained in Enclosure 4.

In approving Option 1 from SECY-96-082, the Commission's SRM directed the staff to issue the final rule as expeditiously as possible and delay the issuance of related guidance documents, should that be necessary, with submittal of such guidance documents to the Commission within 1 year of submitting the final rule to the Commission. As discussed in Enclosure 2, the staff is in the process of preparing regulatory guidance and will provide the appropriate documents to the Commission as requested. In keeping with this approach, the FRN notes that the final rule will become effective 30 days after publication in the Federal Register but that the implementation date will be 1 year after the effective date of the final rule.

With regard to the issue of State compatibility, the draft Federal Register notice indicates that this rule would be a Division 2 rule matter of compatibility under the existing compatibility policy. A meeting was held with Agreement State representatives on December 17, 1996, to discuss the major issues in the rule. They were in agreement with the approach that NRC staff was proposing for the final rule.

The notice of final rulemaking for the Federal Register has been prepared in compliance with the Commission's metrification policy of June 19, 1996 (61 FR 31169) by referring to SI units first and special units in parentheses. However, the rule text retains the current convention in 10 CFR Part 20 of placing special units first. Currently, all records required to be kept by Part 20 must be in the special units. As noted in the preamble to the promulgation of Part 20, it is anticipated that there may be amendments to Part 20 at some later time requiring the use of SI units.

RESOURCES:

Resources to complete and implement this rulemaking are included in the current budget.

COORDINATION:

This paper has been coordinated with the Office of the General Counsel which has no legal

objection. This paper has been coordinated with the Office of

the Chief Financial Officer which has no resource objection. The Office of the Chief Information Officer has reviewed the final rule for information technology and information management implications and concurs in the rulemaking.

RECOMMENDATIONS:

That the Commission:

1. Approve the Notice of Final Rulemaking for publication (Enclosure 2).

2. Certify that this rule, if promulgated will not have a negative economic impact on a substantial number of small entities in order to satisfy the requirements of the Regulatory Flexibility Act, 5. U.S.C. 605(b).

3. Note:

   a. The final rule (Enclosure 2) will be published in the Federal Register and posted on the electronic bulletin board for this rulemaking;

   b. A final generic environmental impact statement has been prepared (Enclosure 5) and will be available as a NUREG publication, as a posting on the electronic bulletin board for this rulemaking, and in the Public Document Room;

   c. A regulatory analysis has been prepared and will be posted on the electronic bulletin board and will be available in the Public Document Room (Enclosure 6);

   d. A public announcement will be issued (Enclosure 7);

   e. The appropriate Congressional committees will be informed (Enclosure 8);

   f. Copies of the Federal Register notice of final rulemaking will be distributed to all licensees as well as commenters on the proposed rule. The notice will be sent to other interested parties upon request;

   g. The staff plans to provide a copy of this document to selected State representatives under the provisions that this document will be treated as pre-decisional information. All Agreement States will be sent a copy of the final rule upon approval for publication;

   h. The Chief Counsel for Advocacy of the Small Business Administration will be informed of the certification regarding economic impact on small entities and the reasons for it as required by the Regulatory Flexibility Act (Enclosure 9);

i. In accordance with the Regulatory Flexibility Act, a regulatory flexibility analysis has been prepared. The analysis is not a separate document but is part of the Federal Register notice. The analysis indicates that the economic impact on licensees and small entities will not be significant. The analysis will be made available in the Public Document Room. A copy will be sent to the Chief Counsel for Advocacy of the Small Business Administration;

j. The final rule contains information collection requirements that are subject to review by OMB. Upon approval, request for review and clearance will be sent to OMB.

L. Joseph Callan
Executive Director
for Operations

Enclosures: As stated (9)

ENCLOSURE 1

December 9, 1996

MEMORANDUM TO: James M. Taylor
Executive Director for Operations

FROM: John C. Hoyle, Secretary /S/

SUBJECT: STAFF REQUIREMENTS - SECY-96-082 - EPA PROPOSED RULE AND SCHEDULING ISSUES RELATED TO PREPARATION OF A FINAL RULE ON RADIOLOGICAL CRITERIA FOR LICENSE TERMINATION

The Commission has approved Option 1 as outlined in SECY-96-082 and subject to the points in the Commission's November 15, 1996 letter to Ms. Sally Katzen of OMB. The staff should issue the final rule as expeditiously as possible and, if needed, delay the issuance of related guidance documents, should that be necessary. Staff should submit guidance documents to the Commission within one year of submitting the final rule to the Commission.
(EDO) (SECY Suspense: 2/28/97)

Based on a review of the public comments on the proposed rule, it is the Commission's preliminary view that the proposed cleanup standard of a 15 mrem per year dose limit to an individual warrants reconsideration since there may be no clear technical or public health basis for the limit. The staff should evaluate dose rates greater than 15 mrem/yr and determine a dose standard that can be justified on a health and safety basis and supported by a cost/benefit analysis. The cost-benefit analysis should be based on the same methodology

(i.e. a discounted cash-flow analysis using $2,000/person-rem for relating acceptable expenditure to averted dose) that is used in the regulatory analysis for other NRC regulations. The staff should address whether, and/or how the ALARA concept should be applied to the cleanup standard that is recommended.

Also based on a review of the public comments, the Commission:

(1) approves the staff's proposal to remove the separate groundwater standard from the final rule;

(2) requests the staff to consider and advise on the use of 100 mrem/yr to an individual as a dose limit (or cap) in the event that institutional controls fail at a decommissioned site when the final rule is submitted for Commission approval; and,

(3) generally supports greater reliance on institutional controls on a case-by-case basis but the staff should provide further analysis and evaluation of the possible implications. The staff should determine 1) ways to mitigate potential long-term cost increases, 2) the effect that institutional controls might have on other NRC regulations and policies, and 3) the role DOE may have in providing long-term oversight of these sites. If the staff recommends that institutional controls are appropriate, they should be included in the proposed final rule when it is submitted to the Commission for approval.

The Commission will consider the staff's evaluation of the public comments and the staff's recommendations on these and other issues before making a final decision on this rule.

cc: Chairman Jackson
Commissioner Rogers
Commissioner Dicus
Commissioner Diaz
Commissioner McGaffigan
OGC
OCA
OIG

ENCLOSURE 2

[7590-01-P]

NUCLEAR REGULATORY COMMISSION

10 CFR Parts 20, 30, 40, 50, 51, 70 and 72

RIN 3150-AD65

Radiological Criteria for License Termination

AGENCY: Nuclear Regulatory Commission.

ACTION: Final rule.

SUMMARY: The Nuclear Regulatory Commission (NRC) is amending its regulations regarding decommissioning of licensed facilities to provide specific radiological criteria for the decommissioning of lands and structures. The final rule is intended to provide a clear and consistent regulatory basis for determining the extent to which lands and structures can be considered to be decommissioned. The final rule will result in more efficient and consistent licensing actions related to the numerous and complex site decommissioning activities anticipated in the future.

EFFECTIVE DATE: This regulation becomes effective on [30 days after publication in the Federal Register]. However, licensees may defer rule implementation until [12 months after effective date of final rule].

FOR FURTHER INFORMATION CONTACT: Cheryl A. Trottier, Office of Nuclear Regulatory Research, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, telephone: (301) 415-6232, e-mail CAT1@nrc.gov; Frank Cardile, Office of Nuclear Regulatory Research, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, telephone: (301) 415-6185; e-mail FPC@nrc.gov; Dr. Carl Feldman, Office of Nuclear Regulatory Research, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, telephone: (301) 415-6194, e-mail CXF@nrc.gov; or Christine M. Daily, Office of Nuclear Regulatory Research, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, telephone: (301) 415-6026, e-mail CXD@nrc.gov.

SUPPLEMENTARY INFORMATION:

2. Criteria for unrestricted use, including total effective dose equivalent, as low as reasonably achievable, and decommissioning objective

3. General comments on the dose criterion

4. Average member of the critical group

B. Criteria for restricted use (proposed rule §§ 20.1402(d) and 20.1405)

1. Proposed rule content

2. Comments on acceptability of restricted use for decommissioned sites

3. Response

4. Summary of rule revisions on restricted use

C. Alternate criteria for license termination

1. Codifying provisions for certain facilities that the proposed rule suggested exempting

2. Exclusion of uranium/thorium mills proposed in § 20.1401(a)

3. Other exemptions

D. Groundwater protection criteria (proposed rule § 20.1403)

1. Proposed rule content

2. Use of Environmental Protection Agency drinking water standards in NRC rule

E. Public participation (proposed rule §§ 20.1406 and 20.1407)

1. Proposed rule content

2. Public participation and notifications

3. General requirements for site-specific advisory boards

4. Specific questions on functioning of site-specific advisory boards

F. Other procedural and technical issues

1. State and NRC compatibility

2. Grandfathering sites with previously approved plans (proposed rule § 20.1401(b))

3. Finality of decommissioning and future site reopening (proposed rule § 20.1401(c))

4. Minimization of contamination (proposed rule §§ 20.1401(d) and 20.1408)

5. Provisions for readily removable residual radioactivity

6. Separate standard for radon

7. Calculation of total effective dose equivalent over 1000 years to demonstrate compliance with dose standard

G. Other comments

1. Definitions (proposed rule § 20.1003)

2. Need for regulatory guidance

3. Need for flexibility

4. Consistency with NRC's timeliness rule

5. Comments from power reactor decommissioning rulemaking

I. Introduction

The Nuclear Regulatory Commission is amending its regulations regarding decommissioning of licensed facilities to provide specific radiological criteria for the decommissioning of lands and structures. This action is necessary to ensure that

decommissioning will be carried out without undue impact on public health and safety and the environment.

These criteria apply to the decommissioning of licensed facilities and facilities subject to the NRC's jurisdiction. The Commission will apply these criteria in determining the adequacy of remediation of residual radioactivity resulting from the possession or use of source, byproduct, and special nuclear material. The criteria apply to decommissioning of nuclear facilities that operate through their normal lifetime and to those that may be shut down prematurely.

The intent of this rulemaking is to provide a clear and consistent regulatory basis for determining the extent to which lands and structures must be remediated before decommissioning of a site can be considered complete and the license terminated. The Commission believes that inclusion of criteria in the regulations will result in more efficient and consistent licensing actions related to the numerous and frequently complex site remediation activities anticipated in the future. The Commission has reassessed residual contamination levels contained in existing guidance based on changes in basic radiation protection standards, improvements in remediation and radiation detection technologies, decommissioning experience, public comments received on rule drafts and public comments presented at workshops held as part of the rulemaking effort and public comments received on the proposed rule.

The NRC has previously applied site release criteria for decommissioning on a site-specific basis using existing guidance. Although site-specific situations will still occur, the Commission believes that codifying radiological criteria for decommissioning in the regulations will allow the NRC to more effectively carry out its function of protecting public health and the

environment at decommissioned sites by providing for more efficient use of NRC and licensee resources, consistent application across all types of licenses, and a predictable basis for decommissioning planning.

II. Background

On August 22, 1994, the NRC published a proposed rule for comment in the Federal Register [59 FR 43200] to amend 10 CFR Part 20 of its regulations "Standards for Protection Against Radiation" to include radiological criteria for license termination. The public comment period closed on January 20, 1995. Comments received on the proposed rule were summarized in NUREG/CR-6353. A workshop was held on December 6-8, 1994, to solicit additional comments related to site-specific advisory boards as described in the proposed rule. Comments received during that workshop were summarized in NUREG/CR-6307. A workshop was also held on September 29, 1995, to specifically discuss methods for implementing the rule. Additionally, communication with the public on the proposed rule was maintained through the Electronic Bulletin Board system.

III. Overview of Public Comments

Over 100 organizations and individuals submitted comments on the proposed rule. The commenters represented a variety of interests. Comments were received from Federal and State agencies, electric utility licensees, material and fuel cycle licensees, citizen and environmental groups, industry groups, native American organizations, and individuals. The commenters offered from 1 to over 50 specific comments and represented a diversity of views. The commenters addressed a wide range of issues concerning all parts of the rule. The reaction to the rule in general and to specific provisions of the rule was varied. Viewpoints were expressed both in support of and in disagreement with nearly every provision of the rule.

IV. Summary of Public Comments, Responses to Comments, and Changes from Proposed Rule

The following sections describe the principal public comments received on the proposed rule (organized according to the major subject areas and sections of the proposed rule), present NRC responses to those comments, and explain principal changes to the proposed rule (where they occur) in response to those comments. The comments are organized according to the following major subject areas and sections of the proposed rule and are presented in the following subsections:

a) Overall license termination approach (unrestricted use, restricted use, exemptions, and alternate criteria), and specific issues on criteria for unrestricted use (including total effective dose equivalent (TEDE), as low as reasonably achievable (ALARA), objective of decommissioning, average member of critical group);

b) Specific issues on criteria for restricted use (bases for using restricted use, reliance on institutional controls, 1 mSv (100 mrem) TEDE cap, engineered barriers, financial assurance);

c) Specific issues on exemptions and alternate criteria for license termination (facilities with large volumes of low level wastes, uranium and thorium mills, exemptions);

d) Groundwater protection criteria (use of Environmental Protection Agency (EPA) drinking water standards of 40 CFR 141 in NRC rule);

e) Public participation (means of notification, site-specific advisory boards (SSABs));

f) Other procedural and technical issues (state compatibility, grandfathering, finality, minimization of contamination, readily removable residual radioactivity, radon, calculation of TEDE over 1000 years to demonstrate compliance with dose standard); and

g) Other comments (definitions, regulatory guidance; timeliness rule; wastes; recycle; rulemaking process).

The comments received from both public comment and the workshops have been factored into the Commission's decisionmaking on the rule and into the technical basis for guidance documents implementing the final rule. The description of changes to the final rule made as a result of the comments in each of the major subject areas follows each comment/response

section, and a presentation of the content of the final rule can be found in §§ 20.1401 - 20.1406 which follows this Supplementary Information.

A. Overall license termination approach and criteria for unrestricted use (proposed rule §§ 20.1402 and 20.1404).

A.1 Proposed rule content.

The proposed rule (§ 20.1402(d)) presented an overall approach for license termination involving either of two basic methods, i.e., unrestricted use or restricted use of sites after license termination. The proposed rule indicated that unrestricted use was generally preferred, but that restricted use was also permitted because it was recognized that there may be cases where achieving unrestricted use would not be reasonable.

Specific requirements for use of each of these two basic methods were presented in the proposed rule. The preamble to the proposed rule also indicated that there may be certain licensees that would seek exemptions from the decommissioning criteria of the proposed rule, although it did not codify this exemption path.

Section IV.A.2 which follows, reviews in detail the development of unrestricted use criteria; and, in doing so it also indicates, in general, how the overall approach for license termination has been reexamined to consider public comments. Specific issues and requirements

regarding other areas, specifically restricted use, exemptions, and alternate criteria, are discussed in more detail in Sections IV.B and IV.C of this preamble.

Section 20.1402(a) of the proposed rule indicated that the objective of decommissioning is to reduce residual radioactivity in structures, soils, groundwater, and other media at the site so that the concentration of each radionuclide that could contribute to residual radioactivity is indistinguishable from the background radiation concentration for that nuclide. Section 20.1402(a) further noted that, as a practical matter, it would be extremely difficult to demonstrate that such an objective had been met and that a site release limit for unrestricted use was being proposed.

Section 20.1404 of the proposed rule indicated that a site would be considered acceptable for unrestricted use if the residual radioactivity that is distinguishable from background radiation results in TEDE to an average member of the critical group of 0.15 mSv/y (15 mrem/y) and has been reduced to levels that are ALARA.

Section 20.1402(d) of the proposed rule indicated that release for unrestricted use of a facility is the preferred approach but that the alternative of release for restricted use would also be allowed if its use were justified (see Section IV.B, below).

A.2 Criteria for unrestricted use, including TEDE, ALARA, and decommissioning objective.

A.2.1 Comments. Some commenters (including EPA) agreed that 0.15 mSv/y (15 mrem/y) is an acceptable criterion because it is attainable, provides a margin of safety, and isn't unjustifiably costly. The Department of Energy (DOE) agreed that 0.15 mSv/y (15 mrem/y) could be acceptable if reasonable scenarios were considered although it preferred 0.25 mSv or 0.3 mSv/y (25 or 30 mrem/y) with ALARA. However, most commenters did not agree with the 0.15 mSv/y (15 mrem/y) criterion. Some opposed 0.15 mSv/y (15 mrem/y) as being too high and preferred alternatives that reduced the contamination level to lower levels, including preexisting background. Others opposed 0.15 mSv/y (15 mrem/y) as being too low and gave alternatives that generally included increasing the limit to 0.25, 0.3, 0.5, or 1 mSv/y (25, 30, 50, or 100 mrem/y) with further reduction based on ALARA. The categories of reasons given by commenters opposing 0.15 mSv/y (15 mrem/y) as either too high or too low included health impacts, consistency with national and international standards, effect of multiple sources, consistency with other NRC/EPA regulations, analysis of costs vs. benefits, ability to measure, effect on disposal capacity, effect on sites with naturally occurring radioactive material (NORM), and responsibility for cleanup of sites.

The proposed rule indicated that licensees would be expected to demonstrate that doses are ALARA below the proposed 0.15 mSv/y (15 mrem/y) dose criterion. Some commenters endorsed ALARA analyses in specific cases to determine if doses should be reduced below 0.15 mSv/y (15 mrem/y) and recommended that a value of 0.03 (or less) mSv/y (3 (or less) mrem/y) be the ALARA objective. Some of these commenters also requested that the NRC explicitly mandate that technical and economic analyses be performed. Other commenters indicated that

ALARA principles and analyses should not be required to determine if cleanup should be performed to reduce doses below 0.15 mSv/y (15 mrem/y) because the costs are large in comparison with the small reduction in risk. Several commenters indicated, alternatively, that ALARA should be allowed above 0.15 mSv/y (15 mrem/y) and that the rule should allow ALARA analyses to be used to permit a licensee to release its site at a value higher than 0.15 mSv/y (15 mrem/y) (up to 1 mSv/y (100 mrem/y)) if ALARA calculations support this alternative. Another commenter disagreed and recommended that ALARA analyses be applied only to demonstrate if additional cleanup is required below 0.15 mSv/y (15 mrem/y). Some commenters stated that guidance should be provided describing how ALARA should be achieved, how doses would be quantified, how models and parameters would be selected, what $/person-rem value would be used, how nonradiological risks would be considered, how net risks would be evaluated, how flexibility would be incorporated, what degree of simplification of complex models would be incorporated, and what final criteria would be used.

The proposed rule also contained, in § 20.1402(a), a decommissioning objective of reducing residual radioactivity to levels that are indistinguishable from background. Section 20.1402(a) further noted that such an objective may be difficult to meet as a practical matter. Many commenters opposed establishment of the decommissioning objective because it is arbitrary, serves no purpose for industrial sites, is costly and a waste of resources, is unlikely to be achieved, and cannot be measured. Some commenters supported establishing the proposed objective because it is reasonable from a health standpoint. Others suggested alternative

objectives such as ALARA or using a dose that is indistinguishable from the variation in background.

A.2.2 Response. The preamble to the proposed rule described three broad considerations as providing the overall rationale for the proposed rule's approach to license termination. The first two considerations were related to health and safety, i.e., level of risk and need for a constraint or margin of safety below the 1 mSv/y (100 mrem/y) public dose limit of 10 CFR Part 20 to account for the potential effect of multiple sources of radiation exposure. The third consideration was related to practicality and reasonableness of costs. The preamble to the proposed rule noted that the risk implied by use of the proposed 0.15 mSv/y (15 mrem/y) dose is comparable to other standards and practices of EPA and NRC for areas of unrestricted access in the vicinity of facilities, and that the proposed 0.15 mSv/y (15 mrem/y) standard provides a substantial margin of safety (constraint) for a single source below the 1 mSv/y (100 mrem/y) public dose limit in 10 CFR Part 20 to account for the potential exposure of a member of the public to other sources. This "constraint" approach was noted as being consistent with generic constraint recommendations made by national and international scientific bodies such as the International Commission on Radiation Protection (ICRP) and the National Council on Radiation Protection and Measurements (NCRP). Requirements related to ALARA, the decommissioning objective, and restricted use were included in the rule based on the NRC staff analysis in the Draft Generic Environmental Impact Statement (DGEIS) (NUREG-1496) that showed that the costs of reducing exposures to, or in some cases below, a 0.15 mSv/y (15 mrem/y) criterion would not generally be unduly burdensome for most licensees, although in those cases where the

costs would present an unreasonable burden, release of the site with restrictions placed on its use would provide an alternative means for achieving the same level of protection. Achieving levels of less than 0.15 mSv/y (15 mrem/y), including achieving the decommissioning objective, was generally seen as not cost-effective because increasingly larger volumes of concrete and soil would have to be removed at a greater net risk due to deaths from transportation accidents and because more difficult survey measurements would have to be made with little net benefit in dose reduction.

The NRC considered alternatives suggested in public comments and reexamined the rationale of the proposed rule. A summary of that reexamination, along with a description of particular comments on the rationale, is contained in the following subsections.

A.2.2.1 Level of risk and consistency with other EPA/NRC standards. Some commenters criticized the health risk associated with a 0.15 mSv/y (15 mrem/y) limit as too high thereby providing inadequate public protection. In particular, they objected to the NRC's reliance on ICRP and NCRP because recent research (including findings in the aftermath of the 1986 Chernobyl accident and in the 1990 report on Biological Effects of Ionizing Radiation (the BEIR V report)) showed risks to be higher than ICRP or NCRP indicated, or suggested other sources for limits, including a British standard and a National Academy of Sciences statement on radiation safety. Commenters also indicated that 0.15 mSv/y (15 mrem/y) was too high because it is higher than other NRC or EPA standards such as those for operating reactors.

Other commenters criticized 0.15 mSv/y (15 mrem/y) as too low because it is far below the level at which health effects have been observed in studies, because the risks associated with

other EPA and NRC standards (including 10 CFR Part 20, 10 CFR Parts 60 and 61, 40 CFR Parts 190 and 191, and EPA's radon action level) are higher, and because it is based on the linear non-threshold theory which is not appropriate for setting such standards. These commenters also criticized the relationship of the risks implied by this rule to those implied by standards for chemical hazards.

In general, many commenters stated that the NRC should work closely with the EPA in developing its decommissioning regulations to assure that there are no conflicting or duplicate requirements and that the acceptable risk levels and associated requirements developed by the two agencies are compatible or the same. DOE noted that a nonuniform approach could significantly impact the DOE environmental restoration program and that NRC/EPA regulations will have an impact beyond NRC licensees. There was some commenter disagreement as to whether EPA or NRC should take the lead in promulgation of exposure standards. In its comments on the NRC's proposed rulemaking, the EPA supported the 0.15 mSv/y (15 mrem/y) limit.

In response, the NRC has considered recent information and recommendations in ICRP Publication 60 and NCRP No. 116. These documents are developed by recognized experts in the fields of radiation protection and health effects and contain reviews of current significant research in radiation health effects. The NCRP is a nonprofit corporation chartered by the U.S. Congress to develop and disseminate information and recommendations about protection against radiation and to cooperate with the ICRP and other national and international organizations with regard to these recommendations. The ICRP has continued to update and revise its estimates of

health effects of radiation since its inception in 1928. In its deliberations, ICRP maintains relationships with United Nations health and labor organizations.

In addition, the NRC evaluated the proposed Federal Radiation Protection Guidance for Exposure of the General Public (FRG) as published for comment at 59 FR 66414; December 23, 1994, in which the EPA, under its charter, made recommendations to the President of the United States concerning recommended practices for protection of the public and workers from exposure to radiation.

Recent recommendations contained in ICRP 60, NCRP No. 116, and the proposed FRG are essentially similar. Use of these sources for formulating basic radiation protection standards is consistent with NRC's general approach regarding risk decisions as is noted in the preamble to issuance of 10 CFR Part 20 on May 21, 1991 (56 FR 23360). The NRC considers it reasonable and appropriate to utilize the findings of these bodies in developing criteria for license termination to apply to its licensees.

The ICRP and NCRP and EPA have reviewed current, significant studies made by other health research bodies, such as the National Academy of Sciences-National Research Council's Committee on the Biological Effects of Ionizing Radiation (BEIR) and the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), and have developed recommendations regarding limitations on exposure to radiation. In particular, the BEIR Committee conducted major reviews of the scientific data on health risks of low levels of ionizing radiation in 1972, 1980, 1988, and 1990, and similar reviews were published by UNSCEAR in 1977, 1982, 1986, and 1988. As noted in the proposed FRG, these studies have

provided more certainty about radiation risks at high doses and dose rates. Using that information and assumptions of linearity with low dose/dose rate reduction factors, BEIR V contains updated risk factors.

Concerning recent information from the Chernobyl accident noted by a commenter, there are still ongoing studies of the effects of the accident. A report published by the principal international organization studying health effects from the accident, the Organization for Economic Co-operation and Development (OECD), entitled "Chernobyl: Ten Years On; Radiological and Health Impact," summarized the findings regarding health impacts by noting that scientific and medical observation of the population has not revealed any increase in cancers or other radiation induced disease that could be attributable to the Chernobyl accident. The only area where an increase was noted was for thyroid cancer. However, these effects most likely resulted from the release of short-lived radioiodine from the accident and the affinity of the thyroid gland for iodine. As such, similar effects would not be applicable in decommissioning because radioactive iodine is not expected to be a significant contaminant. The report further notes that, while studies continue on long term effects, it is unlikely that the exposure to contaminants in the environment will lead to discernible radiation effects in the general population. Thus, this research does not appear to indicate that the findings of the ICRP and NCRP will be shown to underestimate risks.

Specifically with regard to the risk level, some of the commenters stated that the risk of fatal cancers from 0.15 mSv/y (15 mrem/y) is too high in comparison with risk goals in the range $1x10^{-4}$ to $1x10^{-6}$ used by EPA in Comprehensive Environmental Response, Compensation and

Liability Act (CERCLA) regulations. Other commenters disagreed and stated that precedents from earlier NRC rulemakings support a level of risk significantly greater than that and more appropriately in a range of $1x10^{-2}$ to $1x10^{-3}$ (e.g., the level of lifetime risk corresponding to the 1 mSv/y (100 mrem/y) public dose limit of 10 CFR Part 20, that is NRC's basic standard for public safety, is about ($4x10^{-3}$). Several of these commenters also criticized 0.15 mSv/y (15 mrem/y) as too low because the linear non-threshold model overestimates the risk and should not be used in the analysis. In response to comments on the risk level, estimated risk, using the linear non-threshold model, from constant exposure over a 30-year time period to dose levels of about 0.15 - 0.25 mSv/y (15 - 25 mrem/y), results in an estimated lifetime risk of fatal cancer of about $4x10^{-4}$ that is at the upper end of the acceptable risk suggested by EPA in their comments on NRC's proposed rule but lower than that in NRC's public dose limits.(1) In response to specific comments on use of the linear non-threshold model in estimating risk, use of the linear non-threshold model for estimating incremental health effects per radiation dose incurred is considered a reasonable assumption for regulatory purposes by international and national scientific bodies such as ICRP and NCRP. The principal international and national radiological

[1] The risks are estimated assuming a risk coefficient of $5x10^{-4}$ per rem and a 30-year lifetime exposure that is used by EPA in estimating risk from contaminated sites based on the assumption that it is unlikely that an individual will continue to live or work in the same area for more than 30 years. Such an estimate is seen as providing a conservative estimate of potential risk because land use patterns are generally such that persons living at or near a site will not continuously receive the limiting dose, and, for most of the facilities covered by this rule, the TEDE is controlled by relatively short-lived nuclides of half-lives of 30 years or less for which the effect of radioactive decay will, over time, reduce the risk significantly (e.g., at reactors where much of the contamination is from Co-60 with a half-life of 5.3 years).

protection criteria, including the NRC's, are based on this assumption as a measure of conservatism. NRC's policy regarding use of the linear non-threshold model was stated in the preamble to the issuance of 10 CFR Part 20 (56 FR 23360; May 21, 1991) noting that the assumptions regarding a linear non-threshold dose effect model are appropriate for formulating radiation protection standards. Although this matter continues to be the subject of further consideration at this time, there is not sufficient evidence to convince the NRC to alter its policy as part of this rulemaking.

The risk associated with a dose criterion in the range of about 0.15 - 0.25 mSv/y (15 - 25 mrem/y) is generally consistent with the risk levels permitted in standards for low-level waste facilities in 10 CFR 61.41, and for fuel cycle facilities and for spent fuel and high level waste in EPA's 40 CFR 190 and 191. In addition, doses in the range of 0.15 - 0.25 mSv/y (15 - 25 mrem/y) are comparable to current NRC practices for decommissioning of reactors and certain materials facilities and fuel cycle facilities. Specifically, reactors have been decommissioned in accordance with Regulatory Guide 1.86 and with an NRC license termination letter to Stanford University (April 21, 1982, Docket No. 50-141). Materials facilities have been released in accordance with the levels for external radiation for beta/gamma exposure in NRC's Policy and Guidance Directive FC 83-23. In addition, a dose criterion in the range of 0.15 - 0.25 mSv/y (15 - 25 mrem/y) is generally at the low end of the range of values estimated for Option 1 of the 1981 Branch Technical Position (BTP) for sites with uranium and thorium and used for Ra–226 in 10 CFR 40, Appendix A, for uranium mill contamination.

A.2.2.2 Effect of multiple sources and margin of safety below 1 mSv/y (100 mrem/y). Some commenters suggested that 0.15 mSv/y (15 mrem/y) is too low and indicated that the NRC limit was inconsistent with ICRP and NCRP especially with regard to considerations of multiple sources of exposure, and that it would be unusual for an individual to be exposed to multiple sources approaching the 1 mSv/y (100 mrem/y) limit. These commenters suggested that 25 - 30 percent of 1 mSv (100 mrem) is an adequate margin to account for multiple sources.

In response, and by way of background, it is noted that the NCRP in its publication No. 116 (Chapter 15) recommends that, for continuous exposure, the effective dose to members of the public not exceed 1 mSv/y (100 mrem/y) from all man-made sources, other than medical and not including natural background sources. Similarly, ICRP, in Table 6 of ICRP Publication 60, recommends a limit of 1 mSv/y (100 mrem/y) as the dose limit for the public, and recommendation No. 3 of the draft EPA Federal Radiation Protection Guidance (FRG) indicates that the combined radiation doses incurred in any single year from all sources of exposure (excluding medical and natural background) should not normally exceed 1 mSv (100 mrem) and that continued or chronic exposure of an individual over substantial portions of a lifetime at or near 1 mSv/y (100 mrem/y) should be avoided. Consistent with these bodies, the NRC issued 10 CFR Part 20 (56 FR 23360) in 1991 that established a public dose limit of 1 mSv/y (100 mrem/y) in 10 CFR 20.1301.

These national and international bodies also note and agree that, although the limit for the public dose should be 1 mSv/y (100 mrem/y) from all man-made sources combined, it would seem appropriate that the amount that a person would receive from a single source should be

further reduced to be a fraction of the limit to account for the possibility that an individual may be exposed to more than one source of man-made radioactivity, thus limiting the potential that an individual would receive a dose at the public dose limit. Recommendations from these bodies, as well as from the NRC's Advisory Committee on Nuclear Waste (ACNW), regarding what the fraction from a source should be are:

(a) NCRP No. 116, Chapter 15, notes that no single source or set of sources under one's control should result in an individual being exposed to more than 0.25 mSv/y (25 mrem/y). This fraction was presented as a simple alternative to having a site operator (where a site could expose individuals to levels greater than 0.25 mSv/y (25 mrem/y)) investigate all man-made exposures that an individual at the site would be exposed to so as to demonstrate that the total dose does not exceed 1 mSv/y (100 mrem/y). The clear implication in this simple alternative is that, if individual sources are constrained to 0.25 mSv/y (25 mrem/y), NCRP believes it likely, given the low potential for multiple exposures, that the public dose limits will be met. Further reductions considering ALARA would still be considered by NCRP No. 116.

(b) ICRP 60, Section 5.5.1, in discussing the principles of constraints and limits, notes that it is appropriate to select dose constraints applied to each source to allow for contributions from other sources so as to maintain doses below the 1 mSv/y (100 mrem/y) limit. ICRP 60 does not contain numerical guidance on dose constraints for particular practices, but notes that cumulative exposures to individuals from existing sources near 1 mSv/y (100 mrem/y) are rarely a problem primarily because of the widespread use of source-related dose constraints.

Further explanation of the fundamental concepts of ICRP 60 are contained in the paper, "The ICRP Principles of Radiological Protection and Their Application to Setting Limits and Constraints for the Public from Radiation Sources," by Professor Roger Clarke, Chairman of the ICRP (January 12, 1995; a copy is available in the file for this rulemaking in the NRC Public Document Room, 2120 L Street NW. (Lower Level), Washington, DC). The paper notes that the constraint approach derives from the optimization principle of radiation protection in which, for any source, individual doses should be ALARA and also be constrained by restrictions on doses to individuals (i.e., dose constraints). The paper further notes that a constraint is an individual related criterion applied to a single source in order to ensure that the overall dose limits are not exceeded, and that a dose constraint would therefore be set at a fraction of the dose limit as a boundary on the optimization of that source. Based on the principles presented in the paper, the constraint recommended in the paper for a decommissioned site is 0.3 mSv/y (30 mrem/y) and that further optimization through the ALARA principle is appropriate. As is the case for NCRP No. 116, the implication of the paper and ICRP 60 is that the constraint level is a boundary on the dose from this source and is sufficient to assure that members of the public are not exposed to levels in excess of the public dose limit. The rationale for this is expressed in Section 5.5.1 of ICRP 60 where it is noted that the critical group is not normally exposed to the constraint level from more than one source although it may be exposed to some dose level less than the constraint level from more than one source.

(c) The proposed FRG in recommendation No. 4 indicates that individual sources should have "authorized limits" set at a fraction of the 1 mSv/y (100 mrem/y) limit for all sources

combined. The draft FRG notes that the basis for this recommendation is the various categories of activities using radiation that can lead to exposure to members of the public, and also notes the need for broad assumptions about future activities involving radiation use.

The draft FRG does not recommend a level for any one source although it does note that setting such a fraction will necessarily be a broad judgment based on a general observation of the characteristics of existing activities, projections for continuing those activities in the future, and the potential for other uses in the future that can be identified now. Thus, the draft FRG notes that, in the case of authorized limits for broad categories of sources, the judgments will often necessarily be broad and may lead to somewhat higher values, with further implementation of the ALARA process left to management of individual sources within a category. The draft FRG does not indicate how this judgment is to be made although it cites authorized standards for certain sources that currently exist, including 40 CFR Part 190 for the nuclear fuel cycle, Appendix I to 10 CFR Part 50 for power reactors, 10 CFR Part 61, and 40 CFR Part 141. All of these set authorized fractions at 25% or less of the 1 mSv/y (100 mrem/y) public dose limit. NRC, in its comments on EPA's draft FRG, questioned what was the appropriate fraction of the public dose limit in 10 CFR Part 20 that should be used in setting constraints which would thereby become "authorized" limits.

(d) In its review of how the principles and recommendations of the ICRP, NCRP, and FRG are relevant to the proposed NRC rule, NRC's Advisory Committee on Nuclear Waste (ACNW) noted that 0.15 mSv/y (15 mrem/y) represented an unnecessarily conservative fraction of the 1 mSv/y (100 mrem/y) annual limit. The ACNW agreed that the need to partition the

annual recommended dose limit among several sources to which a person is likely to be exposed appears justifiable and noted that no explicit guidance from the various national and international bodies on this subject exists. Nonetheless, ACNW stated that a constraint of 25 percent or 30 percent of the 1 mSv/y (100 mrem/y) limit appears more justified and appropriate based on the likelihood that no more than 3 or 4 separate regulated sources will affect the critical group at any instance. ACNW further noted that the selection of 0.15 mSv/y (15 mrem/y), that represents about 1/7 of the annual limit, assumes that a person will encounter a simultaneous dose from seven different regulated sources and that this appears to them to be unjustified, particularly because the ALARA principle accompanies all such NRC regulatory actions.

The recommendations of the above organizations can be summarized as suggesting that a constraint value should be set as part of the process of optimizing the dose from a particular source and that this constraint value should be set as a boundary value below which further optimization or ALARA principles should be employed. The recommendations also appear to suggest that setting a source constraint of 25 - 33 percent of the annual dose limit of 1 mSv/y (100 mrem/y) is appropriate and adequate to ensure that the dose limit is met, and do not tend to lend support to 0.15 mSv/y (15 mrem/y) as the appropriate fraction to which to constrain the dose from an individual source because it is not likely that a critical group will be exposed to as many as seven sources. Thus, the recommendations appear to indicate that the constraint value should be set using a more reasonable approach.

In discussing the bases for the 0.15 mSv/y (15 mrem/y) dose criterion in the proposed rule, the Commission noted in the preamble (at 59 FR 43219; August 22, 1994) that 0.15 mSv/y

(15 mrem/y) would provide a "substantial" margin of safety and stated in the preamble that this would be appropriate for decommissioned facilities. As part of its review of the public comments, the Commission considered the recommendations of the standards-setting bodies cited above. Further, in making a judgment on the appropriate value of the fraction, the Commission also considered principles of optimization, numbers and types of sources, potential for exposure of critical groups to more than one source at the constraint value, and assumptions regarding the manner in which a critical group would be exposed. NRC reviewed the assumptions of the Draft and Final GEIS regarding exposure pathways and also NUREG/CR-5512 upon which the Draft and Final GEIS are based. NUREG/CR-5512 provides an analysis of exposure pathways for critical groups at decommissioned facilities. The principal limiting scenarios include: (a) full time residence and farming at a decommissioned site, (b) exposure while working in a decommissioned building, and (c) renovation of a newly decommissioned building. These principal limiting exposure scenarios are intended to overestimate dose and also tend to be somewhat mutually exclusive; i.e., a person living near a decommissioned nuclear facility would only receive a dose near the constraint level if his living pattern includes full-time residency and farming at the site. This living pattern would make it difficult for the member of this critical group to also be a member of the critical group from other licensed or decommissioned sources. Conversely, a person having less residency than a full time farmer (e.g., apartment dweller, homeowner who works away from the site) might receive doses from other sources but would receive less than the constraint value from the decommissioned site because the exposure time and the number of pathways would be reduced. Thus, given the

assumptions regarding living patterns made in evaluating compliance with the constraint level, it is difficult to envision an individual receiving levels approaching constraint levels from more than one licensed or decommissioned source. It is also likely that individuals at a decommissioned site will actually be exposed to doses substantially below the constraint level because of ALARA considerations and because of the nature of the cleanup process itself, i.e., the process of scabbling of concrete removes a layer of concrete which likely contains a large fraction of the remaining radioactivity, and the process of soil excavation is a gross removal process that is also likely to remove large fractions of the radioactivity. For example, the Final GEIS indicates that, for the reference cases analyzed, removal of a layer of concrete by scabbling will result in doses at levels from 2 to more than 10 times lower than a constraint value. In addition to consideration of decommissioned sources, it is also difficult to envision that an individual could come in contact with more than a few other sources as part of normal living patterns. For example, the NCRP in NCRP No. 93, "Ionizing Radiation Exposure of the Population of the United States," September 1987, reviewed likely radiation exposures to the public from consumer products, air emissions, and fuel cycle facilities (including nuclear power plants) and found that, in general, exposure to the public is a small fraction of 1 mSv/y (a few mrem/y). Recent experience on nuclear power plant emissions and dose commitments (NUREG/CR-2850) tends to support the conclusions of NCRP No. 93 about power plant exposures.

NRC's generic evaluation of uses of and doses from various sources, including decommissioned sources, supplemented by the recommendations of the standards setting bodies

and advisory committee noted above, suggests that the substantial added margin of safety provided by the 0.15 mSv/y (15 mrem/y) value may be too restrictive for its intended purpose of constraining doses from this category of sources in establishing an appropriate boundary constraint. Rather, the evaluation leads NRC to conclude that 25 percent of the public dose limit is a sufficient and ample fraction to use as the limitation for decommissioned sources.

Thus, the Commission concludes that a generic dose constraint or limitation for decommissioning sources of 0.25 mSv/y (25 mrem/y) for unrestricted release of a site is reasonable from the standpoint of providing a sufficient and ample margin of safety for protection of public health and safety. It is recognized that this conclusion reflects a judgment regarding the likelihood of individuals being exposed to multiple sources with cumulative doses approaching 1 mSv/y (100 mrem/y) rather than an analysis based on probability distributions for such exposures. However, considering the kinds of occupancy time typically assumed for the average member of the critical group at a site, it is highly unlikely that individuals could realistically be expected to experience exposures to other sources with a cumulative effect approaching 1 mSv/y (100 mrem/y).

A.2.2.3 Cost and practicality of standard. Comments received on cost and practicality were analyzed to determine whether such an analysis can provide additional information related to the criteria of this rule. This analysis includes how, and to what level, ALARA efforts should be made, how the proposed decommissioning objective of returning a site to background should be applied, and what provisions should there be (e.g., restricted use) for sites where it is unreasonable or unwise to attain the unrestricted dose criterion.

Some commenters criticized the proposed rule for including considerations of cost-effectiveness, objecting to using cost in decisionmaking. Other commenters criticized the rule because, although they favored use of cost-benefit analyses in decisionmaking, they felt that the cost-benefit analysis in the draft GEIS and draft Regulatory Analysis (RA) was inadequate to justify a 0.15 mSv/y (15 mrem/y) dose criterion because it used an improper approach (i.e., combining the building and soil analysis). They also felt that it underestimated the amount of contamination at reference facilities, as well as the costs of remediation and final site closeout surveys.

The Commission considered the concerns of commenters who criticized inclusion of cost as a consideration in decisionmaking. NRC methods and policy regarding cost considerations are stated in NUREG/BR-0058, Rev. 2, and call for preparation of an appropriate regulatory analysis in support of regulatory decisions. NUREG/BR-0058 does note that costs cannot be considered for regulatory actions necessary to ensure adequate protection of the health and safety of the public; however, it further notes that costs can be a factor in those cases where there may be more than one way to reach a level of adequate protection. Thus, the analysis in the GEIS and RA was prepared in support of the rulemaking to provide additional information to decisionmakers with regard to the rule criteria being considered.

The Commission has also considered the concerns of those commenters that criticized the analysis of costs and risks as incomplete and inadequate and reviewed information submitted in support of those comments. In general, some of the major comments suggested, and provided data on, the following:

(a) Additional data from actual decommissionings should be included that would consider variations in site contamination characteristics, including the concentration and volume of contamination and the profile of the contamination with depth;

(b) Reevaluation of remediation and survey costs should be conducted, including consideration of variation in waste burial charges, remediation methods, and survey procedures;

(c) Separate analyses of the cost-effectiveness of soil removal and building removal should be performed. A commenter illustrated that such separate analyses would clarify differences between costs and impacts of cleanup of soils and structures that were not obvious in the Draft GEIS. Commenters also suggested deleting the "knee-in-curve" approach as not clearly illustrating the information regarding costs and impacts for cleanup of both soils and structures; and

(d) Potential alternative uses of the site lands and facilities should be considered to provide a higher level of realism in the dose estimates. These alternative uses can result in variations in direct exposure and ingestion pathways and in the number of persons exposed and thus the collective exposure and net health effects.

Based on the comments and information received, additional information has been added to the GEIS. Data on contamination submitted by the commenters were reviewed, compared with other existing data, including that in the Draft GEIS, and incorporated into the Final GEIS as appropriate. The Final GEIS thus considers additional soil contamination data as well as soil and building contamination comparable to that in the draft GEIS. It also considers the range of disposal costs and survey methods and costs presented in the Draft GEIS, as well as those

suggested in the comments. The Commission agrees with the commenters that consideration of soil and buildings separately can provide added information. Thus the Final GEIS has used the analysis of the Draft GEIS, that contained the data for performing separate analyses, and has presented the data more clearly in revised tables. In addition, the "knee-in-curve" figures, that provided general information about behavior of costs and impacts associated with cleanup, have been replaced with a simpler set of tables similar to the presentation in the Draft Regulatory Analysis, in Tables 6.1 and 6.2. In response to comments suggesting that the Final GEIS consider more realistic post decommissioning uses, the Final GEIS considers a range of possible uses, including residential farming, denser residential use, industrial/office use, and higher building occupancy rates.

Given the range of possible parameters, scenarios, and site-specific situations, the Final GEIS concludes, in a manner similar to the Draft GEIS, that there is a wide range of cost-benefit results among the different facilities and within facility types and that there is no unique algorithm that decisively produces an ALARA result for all facilities. Despite these difficulties, the Final GEIS and RA provide the following results that can be helpful for gaining insight in making decisions regarding ALARA, the decommissioning objective, and whether restricted use should be permitted:

(a) Achieving, as an objective of ALARA, reduction to preexisting background. The objective of returning a site to preexisting background conditions is consistent with the concept of returning a site to the radiological condition that existed before its use. However, the question of whether this objective, as a goal of ALARA, should be codified by rule depends on a variety

of factors, including cost, practicality (e.g., measurability) of achieving the objective, and the type of facility involved.

As noted in Section 7.3.1 of the Draft GEIS, decommissioning is expected to be relatively easy for a certain class of non-fuel-cycle nuclear facilities (i.e., those that use either sealed radioactive sources or small amounts of short-lived nuclides), because there is usually no residual radioactive contamination to be cleaned up and disposed of, or, if there is any, it should be localized or it can be quickly reduced to low levels by radioactive decay. Decommissioning operations will generally consist of disposing of a sealed source or allowing licensed short-lived nuclides to decay in storage, submitting Form NRC-314, and demonstrating (either through radiation survey or other means such as calculation of reduction of the contamination level by radioactive decay) compliance with the requirements for license termination. Because contamination at these facilities is expected to be negligible or to decay to negligible levels in a short time, achieving an objective of returning these facilities to background would not appear to be an unreasonable objective of ALARA.

However, in general, for those nuclear facilities where contamination exists in soils and/or structures, the Final GEIS analysis shows, in a manner similar to the Draft GEIS, that achieving an ALARA decommissioning objective of "return to a preexisting background" is not reasonable as it may result in net detriment or because cost cannot be justified because detriments and costs associated with remediation and surveys tend to increase significantly at low levels, while risk reduction from radiation exposure from criteria near background is marginal.

(b) ALARA analysis for soil contamination. Soil contamination can exist onsite at nuclear facilities because of a variety of reasons including spills or leaks, deposition from airborne effluents, or burial or placement of system byproducts or other waste materials in onsite soils. The level of soil contamination for the large majority of NRC-licensed facilities (>6000) is either zero or minimal (it is expected that the large majority of Agreement State licensees would have similar contamination). Certain facilities (e.g., power reactors, fuel facilities, industrial facilities) may have greater soil contamination, and certain of these facilities have been identified as having extensive soil contamination (albeit generally at relatively low levels) and have been placed in the Site Decommissioning Management Plan (SDMP) (see NUREG-1444, October 1993). These sites warrant specific NRC attention regarding their decommissioning.

For the generic scenarios considered, the results of the Final GEIS evaluation indicate that there is a wide range of possible cost-benefit ratios. Nevertheless, there appears to be a strong indication that removing and transporting soil to waste burial facilities to achieve exposure levels at the site at or below a 0.25 mSv/y (25 mrem/y) unrestricted use dose criterion is generally not cost-effective when evaluated using NRC's regulatory analysis framework presented in NUREG/BR-0058 and NUREG-1530. Further, even for a range of cleanup levels at or above a 0.25 mSv/y (25 mrem/y) criterion, there can also be cases where costs are unreasonable in comparison to benefits realized.

(c) ALARA analysis for structures containing contamination. Building floors and walls at nuclear facilities can be contaminated for a variety of reasons, including system leaks, spills, tracking, and activation. The large majority of NRC licensed facilities have zero or limited

building contamination. Generally, contamination does not penetrate the surface of concrete and can be readily removed by water jets or concrete scabbling. If the building is reused for some new industrial, office, or other use after license termination, persons can be in direct contact with the decommissioned floors and walls.

For the range of generic situations considered, the results of the Final GEIS evaluation indicate that there is a wide range of possible cost-benefit ratios. It appears that cleanup of concrete to levels at or below 0.25 mSv/y (25 mrem/y) can be cost effective, depending on the number of individuals projected to be occupying a building, when using the decisionmaking guidelines of NUREG/CR-0058 and NUREG-1530.

A.2.3 Conclusions regarding overall approach to license termination and unrestricted dose criterion. Based on the above discussion, the Commission has concluded that the overall license termination approach of this final rule should include:

o An unrestricted use dose criterion of 0.25 mSv/y (25 mrem/y) applicable on a generic basis without site-specific analysis;

o Considerations regarding ALARA, including the decommissioning objective;

o A tiered approach of unrestricted use and allowing restricted use if certain provisions are met; and

o Codifying alternate site-specific criteria in the rule to alleviate the need for exemptions in special circumstances.

The reasons for these conclusions are discussed in the following subsections.

A.2.3.1 An unrestricted use dose criterion of 0.25 mSv/y (25 mrem/y) applicable on a generic basis without site-specific analysis. For the reasons described in some detail above, the Commission is establishing a dose of 0.25 mSv/y (25 mrem/y) as an acceptable criterion for release of any site for unrestricted use without further analysis of the potential for exposures from other man-made sources. The Commission concludes that a generic dose constraint or limitation for decommissioning sources of 0.25 mSv/y (25 mrem/y) for unrestricted use of a site appears reasonable from the standpoint of providing a sufficient and ample margin of safety in protection of public health and safety. This conclusion reflects the Commission's judgment that the likelihood of individuals being exposed to multiple sources with cumulative doses approaching 1 mSv/y (100 mrem/y) is quite small. This conclusion is based on consideration of the kinds of occupancy times generally expected for the average member of the critical group at typical decommissioned sites and the low probability that individuals could realistically be expected to experience significant exposures to other sources, particularly with a cumulative effect approaching 1 mSv/y (100 mrem/y). In view of these perspectives, the Commission believes that a generic dose criterion of 0.25 mSv/y (25 mrem/y) provides a sufficient and ample, although not necessary, margin to protect the public.

A.2.3.2 Considerations regarding ALARA, including the decommissioning objective.

The ICRP, NCRP, and draft FRG all suggest that, in addition to setting a constraint value for an individual source, achievement of exposures that are ALARA should continue to be considered as a means of optimization. For this reason and because the generic analysis of the Final GEIS tends to indicate that achieving doses below 0.25 mSv/y (25 mrem/y) may be

ALARA for some cases, the rule continues to require an ALARA evaluation below the unrestricted dose criterion.

It would be useful if the analyses in the Final GEIS could have arrived at a value of ALARA for all facilities or classes of facilities so that no further estimate of ALARA would be needed in site-specific cases. However, it was not feasible for the Commission to use the results of the Final GEIS to determine a generic optimum ALARA dose because of the variety of possible scenarios, assumptions, parameters, and site-specific conditions that could exist. Nevertheless, the Final GEIS does contain information about certain trends in impacts and costs of decommissioning that can be useful in preparation of regulatory guidance supporting site-specific ALARA provisions. In particular, it is clear from the Final GEIS that removal of soil to achieve dose levels below the 0.25 mSv/y (25 mrem/y) dose criterion is generally unlikely to be cost-effective, whereas it may be for concrete in certain cases. It is also clear that removal of soil or concrete to "pre-existing background" levels is generally not cost effective.

Thus, for those facilities where soil or building contamination exists, it would be extremely difficult to demonstrate that an objective of return to background had been achieved. Therefore it is concluded, as was previously done in the proposed rule, that for these sites use the unrestricted dose criterion with appropriate ALARA considerations would be appropriate. For restricted use, the Final GEIS suggests that although removal of soil to achieve dose levels below 0.25 mSv/y (25 mrem/y) may not be cost-effective, other simple and less costly measures to restrict the use of the site such as fencing or barrier plantings may be cost-effective and should be considered as part of the ALARA process. For groundwater contamination, as discussed later in

Section IV.D, ALARA considerations should consider the situation where populations use groundwater plumes from a facility as drinking water.

In actual situations, it is likely that, even if no specific analysis of ALARA were required for soil and concrete removal, the actual dose will be reduced to below 0.25 mSv/y (25 mrem/y) because of the nature of the removal process. For example, the process of scabbling of concrete removes a layer of concrete that likely contains a large fraction of the remaining radioactivity, and the process of soil excavation is a gross removal process that also is likely to remove large fractions of the radioactivity.

To clarify the concept of ALARA, the regulatory guidance to be prepared will refer to the existing requirements of §§ 20.1003 and 20.1101 where ALARA is defined to include considerations of the state of technology, economics of improvement in relation to the state of technology, economics of improvements in relation to benefits to the public health and safety, and other societal and socio-economic considerations. Although preparation of such guidance is in a preliminary stage, it is anticipated that this guidance would likely indicate that ALARA during decommissioning should include typical good practice efforts (e.g., floor and wall washing, removal of readily removable radioactivity in buildings or in soil areas), as well as ALARA analyses for buildings to levels less than 0.25 mSv/y (25 mrem/y) based on the number of individuals projected to be occupying the building, but that an ALARA analysis below 0.25 mSv/y (25 mrem/y) for soil removal would not need to be done. It is expected that use of the dose criterion of the final rule and the regulatory guidance on ALARA would achieve consistency with current practices where it is cost-effective to do so.

The Commission also believes that, in any ALARA analysis conducted to support decisions about site cleanup, all reasonably expected benefits and detriments resulting from the cleanup activities should be taken into consideration in balancing costs and benefits. An example of such a detriment would be transportation deaths that might occur as contaminated waste is transported away from the site.

A.2.3.3 Tiered approach of unrestricted use and allowing restricted use if certain provisions are met. It appears reasonable to retain the basic structure presented in the proposed rule and allow for both unrestricted and restricted use of sites. Allowance of restricted use is appropriate because there can be situations where restricting site use can provide protection of public health and safety by reducing the TEDE to 0.25 mSv/y (25 mrem/y) in a more reasonable and cost-effective manner than unrestricted use. This protection is afforded by limiting the time period that an individual spends onsite or by restricting agricultural or drinking water use. For many facilities, the time period needed for restrictions can be fairly short; i.e., long enough to allow radioactive decay to reduce radioactivity to levels that permit release for unrestricted use. For example, at reactors, manufacturing facilities, or broad scope licensees, where the principal contaminants can have half-lives of 5 - 30 years (e.g., Co-60, Cs-137), restricting site use for about 10 - 60 years can result in achieving unrestricted use levels. Thus, it continues to be appropriate to allow restricted use if accompanied by provisions that ensure the restrictions remain in place to achieve a dose of 0.25 mSv/y (25 mrem/y). Considerations for assuring that restrictions remain in place and that public health and safety is protected are discussed further in Section IV.B.

A.2.3.4 Codifying alternate site-specific criteria in the rule to alleviate the need for exemptions in special circumstances. The preamble to the proposed rule recognized that there would likely be facilities that would seek exemptions from the rule's requirements. However, as noted in Section IV.C below, because the Commission finds that it would be preferable to deal with those facilities under the aegis of a rule rather than as exemptions and because the Commission has established the 0.25 mSv/y (25 mrem/y) dose criterion as providing a sufficient and ample, rather than necessary, margin below the public dose limit, the Commission has included a provision for alternate criteria in its final rule. In allowing such a provision, it is nevertheless the Commission's judgment that: (1) it is in general preferable for sites to reduce doses to 0.25 mSv/y (25 mrem/y) due to the uncertainty over the number of sources where nuclides may be present for a long time-frame; (2) the large majority of sites can reduce doses to less than 0.25 mSv/y (25 mrem/y) through restricting site use; and (3) permitting large numbers of licensees to propose alternate criteria is not advisable because it would be contrary to one of the goals of this rulemaking that is to achieve more efficient and consistent licensing actions. Therefore, the Commission has limited the conditions under which a licensee could apply for alternate criteria. A licensee proposing to terminate a license at a site-specific level above 0.25 mSv/y (25 mrem/y) would be required to:

(a) Provide assurance that public health and safety would continue to be protected by means of a complete and comprehensive analysis of possible sources of exposure so that the total dose from all potential man-made sources would remain below the 1 mSv/y (100 mrem/y) public dose limit of 10 CFR Part 20;

(b) Employ, to the extent practical, restrictions on site use for minimizing exposures at the site using the provisions for restricted use outlined in Section IV.B, below; and

(c) Reduce doses to ALARA levels.

A description of these circumstances and potential resolutions on a site-specific basis, short of exempting a facility from this rule, appears in Section IV.C.

If license termination still cannot be met even under alternate criteria, it may be necessary for the site (or a portion thereof) to be kept under license in order to assure that exposures to the public are appropriately monitored. The evaluation of the maintenance of a site or a portion thereof under a continued license is outside the scope of this rulemaking because this rule contains provisions addressing radiological criteria that apply to termination of a license.

A.2.4 Summary of rule revisions on unrestricted use and plans for implementation. The final rule has been modified to indicate that the dose criterion for unrestricted use is 0.25 mSv/y (25 mrem/y). Requirements that a licensee consider how the ALARA requirements of 10 CFR Part 20 can be applied to achieve a dose below the dose criterion have been retained.

Regulatory guidance is planned on how to meet these existing ALARA requirements. In addition, to assist in implementing the dose criterion, regulatory guidance will also be issued to provide clear guidance to licensees on how to demonstrate compliance with the dose criterion by using either:

(a) Screening analyses that use relatively simple approaches for demonstrating compliance; or

(b) Site-specific modeling for more complex sites and contamination. Regulatory guidance will also be issued to provide clear guidance on statistical tests and survey methods available to licensees for demonstrating compliance.

The Commission is retaining the distinguishable from background provision in the final rule to allow release of sites when residual contamination, if any, cannot be distinguished from background on a statistical basis using proper survey techniques. In particular, at the levels of the dose criterion, concentrations of uranium and thorium in soil are extremely low and may not be distinguishable from background on a statistical basis even when using proper survey techniques.

A.3 General comments on the dose criterion.

A.3.1 Comments. Comments were received on the 0.15 mSv/y (15 mrem/y) dose criterion that questioned its effect on disposal capacity, the relationship to naturally occurring radioactive material (NORM), and the issue of fixing the responsibility for cleanup.

A.3.2 Response. Some commenters were concerned about the effect of 0.15 mSv/y (15 mrem/y) criterion on disposal capacity. As noted in Section IV.A.2.2, several of the assumptions, models, and approaches in the GEIS and Regulatory Analysis have been revised to include additional data and alternate waste disposal costs. A complete discussion of these revisions and analysis of disposal capacity is in the Final GEIS and the Regulatory Analysis.

Some commenters questioned the relationship of this rule to NORM. In response, the criteria of this rule apply to residual radioactivity from activities under a licensee's control and not to naturally occurring background radiation. Issues related to NRC-licensed sites containing materials that occur in nature are discussed in Sections IV.B and IV.C.

There is a wide variety of sites containing NORM subject to EPA jurisdiction and not licensed by the NRC. The extent to which criteria in this rule would apply to these sites would be based on a separate evaluation although certain aspects of the rule, for example control of sites with restrictions imposed, could be similar. For further discussion, see also Section IV.G.6.

With regard to responsibility for cleanup, several commenters stated that the 0.15 mSv/y (15 mrem/y) limit is too high because licensees should have to clean up contamination that they created. Because these are final licensing actions before releasing the site to the public, they stated that only a lower criterion such as return to background would adequately protect the public. In response, the NRC agrees with the need to fix responsibility for decommissioning of licensed sites. The planning and financial assurance requirements adopted June 27, 1988 (53 FR 24018) recognized the responsibility of licensees to plan for the cleanup of their sites and to provide adequate financial assurance for that cleanup. Similarly in this regulation, licensees are not permitted to release a facility for unrestricted or restricted public use unless the dose criteria stipulated in the rule have been satisfied. As noted in the Final GEIS, further cleanup to levels such as background is not generally reasonable because it results in very little additional health benefit with very large costs incurred and could result in an increase in the overall risk associated with cleanup of a particular site when all factors (e.g., estimated fatalities due to transportation

accidents during transport of radioactive wastes) are considered. Therefore, for the reasons discussed in Section IV.A.2.2, the criteria in the final rule are considered appropriate to protect public health and safety and to permit release of the sites and termination of license.

A.4 Average member of the critical group.

A.4.1 Comment. Some commenters agreed with provisions of the rule that would apply the dose limit to an average member of the critical group rather than to the "reasonably maximally exposed (RME) individual" because it is consistent with ICRP and provides an appropriate protection standard. Other commenters objected to use of "an average member of the critical group." These commenters favored applying the dose limit to the most exposed person rather than to an average person. They asserted that this would be consistent with the approach used for other licensed activities and environmental protection.

A.4.2 Response. As noted in the preamble to the proposed rule (59 FR 43218; August 22, 1994), use of the term "average member of the critical group" refers to the group of individuals reasonably expected to receive the greatest exposure to residual radioactivity given the circumstances under which the analysis would be carried out. For example, if a site were released for unrestricted use, the critical group would be the group of individuals reasonably expected to be the most highly exposed considering all reasonable potential future uses of the site. As also noted in the preamble, NUREG/ CR–5512 defines the critical group as an individual or relatively homogeneously exposed group expected to receive the highest exposure

within the assumptions of a particular scenario and the dosimetric methods of 10 CFR Part 20. The average member of the critical group is an individual who is assumed to represent the most likely exposure scenario based on prudently conservative exposure assumptions and parameter values within model calculations. For example, the critical group for the building occupancy scenario can be the group of regular employees working in a building that has been decontaminated. If a site were converted to residential use, the critical group could be persons whose occupations involve resident farming at the site, not an average of all residents on the site.

Although the terms "critical group" and "average member" are new terms in NRC regulations, they are consistent with ICRP practice of defining and using a critical group when assessing individual public dose from low levels of radioactivity similar to those expected from a decommissioned site. ICRP recommends that such analyses should consider exposure to individuals representative of those expected to receive the highest dose using cautious but reasonable assumptions. This approach has been adopted in the proposed FRG and is also consistent with the recommendations of the National Academy of Sciences on the Yucca Mountain Standards (August 1995).

A.4.3 Summary of rule revisions. The rule has not been changed from that proposed.

B. Criteria for restricted use (proposed rule §§ 20.1402(d) and 20.1405).

B.1 Proposed rule content.

As described in the proposed rulemaking and restated in Section IV.A.2.2, above, there are potential situations under which termination of a license under restricted conditions could be used in the decommissioning of a site. Proposed § 20.1405 indicated that a site would be considered acceptable for license termination under restricted conditions if the licensee:

(a) Made provisions for institutional controls that provide reasonable assurance that the TEDE to the average member of the critical group would not exceed the unrestricted use dose criterion;

(b) Reduced residual radioactivity at the site such that, if the controls were no longer in effect, there is reasonable assurance that the TEDE would not exceed 1 mSv/y (100 mrem/y);

(c) Demonstrated that complying with the unrestricted use dose criterion would be prohibitively expensive, result in net public or environmental harm, or not be technically achievable;

(d) Obtained advice on the restrictions from the affected community by convening a site-specific advisory board, and;

(e) Provided financial assurance to ensure the controls remain in place.

B.2 Comments on acceptability of restricted use for decommissioned sites.

A variety of comments was received on the restricted use option. The major comment categories are listed below. Although the comment categories address somewhat separate issues, they are listed and answered together to develop a unified response on the issue of restricted use.

B.2.1 The general concept of restricted use. Some commenters agreed with the proposal to permit restricted use of decommissioned sites because it may be financially impractical to reach unrestricted levels, especially if health and safety considerations do not warrant it and because restricted release allows realistic land uses to be considered. Some commenters opposed the concept of any planned, restricted release of decommissioned sites because of concerns over the durability and effectiveness of institutional controls, because license termination should be a final action with full licensee responsibility for site disposition, and because cleanup costs should have been previously considered.

B.2.2 The need for licensees to demonstrate that restricted use is appropriate for their sites. In allowing restricted use, the proposed rule would have required licensees to demonstrate the appropriateness of restricting site use for their particular situation by showing that it would be "prohibitively expensive," "technically unachievable," or cause "net public or environmental harm" to achieve unrestricted use (proposed § 20.1405(a)). Some commenters supported the restricted use of sites but indicated that the proposed requirements for demonstrating its appropriateness were unreasonably restrictive. These commenters stated that the provisions in proposed

§ 20.1405(a) were structured so narrowly that few sites would be able to qualify for license termination under restricted conditions. Commenters stated that these terms should be explained, deleted, or replaced with a less onerous requirement allowing restricted use if justified by an ALARA analysis or if there were continued ownership and industrial use of the site.

B.2.3 The durability of institutional controls. Several commenters opposed or expressed concern about the ability of institutional controls to provide needed protection of public health and safety at decommissioned sites because they cannot be enforced indefinitely into the future and can be struck down or become ineffective. Other commenters favored reliance on more flexible institutional controls and recommended that the rule should not assume that they will eventually fail. Approaches for using institutional controls were suggested including Federal Government ownership of sites or legislative solutions for complex sites similar to the National Waste Policy Act (NWPA) of 1982.

B.2.4 The 1 mSv/y (100 mrem/y) cap if institutional controls fail. Some commenters stated that the proposed 1 mSv/y (100 mrem/y) restriction is unreasonably low when used to assess the worst case scenario. They recommended that the rule should not stipulate that a licensee must assume that all institutional controls will eventually fail. Alternatively, they recommended that a 5 mSv/y (500 mrem/y) backup limit be allowed if restrictions such as institutional controls or engineered features fail. The commenters believed that a 5 mSv/y (500 mrem/y) limit is consistent with other regulations, since residential use of an industrial site is unlikely, and failure of controls is speculative. Several commenters objected to the last sentence of proposed § 20.1405(d), that stated that licensees may not assume any benefits from an earthen cover, other earthen barriers, or engineered controls in complying with the 1 mSv/y (100 mrem/y) cap unless specifically authorized by the Commission and recommended that the sentence be deleted. Some commenters recommended that the rule specify the extent to which licensees may take credit for engineered barriers. Other commenters stated that 1 mSv/y (100

mrem/y) is too high and that a lower value (e.g., 0.15, 0.3, 0.5, 0.75 mSv/y (15, 30, 50, or 75 mrem/y)) should be applied because institutional controls are uncertain, concerns over health effects would exist, and doses in excess of 40 CFR Part 190 are unreasonable. Some commenters agreed with establishing a maximum TEDE of 1 mSv/y (100 mrem/y) in the event institutional controls are no longer in effect.

B.2.5 Financial assurance for restricted use. Some commenters questioned the need for financial assurance provisions and suggested that more flexibility be provided for licensees. Other commenters questioned whether the financial assurance provisions were adequate. One commenter stated that there should be more detail on financial assurance provided in the rule.

B.3 Response.

B.3.1 The general concept of restricted use. Current NRC regulations pertaining to decommissioning, promulgated on June 27, 1988 (53 FR 24018), do not contain provisions for release of a facility for restricted use but limit a licensee's options in decommissioning to release of a facility for unrestricted use. Experience with decommissioning of facilities since 1988 has indicated that for certain facilities, achieving unrestricted use might not be appropriate because there may be net public or environmental harm in achieving unrestricted use, or because expected future use of the site would likely preclude unrestricted use, or because the cost of site cleanup and waste disposal to achieve unrestricted use is excessive compared to achieving the same dose criterion by restricting use of the site and eliminating exposure pathways. The input received

from the rulemaking workshops held from January through May 1993 confirmed this experience and indicated that restricted use of a facility, if properly designed and if proper controls were in place, was a reasonable means for terminating licenses at certain facilities.

Current NRC-licensed sites that might request restricted use are largely industrial sites. It is reasonable for them to remain industrial because of their locations and previous siting considerations. Nevertheless, there may be instances where, if a site had high cultural value, such considerations would be presented as part of the public process that is part of restricted use (see Section IV.E, below) and could be considered as a socioeconomic effect under the ALARA process.

The proposed rule thus provided for both unrestricted and restricted use of sites. Both the Draft and Final GEIS provide discussions of the environmental impact of decommissioning for the reference sites and of the costs related to decommissioning. From this it may be concluded that release of certain facilities for restricted use is an appropriate option assuming the presence of the specific provisions described below to ensure that appropriate controls are in place so that the restrictions on use remain in effect.

B.3.2 The need for licensees to demonstrate that restricted use is appropriate for their sites. As described in IV.B.3.1, the proposed rule allowed restricted use because release of a site under restricted conditions can be an appropriate method of decommissioning from both health and safety, and cost-benefit bases, especially for certain facilities with soil contamination. Nevertheless it did so under the philosophy (stated in § 20.1402(d)) that, in general, termination of a license for unrestricted use is preferable because it requires no additional precautions or

limitations on use of the site after licensing control ceases, in particular for those sites with long-lived nuclides. In addition, there may be societal or economic benefits related to future value of the unrestricted use of the land to the community. Thus, § 20.1405(a) of the proposed rule stated the provisions the NRC would consider in evaluating a request for termination of a site under restricted conditions, including that it is "prohibitively expensive" or there is "net public or environmental harm" in achieving unrestricted release.

The Commission continues to believe that unrestricted use is generally preferable for the reasons noted. However, the NRC has reexamined the provisions for allowing restricted use because of the potential benefits. In explaining the provision of "prohibitive" cost, the proposed rule noted (at 59 FR 43220) that costs to achieve unrestricted use may be "excessive," indicating that this means there may be situations where removal and disposal of large quantities of material is simply "not reasonable" from a cost standpoint. Consistent with this, the proposed rule noted in § 20.1402(d) that the Commission expected licensees to make every reasonable effort to achieve unrestricted release. The specific cost that would be considered excessive, not reasonable, or prohibitive was not included in the proposed rule. This value depends on costs of unrestricted and restricted use, and on an evaluation of these alternatives using the regulatory analysis framework presented in NUREG/BR-0058 and NUREG-1530. NUREG/BR-0058 provides a decisionmaking tool for deciding between regulatory alternatives. As noted in the discussion below, restricted use with appropriate institutional controls (accompanied by sufficient provisions for ensuring their effectiveness) can provide protection of public health and

safety because the dose level will be reduced to the same 0.25 mSv/y (25 mrem/y) criterion as for unrestricted use. Thus, use of the guidelines in NUREG/BR-0058 is appropriate for determining whether restricted use should be permitted. Therefore, the Commission has modified the rule to incorporate an ALARA standard rather than prohibitive costs as the basis for selecting restricted use. To support a request for restricted use, a licensee would perform an ALARA analysis of the risks and benefits of all viable alternatives and include consideration of any detriments. This could include estimated fatalities from transportation accidents that might occur as the result of transport of wastes from cleanup activities, and societal and socioeconomic considerations such as the potential value to the community of unrestricted use of the land.

The proposed rule also noted that because the net public or environmental damage through removal, transport, and disposal of materials could be larger than the benefit in dose reduction at the site, it may be more reasonable for the material to remain onsite. The Final GEIS illustrates when it may be inappropriate, when considering such relative impacts, to completely remediate a site to an unrestricted level that assumes activities such as farming or residence, and then, as would be the case for a number of currently licensed sites, actually employ a commercial or industrial use that would eliminate significant pathways of exposure. Specific examples include reactors or other materials facilities where the dose is controlled by relatively short-lived nuclides (e.g., Co-60 and Cs-137 with half-lives of 5.3 and 30 years, respectively) that will decay to unrestricted dose levels in a finite time period of institutional control (e.g., about 10 - 60 years). For these facilities, there may be net public or environmental harm from removing and transporting soil to achieve unrestricted use compared to restricting use for a period of time

associated with a reasonable decay period (see the Final GEIS, Chapter 6). Thus, the consideration of potential detriments from cleanup activities and the possibility of net harm have been retained in the final rule. Both terms, net public harm and net environmental harm, are retained in the final rule to indicate that a licensee's evaluation should consider the radiological and nonradiological impacts of decommissioning on persons who may be impacted, as well as the potential impact on ecological systems from decommissioning activities.

B.3.3 The durability of institutional controls. As described in Sections IV.B.3.1 and B.3.2, above, use of restrictions that employ institutional controls appears appropriate in specific situations. However, an important question raised in the public comments relates to the durability of institutional controls, i.e., whether the controls provide reasonable assurance that the exposure will be limited to the dose criterion in the rule over the periods in question.

For many types of decommissioned sites released under restricted conditions where potential doses to an individual are caused by relatively short-lived nuclides, the radiation exposure that could potentially be received were controls to fail will gradually decrease to below the unrestricted dose criterion so the restrictions on use would no longer be necessary. Examples of facilities with nuclides of this type include reactors or materials facilities for which the principal dose contributing nuclides after decommissioning are Co-60 or Cs-137 (half-lives 5.3 and 30 years, respectively), or other similarly short-lived nuclides. The Commission has considered the effectiveness of institutional controls for up to 100 years in similar contexts such as low-level waste disposal sites. Because decommissioned facilities will have minimal contamination compared to large volumes buried at low-level disposal sites, the Commission

believes that institutional controls using relatively simple deed restrictions can provide reasonable assurance that the TEDE will be below the 0.25 mSv/y (25 mrem/y) dose criterion with restrictions in place

In a limited number of cases, in particular those involving large quantities of uranium and thorium contamination, the presence of long-lived nuclides at decommissioned sites will continue the potential for radiation exposure beyond the 100-year period. More stringent institutional controls will be required in these situations, such as legally enforceable deed restrictions and/or controls backed up by State and local government control or ownership, engineered barriers, and Federal ownership, as appropriate. Such Federal control is authorized under Section 151(b) of the National Waste Policy Act (NWPA). Requiring absolute proof that such controls would endure over long periods of time would be difficult, and the Commission does not intend to require this of licensees. Rather, institutional controls should be established by the licensee with the objective of lasting 1000 years to be consistent with the time-frame used for calculations (and discussed in Section IV.F.7). Having done this, the licensee would be expected to demonstrate that the institutional controls could reasonably be expected to be effective into the foreseeable future.

To provide added assurance that the public will be protected, the final rule incorporates provisions (§ 20.1405(c)) for financial assurance to ensure that the controls remain in place and are effective over the period needed. Given these provisions, the Commission believes that the use of reliable institutional controls is appropriate and that such controls will provide a high level of assurance that doses will not exceed the dose criterion for unrestricted use.

Although the Commission believes that failure of active and passive institutional controls with the appropriate provisions in place will be rare, it recognizes that it is not possible to preclude the failure of controls. Therefore, in the proposed rule, the Commission included a requirement that remediation be conducted so that there would be a maximum value ("cap") on the TEDE from residual radioactivity if the institutional controls were no longer effective in limiting the possible scenarios or pathways of exposure. The cap included in the proposed rule was 1 mSv/y (100 mrem/y), which is the public dose limit codified in 10 CFR Part 20. Public comments on the proposed rule suggested other values for the cap, both higher than and lower than the proposed value. The analysis of those comments, and their potential effect on the institutional controls used, is discussed in Section IV.B.3.4, below.

The Commission believes that, given the discussion above on the viability of controls and on the provisions for financial assurance and for a "cap," the provision for restricted use and institutional controls will provide a high level of assurance that public health and safety will be protected. Licensees seeking restricted use will be required to demonstrate, to NRC's satisfaction, that the institutional controls they propose are comparable to those discussed above, are legally enforceable, and are backed by financial assurance. Licensees will also be required to demonstrate that the cap will be met. The Commission believes that the provision for restricted use should be retained in the final rule.

B.3.4 The 1 mSv/y (100 mrem/y) cap if institutional controls fail. A "cap" of 1 mSv/y (100 mrem/y), corresponding to the public dose limit, was proposed in § 20.1405(d) of the proposed rule. Various possible "cap" values were suggested by the commenters, both lower

than (e.g., values such as 0.15, 0.3, or 0.85 mSv/y (15, 30, or 85 mrem/y)) or higher than the proposed cap.

The Commission has reviewed the comments suggesting that the specific cap value be set at levels other than 1 mSv/y (100 mrem/y). The rationale for setting the cap at 1 mSv/y (100 mrem/y) presented in the proposed rule (at 59 FR 43221) was that the value of the cap coincides with NRC's public dose limit of 10 CFR Part 20. This value was premised on the assumption that circumstances could develop under which the restrictions might no longer be effective in limiting the exposure scenarios or pathways. Although this occurrence need not be assumed for planning purposes, a safety net is needed to prevent exposures in excess of the public dose limits. Thus, a cap using the public dose limits would provide an additional level of protection in the unlikely event that restrictions were not effective. Although, as noted in Section IV.A.2, above, the Commission has used a fraction of the public dose limit in setting the 0.25 mSv/y (25 mrem/y) dose limit for decommissioning, it indicated in the proposed rule that, in the case of the "cap" or "safety net," it did not believe that fractionation, i.e., setting a cap value less than 1 mSv/y (100 mrem/y), would be necessary because:

(a) The 1 mSv/y (100 mrem/y) cap is less than values suggested in the proposed FRG for members of the public in unusual circumstances and less than values used for other types of facilities where some type of institutional control is used;

(b) The Commission believes that failure of all site restrictions at decommissioned sites is a highly unlikely event; and

(c) Radioactive decay for relatively short-lived nuclides (e.g., Co-60 and Cs-137), that are the principal dose contributing contaminants at the large majority of NRC licensed facilities, will actually reduce the dose level over a period of time for most sites that will provide an additional margin of safety equivalent to fractionation of the limit.

The rationale for setting a cap value at 1 mSv/y (100 mrem/y) continues to appear appropriate. In addition, setting a cap at a lower value does not appear warranted because: (1) it appears arbitrary to assume that the same person would be an average member of the critical group both near a facility where there was failure of controls and near another decommissioned facility; and (2) the failure of restrictions would be infrequent and therefore it is likely that the overall lifetime risk to the critical group would still be maintained at levels comparable to unrestricted use while providing a more cost-effective use of resources.

Although the Commission did not fractionate the cap, it did include in the proposed rule, and continues to include in the final rule, a provision that would require exposures to be below the cap to a degree that is ALARA. The purpose of this requirement is that licensees would not simply leave behind contamination corresponding to the value of the cap but would evaluate the level below the cap that is cost effective and reduce the contamination to that level. This will provide a requirement that will effectively fractionate the doses and result in doses not dissimilar from those suggested by the commenters if it is cost-effective to do so. This approach is consistent with the current requirements in 10 CFR Part 20.

Based on its experience with sites with difficult contamination issues, in particular those sites treated in NRC's SDMP, and as described in the Final GEIS, the Commission anticipates

that there may be sites where compliance with the 1 mSv/y (100 mrem/y) cap could cause impacts resulting from cleanup to that level (e.g., estimated industrial or traffic fatalities associated with removing or transporting waste) that exceed the benefits of averting radiation exposure (thus causing a net detriment to public health or the environment) or that diminish the net benefit to where costs of cleanup would be prohibitive compared to the net benefit. Although the NRC recognizes that it is always the licensee's responsibility to clean up the contamination that it has caused, the appropriate course of action should not result in net public or environmental harm from a cleanup, and it is not clear that it is beneficial if resources are spent in a manner prohibitive in relation to other benefits which could be achieved, or if a licensee is put into a financial position where it cannot continue to perform the cleanup safely.

Although a cap higher than 1 mSv/y (100 mrem/y) would result in using a value in excess of the public dose limit in § 20.1301(a), existing requirements in § 20.1301(c) permit levels up to values of 5 mSv/y (500 mrem/y), provided that a licensee would apply to the Commission for permission to operate at that level, submit reasons why it is necessary, and indicate procedures to maintain doses ALARA. The proposed FRG, Recommendation No. 4, states that the dose from all sources should not exceed 1 mSv/y (100 mrem/y) although it may be exceeded temporarily in unusual situations that are not expected to recur.

Based on this existing requirement, the Commission has incorporated specific language into the final rule under which, in unusual site-specific circumstances, a licensee could propose exceeding the 1 mSv/y (100 mrem/y) cap if, in addition to the normal provisions of restricted use, it also met the following additional stringent provisions:

(a) A licensee would have to demonstrate that it cannot meet the 1 mSv/y (100 mrem/y) cap because of net public or environmental harm or prohibitive costs by means of a site-specific evaluation of the issues associated with complying with the 1 mSv/y (100 mrem/y) cap. The NRC expects that only a very few facilities (e.g., sites with soil contaminated with naturally occurring radionuclides in small radioactivity levels but large volumes, certain SDMP sites) could provide sufficient rationale for seeking a higher cap. Although the proposed rule contained a reference to the use of prohibitive cost, it did not quantify or define these costs beyond noting that they would be excessive or unreasonable. The Commission believes it appropriate to consider a prohibitive cost to be one that would be an order of magnitude greater than that contained as part of the decisionmaking guidelines in NUREG/BR-0058, although a lower factor may be appropriate in specific situations when a licensee could become financially incapable of carrying out decommissioning safely;

(b) Under such circumstances, the licensee would be required to reduce contamination so doses would be no greater than the 5 mSv/y (500 mrem/y) value currently contained in § 20.1301(a). Also, the actual dose level to which the licensee would have to clean the site would be less than that value based on an ALARA evaluation of the site. This provision is consistent with existing requirements in § 20.1301(c) that permit levels up to values of 5 mSv/y (500 mrem/y) for specific cases;

(c) Durable institutional controls must be in place. These controls could include significant engineered barriers and/or State, local, or Federal Government control of sites or maintenance of site deed restrictions so that site access is controlled. Under Section 151(b) of

the NWPA of 1982, the DOE has already been authorized to take possession of waste disposal sites in certain situations. A similar provision in Section 151(c) was used as the vehicle to transfer custody of the Amax site from Amax to DOE;

(d) A licensee would make provisions for a verification of the continued effectiveness of institutional controls at the site every 5 years recheck after license termination to ensure that the institutional controls are in place and the restrictions are working, and that there is financial assurance to reestablish controls if the recheck indicates otherwise. This 5-year recheck is consistent with 10 CFR Part 20 and also with the FRG, Recommendation No. 4, that states that in some unusual situations the 1 mSv/y (100 mrem/y) may be exceeded temporarily in situations that are not anticipated to recur. It is also consistent with the approach for institutional controls used in CERCLA that allows for release of sites without a cap providing there is continuous checking on the status of the controls.

The NRC would retain the authority to take appropriate action in those unusual situations when both the 5 mSv/y (500 mrem/y) cap was in effect and the controls had failed. This action might include oversight over actions needed to reinstate the controls and any necessary cleanup and/or monitoring actions.

B.3.5 Financial assurance. As a second provision for ensuring that the institutional controls provide protection of public health and safety, financial assurance requirements were included to ensure that funds will be available to enable an independent third party, including a governmental custodian of a site, to implement and ensure continued effectiveness of institutional controls. Some commenters questioned whether these provisions were necessary

while others questioned whether they went far enough. In response, the Commission continues to believe the proposed provisions are reasonable and adequate for their purpose. The provisions are consistent with financial assurance requirements currently in 10 CFR Parts 30, 40, 50, 61, 70, and 72 that call for financial assurance to provide funds for decommissioning in cases when licensees might otherwise be financially unable to remediate a site. Reference to an independent third party is necessary in the regulations because after the license is terminated, the licensee may no longer be the party ensuring the effectiveness of the controls. Because the purpose of this provision in the rule is to provide broad requirements for financial assurance necessary to ensure that the controls continue to limit the dose, more specific details are not included in the rule. The level of detail in the rule is similar to that in other similar NRC regulations on financial assurance. As requested by a commenter, the funding provisions include a trust fund (or similar funding mechanism) for surveillance and enforcement of the institutional controls. The financial assurance requirements must be in place before the license is terminated and be flexible enough to allow for the necessary site-specific details.

B.4 Summary of rule revisions on restricted use.

Based on the discussions above, restricted use has been retained in the final rule. Based on its analyses in the Final GEIS and its experiences with actual decommissioned sites, the Commission recognizes that, although unrestricted use is generally preferred, restricted use, when properly designed in accordance with the rule's provisions, can provide a cost-effective

alternative to unrestricted use for some facilities and maintain the dose to the average member of the pertinent critical group at the same level. Thus, the Commission has replaced the prohibitively expensive provision for justifying restricted use with a reasonable cost provision. The net harm provision remains the same. The general cap value has been retained at 1 mSv/y (100 mrem/y) as has the requirement that licensees reduce the actual level of contamination to levels as far below the cap as is ALARA, where appropriate. The rule has been modified to allow for exceeding the 1 mSv/y (100 mrem/y) cap in site-specific situations and under specific provisions. No change has been made to the financial assurance provisions of the rule.

C. Alternate criteria for license termination.

C.1 Codifying provisions for certain facilities that the proposed rule suggested exempting.

C.1.1 Proposed rule content. The preamble to the proposed rule noted that there were several existing licensed sites where public health and the environment may best be protected by use of alternate criteria, although these situations were not codified in the proposed rule; rather, it was thought that these facilities might seek exemptions (under § 20.2301) from the criteria of this rule.

C.1.2 Comments. Some commenters recommended that the rule should not apply to any facility that possesses large volumes of low-level contaminated wastes (including SDMP sites)

and should explicitly provide a specific exemption or exemption procedures for the "tens" of existing facilities for which application of the proposed criteria is inappropriate and too restrictive. Commenters suggested that guidance is needed on sites that should be turned over to the Federal Government after license termination and sites that should be kept under license. Commenters also recommended that NRC ask Congress to amend the NWPA of 1982 to allow Federal ownership of extensively contaminated sites. Other commenters objected to exempting facilities from the proposed radiological criteria and stated that the rule should cover all decommissioning cases.

C.1.3 Response. For the very large majority of NRC-licensed sites, the Commission continues to believe that the unrestricted and restricted use provisions of the rule provide appropriate and achievable criteria for decommissioning.

Licensees who would have sought exemptions to the proposed rule's criteria would have had to follow processes similar to the other facilities covered by the rule. In addition, licensing efficiency, consistency of application of requirements, and oversight of these facilities can best be achieved by codifying application of criteria to all facilities. Therefore, the Commission believes that it is preferable to codify provisions for these facilities under the aegis of the rule rather than requiring licensees to seek an exemption process outside the rule as was contemplated in the proposed rulemaking.

In addition, as discussed in Section IV.A, above, the Commission has concluded that for any site where the 0.25 mSv/y (25 mrem/y) dose criterion is met, there will be a very low likelihood that individuals who use the site will be exposed to multiple sources with cumulative

doses approaching 1 mSv/y (100 mrem/y). Thus, the discussion in Section IV.A of this notice establishes this level as a sufficient and ample, but not necessary, margin of safety.

Based on these considerations, the Commission has included a provision for alternate criteria in its final rule. However, for the reasons previously listed in Section A.2.3.4, the Commission has limited the conditions under which a licensee would apply to the NRC for alternate criteria to special circumstances. Thus, the Commission considers it reasonable to modify the rule to allow alternate dose criteria in very specific situations subject to the following provisions:

(a) A licensee must provide assurance that, for the site under consideration, it is unlikely that the dose to an average member of the critical group for that site, from all potential man-made sources, would exceed the 1 mSv/y (100 mrem/y) public dose limit of 10 CFR Part 20. The Commission envisions that a licensee proposing to use alternate criteria will have to provide a complete and comprehensive analysis that would build upon generic considerations such as those discussed in Section IV.A.2, above, and also include site-specific considerations. The NRC is continuing to develop generic information on the potential for exposure to radioactivity from various sources, including decommissioned sources, to supplement currently available knowledge. This information, that will be made publicly available through publication of a NUREG report, is expected to be useful in implementing the alternate criteria provision of the rule. Site-specific factors that licensees might consider in their analysis could include soil and aquifer characteristics, the nature of the critical groups likely to use the site, the detailed nature of

the contamination patterns at the site, and the characteristics of residual radionuclides remaining at the site, including considerations related to whether the nuclides are long-lived or short-lived;

(b) A licensee will employ restrictions on site use to the extent practical;

(c) A licensee will indicate that a comprehensive analysis had been performed of the risks and benefits of all viable alternatives and consideration of any detriments, such as transportation fatalities that might occur as the result of cleanup activities, in order to reduce the residual radioactivity at the site to levels that are ALARA.

If the license termination conditions under alternate criteria cannot be met, it may be necessary for the site (or portion thereof) to be kept under license in order to ensure that exposures to the public are appropriately monitored. The evaluation of maintenance of a site or a portion of that site under continued license is outside the scope of this rulemaking because this rule contains provisions, including radiological criteria, that apply to termination of a license.

With regard to the comment on the NWPA, it should be noted that Section 151(b) of the NWPA already authorizes such ownership by the U.S. Department of Energy, if NRC makes certain determinations. Therefore, no further legislation is needed to grant such authority. The rule language has been clarified to ensure that this authority may be implemented by NRC and DOE.

C.1.4 Summary of revisions to rule on codifying provisions for certain facilities. The rule has been modified to include the use of alternate criteria in specialized circumstances and under the provisions described above.

C.2 Exclusion of uranium/thorium mills proposed in § 20.1401(a).

C.2.1 Proposed rule content. The proposed rule stated that, for uranium mills, the criteria of the rule apply to the facility but do not apply to the disposal of uranium mill tailings or to soil cleanup. The proposed rule referred, at § 20.1401(a), to 10 CFR Part 40, Appendix A, where criteria already exist.

C.2.2 Comments. Comments on the proposed rule generally agreed with the exclusion for disposal of mill tailings and soil cleanup. Commenters also recommended that the rule exempt conventional thorium and uranium mill facilities and in situ leach (ISL) (specifically uranium solution extraction) facilities from the scope of coverage. This is similar to the exemption proposed for uranium mill tailings because the decommissioning of these operations is covered by Appendix A to 10 CFR Part 40 and 40 CFR Part 192. At these facilities, the decommissioning activities are similar to those at uranium mills and consist mainly of the cleanup of uranium and thorium mill tailings byproduct material as defined in Section 11e.(2) of the Atomic Energy Act of 1954, as amended.

C.2.3 Response. Current regulations applicable to remediation of both inactive tailings sites, including vicinity properties, and active uranium and thorium mills have been issued by the EPA and the NRC under the Uranium Mill Tailings Radiation Control Act (UMTRCA) of 1978, as amended. EPA's regulations in 40 CFR Part 192 and NRC's in 10 CFR Part 40, Appendix A, apply to remediation and decommissioning criteria, respectively.

Thus, applicable cleanup standards already exist for soil cleanup of radium in 10 CFR Part 40, Appendix A, Criterion 6(6) (radium is the main contaminant at mills in the large areas (20 - 400 hectares (50 to 1000 acres) for uranium mills) where windblown contamination from the tailings pile has occurred, and at ISLs (in holding ponds). These standards require that radium contamination in those large areas be cleaned to concentrations above background of 37 Bq/gm (5 pCi/gm) in the first 15 cm (6 inches) of soil, and 111 Bq/gm (15 pCi/gm) for every 15 cm (6 inches) below the first 15 cm (6 inches). Calculation of the dose resulting from cleanup of radium to these standards would generally result in doses much higher than the unrestricted use dose criterion of this rulemaking, although in actual practice cleanup of uranium mill tailings results in radium levels much lower than the 10 CFR Part 40 standards, and radium is usually removed to background levels during cleanup of uranium and thorium to the criteria of the SDMP Action Plan (57 FR 13389).

However, in other mill and ISL site areas proximate to locations where radium contamination exists (e.g., under the mill building, in a yellow cake storage area, under/around an ore pad, and at ISLs in soils where spray irrigation has occurred as a means of disposal), uranium or thorium would be the radionuclide of concern. Application of the decommissioning dose criterion of the final rule to these areas would result in a situation where the cleanup standard of that small portion of the mill site would be much lower than the standard for the large windblown tailings areas where radium is the nuclide of concern. This would result in situations of differing criteria being applied across essentially the same areas. A difficulty in application of 10 CFR

Part 40, Appendix A, to uranium and thorium is that it does not have any cleanup standards for soil contamination from radionuclides other than radium.

To address this situation, the Commission has decided that § 20.1401(a) should be modified to use a dose objective for uranium and thorium in soil and buildings at uranium and thorium sites to be consistent with the radium cleanup standard already in place for those sites in 10 CFR Part 40, Appendix A, and 40 CFR Part 192. Under this approach, uranium and thorium mills and ISLs would use the dose from radium in existing 10 CFR Part 40 as a benchmark for the cleanup of uranium and thorium contaminated soil. This is consistent with the discussion in the preamble to the proposed rule for dealing with large volume, low contamination at certain sites. A similar approach would be used at ISLs where land application and spills have resulted in uranium contamination.

With respect to groundwater cleanup, the Commission has established standards in 10 CFR Part 40, Appendix A, for the cleanup of groundwater contamination from byproduct material in the tailings impoundment. As is the case for soil contamination, these standards are not applicable to the cleanup of groundwater contamination from other activities and other radionuclides on the mill site such as ore or yellowcake storage. Thus, as is also the case for soil contamination, to avoid situations of differing criteria being applied across essentially the same areas, it is reasonable to apply a consistent set of standards at a site. Unlike soil cleanup, groundwater contamination resulting from sources other than the tailings impoundment can be addressed through Criterion 5(F) of 10 CFR Part 40, Appendix A. Under Criterion 5(F), uranium and thorium recovery licensees would be required to address seepage of contaminants into the

groundwater from sources other than byproduct material. Further, Criterion 5(F) specifies that the cleanup standards for this contamination would be determined on a site-specific basis. Therefore, the Commission expects that standards for groundwater cleanup from sources other than byproduct will be comparable to the standards currently in Criterion 5(B) of 10 CFR Part 40.

C.2.4 Summary of rule revisions for uranium/thorium mills. The rule has been modified to indicate that for uranium and thorium facilities already subject to 10 CFR Part 40, Appendix A, and uranium solution extraction facilities, cleanup of radionuclides other than radium from buildings and soils shall result in a dose no greater than the dose resulting from cleanup of radium contaminated soil to the standard specified in Criterion 6(6) of 10 CFR Part 40, Appendix A. Groundwater protection and decontamination at uranium and thorium recovery facilities subject to 10 CFR Part 40, Appendix A, shall be governed solely by the applicable requirements of Appendix A.

C.3 Other exemptions.

C.3.1 Comments.

Commenters suggested certain other exemptions be specifically provided for in the rule including:

(a) Licensees that possess and hold only sealed sources or limited quantities; and

(b) Radioactive waste materials disposed of in accordance with NRC regulations in formerly used §§ 20.302 and 20.304 because ALARA was applied on a site-specific basis for these facilities.

Other commenters disagreed and stated that all such waste must be decommissioned. In addition, there were commenters who stated that exemption procedures should be spelled out.

C.3.2 Response. No exemption from the rule for sealed source or limited quantity users is necessary. Under provisions of 10 CFR Parts 30, 40, and 70, §§ 30.36(c)(1)(v), 40.42(c)(1)(v), and 70.38(c)(1)(v), the licensee could provide assurance that building or soil contamination has never occurred or demonstrate that the level of radioactive material contamination in the facility conforms with screening criteria.

With regard to burials, as discussed in the preamble to the proposed rule, the determination of whether the licensee meets the radiological criteria of the final rule includes consideration of all residual radioactivity at the site, including burials made in conformance with 10 CFR Part 20 (both existing § 20.2002 and formerly used §§ 20.302 and 20.304). This is consistent with prior Commission statements made in the preamble to the 1988 rulemaking on general requirements for decommissioning (53 FR 24018; June 27, 1988) and in promulgation of the final rule on timeliness of decommissioning (59 FR 36026; July 15, 1994). More recent past burials (1981 to present) were frequently made in conformance with guidelines defined in "Onsite Disposal of Radioactive Waste," NUREG-1101, Volumes 1 through 3. This guidance was based on a maximum annual whole body or critical organ dose of 0.25 mSv (25 mrem). Although numerically similar to the existing low-level waste disposal criteria in 10 CFR Part 61,

the Commission believes that, as a whole, the regulations applicable to low-level waste disposal sites are much more restrictive than those applicable to onsite burials. The pathway parameters on which NUREG-1101 is based may not be comparable to those used to define the rule's unrestricted release criteria. Nevertheless, case-by-case analysis of the potential radiological impacts could indicate that leaving the burials in place could be consistent with unrestricted or restricted release of the affected site. For past burials that have involved long-lived nuclides, site-specific modeling may also justify leaving these burials in place. Thus, the Commission sees no reason to specifically exempt these burials from consideration under this final rule but would continue to require an analysis of site-specific overall impacts and costs in deciding whether or not exhumation of previous buried waste is necessary for specific sites. In addition, the general exemption provisions of 10 CFR Part 20 are available to consider unique past burials on a case-by-case basis.

With regard to specific provisions in the rule for exemptions, the Commission is not convinced that a significant number of exemptions to the unrestricted or restricted use provisions of the final rule will be necessary. The Commission believes that the options in this rule for release under alternate criteria and the flexibility contained in the rule including the use of realistic site-specific screening and modeling provide licensees with sufficient latitude.

D. Groundwater protection criteria (proposed rule § 20.1403).

D.1 Proposed rule content.

The proposed rule (§ 20.1403(d)) indicated that a licensee must demonstrate a reasonable expectation that residual radioactivity from the site will not cause the level of radioactivity in groundwater that is a current or potential source of drinking water to exceed the limits specified in 40 CFR Part 141. This groundwater requirement would have been in addition to the proposed dose criterion for unrestricted use and was included as part of the proposed rule on EPA's recommendation. The preamble to the proposed rule solicited responses to three specific questions on this proposal, including whether such a separate standard was appropriate as a supplement to an overall radiological dose criterion that applies to all exposure pathways.

D.2 Use of EPA drinking water standards in NRC rule.

D.2.1 Comments. A number of commenters disagreed with the inclusion of a separate groundwater requirement. In response to the specific questions asked, many of these commenters stated that a separate requirement for groundwater was not necessary if the rule included an all-pathways standard. A commenter also noted that application of Maximum Contaminant Levels (MCLs) to groundwater was inappropriate because the MCLs of EPA's drinking water standards were based on outdated dosimetry (ICRP2) and were applicable to public water systems rather

than to groundwater directly. Other commenters supported establishing a separate groundwater requirement as being consistent with the EPA standard.

D.2.2 Response. As noted above, the NRC's proposed rule included separate requirements for groundwater protection. The NRC staff has reviewed the public comments on its proposed rule, including the EPA comments supporting the separate requirement, has reviewed the bases and rationale for a separate groundwater standard, and has conducted further technical analyses of groundwater protection in the Final GEIS.

As described in some detail in Section IV.A.2.2, above, there were three broad considerations that provided the overall rationale for the proposed rule's contents. The first two considerations were related to the health and safety aspects, and the third was related to cost and practicality aspects. As was done in Section IV.A.2.2, above, regarding the establishment of unrestricted and restricted dose criteria, this section reexamines these three considerations in the context of determining appropriate groundwater cleanup requirements for decommissioning.

With regard to the first two considerations, as described in Section IV.A.2.2, above, this final rule contains acceptable criteria (including the dose criterion for unrestricted use, and provisions for ALARA, restricted use, and alternate site-specific criteria) to protect the public from radiation from all of the pathways that they could be exposed to from a decommissioned facility (e.g., direct exposure to radiation, ingestion of food, inhalation of dust, and drinking water). The bases used in selecting the dose criterion for this final rule are stated above in Section IV.A.2.

The dose criterion thus codified in § 20.1402 of this final rule limits the amount of radiation that a person can potentially receive from all possible sources at a decommissioned facility. Therefore, it is an "all-pathways" standard. Examples of these pathways include:

(a) Direct exposure to radiation from material on the soil surface;

(b) Eating food grown in the soil and eating fish from surface waters;

(c) Inhalation of dust from soil surfaces; and

(d) Drinking water obtained from the groundwater.

Because equivalent doses received through any pathways of exposure would involve equivalent risks to the person exposed, NRC concludes the following with regard to the need to set a separate standard for groundwater:

(a) There is no reason from the standpoint of protection of public health and safety to have a separate, lower dose criterion for one of the pathways (e.g., drinking water) as long as, when combined, the dose from all the pathways doesn't exceed the total dose standard established in the rule;

(b) A standard imposed on a single pathway, such as drinking water, may have been appropriate in the past for site cleanups when a dose-based standard for decommissioning did not exist. It may also be appropriate for chemical contamination when no total limit on exposure exists. However, NRC's final rule on decommissioning would promulgate an overall TEDE criterion for all radionuclides combined and for all pathways of exposure combined, including drinking water, thus removing the need for a single-pathway standard. This is a more uniform method for protecting public health and safety than, as was contained in NRC's proposed rule,

setting separate requirements using the MCLs contained in 40 CFR Part 141. This is because the MCL requirements do not cover all radionuclides and do not provide a consistent risk standard for different radionuclides as will be provided by adoption of a single dose criterion in the final rule.

The Commission agrees with the commenters that exposures from drinking contaminated groundwater need to be controlled; with the EPA's groundwater protection principles contained in the document "Protecting the Nation's Groundwater: EPA Strategy for the 1990's," 212-1024 (July 1991); and with the EPA position that the environmental integrity of the nation's groundwater resources needs to be protected. Nonetheless, it is the Commission's position that protection of public health and safety is fully afforded by limiting exposure to persons from all potential sources of radioactive material by means of a TEDE at a decommissioned facility. There is, therefore, no compelling reason to impose a separate limit on dose from the drinking water pathway, and the rule has been modified to delete separate groundwater requirements. Nevertheless, to make clear NRC's concern over the importance of protecting this resource as a source of potential public exposure, the rule has also been modified to include a direct reference to the groundwater pathway in the all-pathways unrestricted use dose criterion in § 20.1402. Further separate protection of the resource cannot be effected unilaterally by this rulemaking but might be the subject of some future EPA action.

In actual situations, based on typical operational practices of most nuclear facilities and on the behavior of radionuclides in the environment for the very large majority of sites, concentrations of radionuclides in the groundwater will be well below the dose criterion of this

final rule and would be either below or only marginally above the MCLs codified in 40 CFR Part 141 as referenced in the proposed NRC rule. For example, because the large majority of NRC licensees either use sealed sources or have very short-lived radionuclides, it is highly unlikely that contamination from these facilities would reach the groundwater. Even for facilities like reactors or certain industrial facilities, whose major contaminants are relatively short-lived nuclides like Co-60 or Cs-137, the migration of these nuclides through soil is so slow that it precludes groundwater contamination of any significance. In addition, it is not anticipated that decommissioned nuclear facilities will be located near enough to public water treatment facilities so that treatment facilities would be affected by the potential groundwater contamination from decommissioned facilities.

As further described in Section IV.A.2, above, the Commission is basing its decision on analyses in the Final GEIS, that consider cost and practicality factors, to provide additional information regarding decisions on issues such as achieving ALARA levels below the dose criterion of § 20.1402 and allowing restricted use. These analyses also consider how these issues relate to groundwater cleanup, including how, and to what level, ALARA efforts should be made, and if, and in what manner, restrictions on use should be considered. The analysis of impacts to populations and the cost of remediating those impacts is particularly important for groundwater because this resource can be used in a variety of public uses away from the site being decommissioned. The Final GEIS draws from NRC's experience and the public comments regarding contaminated sites. In particular, considerations with regard to groundwater remediation include potential remediation methods such as removal of soil to preclude

prospective contamination, pump and treat processes for the cleanup of existing groundwater contamination, and the supply of alternate sources of drinking water, as well as a consideration of administrative costs associated with predicting and measuring levels of contaminated groundwater.

Given the range of possible parameters, scenarios, and site-specific situations, Section IV.A.2 notes that the Final GEIS finds that there is a wide range of cost-benefit results and there is no unique algorithm that is a decisive ALARA result for all facilities. This finding is especially true for groundwater contamination where the behavior of radionuclides in soil and in the aquifer is highly site-specific; much more so than, for example, behavior in concrete. The results of the overall considerations of Section IV.A.2 for all pathways would be applicable to the groundwater component. As pointed out in Section IV.A.2.3.2, it is intended that the regulatory guidance to be developed to support the final rule will provide guidance on these considerations. Although preparation of such guidance is in a preliminary stage, it is anticipated that this guidance would likely indicate that reducing doses to values less than the dose criterion of 0.25 mSv (25 mrem/y) is generally not likely to be cost-effective when evaluated using NRC's regulatory analysis framework presented in NUREG/BR–0058 and NUREG-1530, although there may be ALARA considerations for sites with a relatively large population obtaining all their drinking water from the site plume.

D.2.3 Summary of rule revisions on groundwater and plans for implementation. Based on the above, the Commission concludes that application of a separate groundwater protection

limit, in addition to the all pathways dose limit, is not necessary or justified and has deleted this requirement from its final rule.

As noted above, regulatory guidance to be prepared in support of the final rule will likely describe site-specific conditions under which an ALARA analysis could identify the need to consider reducing the dose below the unrestricted use dose criterion (e.g., large existing population deriving its drinking water from a downstream supply using a downstream plume).

E. Public participation (proposed rule §§ 20.1406 and 20.1407).

E.1 Proposed rule content.

The proposed rule included a requirement that upon receipt of a decommissioning plan or proposal for restricted use from a licensee, the NRC must notify and solicit comments from local and State governments and Indian nations in the vicinity of the site and publish a notice in a forum that is readily accessible to persons in the site vicinity to solicit comments from affected parties.

The proposed rule also required that for decommissionings when the licensee does not propose to achieve unrestricted release (i.e., instead restrict site use after license termination), the licensee must convene an site-specific advisory board (SSAB) for the purpose of obtaining advice from affected parties on the decommissioning. The Commission envisioned that the advice obtained would address whether:

(a) There are ways to achieve unrestricted release that would not be prohibitively expensive or cause net public or environmental harm;

(b) Institutional controls proposed by the licensee will provide reasonable assurance that the TEDE does not exceed the dose criterion, will be enforceable, and will not impose an undue burden on affected parties; and

(c) There is sufficient financial assurance to maintain the institutional controls.

E.2 Public participation and notifications.

E.2.1 Comments. Several commenters supported the public notification requirements in proposed § 20.1406(a). Other commenters stated that the proposed notification requirements exceeded requirements of the Administrative Procedures Act (APA) and that NRC has not demonstrated a health and safety need for these requirements. Suggestions for public participation offered by some commenters included that the public not only be informed but be able to participate effectively in all decommissioning cases, not just those related to SSABs. Other specific comments addressed the type and timing of the notification, meetings to be held, who should bear the cost of public participation, the availability of licensee documents, NRC's role, and the need for exemptions.

E.2.2 Response. A variety of comments have been provided on this issue during all phases of this rulemaking from the earliest workshops through comments on the NRC staff draft

rule (February 2, 1994; 59 FR 4868) and the proposed rule, and in a workshop on public participation aspects of the rule

held in December 1994. Comments provided in these forums have been similar to those noted above. A common theme of the December 1994 workshop was that there are many approaches for involving the public in the decommissioning process. Participants generally favored exploration of site-specific alternatives as opposed to generally mandated processes, like SSABs. Many commenters suggested that there was merit to having a public participation plan developed by the licensee in cooperation with interested parties. This way, public participation could be tailored to the needs of the community and the licensee.

The Commission agrees that public participation can be an important component for informing and involving the public. The Commission recognizes the potential benefit for all decommissionings and site releases of significant community concern to keep the public informed and educated about the status of decommissioning at a particular site and to elicit public concerns about the decommissioning process at that site. Based on the comments received and on a consideration of current Commission practices, the provisions in § 20.1404(a) that provide for notification of the public and solicitation of comment have not been modified to include additional specific requirements. This is because existing Commission policies and practices, coupled with the provisions of this rule and a recent rulemaking on power reactor decommissioning, appear reasonable by providing for public participation in the decommissioning and site release process. Specifically in the case of power reactors, as is noted in the preamble to the separate final rule entitled "Decommissioning of Nuclear Power Reactors" that was published on July 29, 1996 (61 FR 39278), the Commission has held public meetings and informal hearings for plants undergoing decommissioning, even though limited formal

requirements exist for this type of involvement. To codify those activities, that rule requires a public meeting to be held at the time of submittal of a reactor licensee's Post-Shutdown Decommissioning Activities Report (PSDAR) and requires that this meeting be noticed in a local public forum and held in the vicinity of the facility. The PSDAR must also be made available for public review and comment. In addition, a licensee is required to hold a public meeting on the License Termination Plan (LTP), that for power reactors now replaces the decommissioning plan, in the vicinity of the facility following notice of the meeting in a local public forum. The LTP is also required to be made available for public comment with full hearing rights under Subpart G or L of 10 CFR 2.1201, depending on the disposition of the spent fuel.

Similarly, for materials facilities involving significant decommissioning efforts, the Commission has implemented efforts to inform and involve the public in the process. These efforts were intended to provide early and meaningful opportunities for public involvement in the decommissioning process. For example, the NRC staff has initiated public information meetings at the Parks Township shallow land disposal area and the Sequoyah Fuels Corporation facility and conducted public information roundtables at various sites. Stakeholder representatives are routinely invited to participate in roundtable discussions and information exchanges on the status and issues associated with the decommissioning project. These initiatives are consistent with the NRC staff's public responsiveness plan in NUREG/BR-0199. Other public information meetings and involvement efforts, such as community information boards, are anticipated to be implemented at other facilities on a site-specific basis to address specific needs that exist in affected communities.

E.2.3 Summary of rule revisions on public participation and notifications. Based on these considerations, current practices and procedures and existing rule provisions are appropriate to provide for public participation in the decommissioning and license termination process and to provide sufficient flexibility to accommodate different situations. Therefore, no overall changes were made to the provisions for public notification in the final rule.

E.3 General requirements for SSABs.

E.3.1 Comments. Comments were specifically submitted on the requirement in § 20.1406(b) for the use of SSABs. These comments were submitted both in response to the proposed rule, as well as in connection with the NRC workshop on SSABs held on December 6 - 8, 1994 (see NUREG/CR-6307 for a summary of the workshop).

Some commenters supported the proposed requirement in § 20.1406(b) that would require licensees to convene an SSAB for restricted release of a site. Other commenters objected to the use of an SSAB in each case involving a restricted release of a site. These commenters expressed concern that use of SSABs was inconsistent with the timeliness rule or that exemptions or other relief from the timeliness rule would be needed; that a need for SSABs has not been demonstrated; and that SSABs are inconsistent with Federal Advisory Committee Act, Administrative Procedures Act, and Atomic Energy Act requirements. Commenters suggested alternatives to mandatory SSABs, such as addressing the need for a board in a public

participation plan or providing more flexibility in deciding when to use SSABs. Some commenters indicated that use of SSABs should be extended to the unrestricted use of sites.

E.3.2 Response. One of the major issues raised by the comments and in the workshop discussions on the SSAB was the advisability of mandating a specific public involvement mechanism such as an SSAB as opposed to establishing broad performance criteria that would allow the licensee flexibility in selecting the appropriate public involvement mechanism for a particular site. There was general agreement that flexibility was always desirable, if it were possible, in establishing meaningful performance criteria. However, it should be emphasized that some of those who supported the use of performance criteria did so only in the context of the expansion of the scope of licensee public involvement requirements, including an SSAB, to cover facilities beyond the restricted use category. An additional issue of concern to commenters was whether it was more appropriate for the licensee to establish the SSAB, as contemplated by the proposed rule, or whether the Commission should establish the SSAB. The resolution of this issue depends not only on the objectives that the Commission believes will be served by an SSAB, but also on what the Commission's broader responsibilities are in the public involvement area. This, in turn, relates to another issue raised by the commenters: the scope and duration of an SSAB's responsibilities.

In proposing a requirement for obtaining advice from affected parties on restricted use, the Commission's objective is to involve diverse community interests directly with the licensee in the development of the LTP or decommissioning plan for a proposed restricted use decommissioning. Community concerns, as well as community-based knowledge on the

appropriate selection of institutional controls, risk issues, and economic development, can be potentially useful in the development of the LTP or decommissioning plan. In order for Commission and licensee resources to be used efficiently, the Commission believes that this type of information should be considered and incorporated as appropriate into the LTP or decommissioning plan before the plan is submitted to the NRC for review. The licensee is the appropriate entity to accomplish this.

In considering a requirement to convene an SSAB or similar group, the Commission has considered alternatives regarding the most effective way to ensure that the licensee considers the diversity of views in the community. Small group discussions can be a more effective mechanism than written comments or large public meetings for articulating the exact nature of community concerns, determining how much agreement or disagreement there is on a particular issue, and facilitating the development of acceptable solutions to issues. Also, the type of close interaction resulting from a small group discussion could serve the licensee well in developing a credible relationship with the community in which it is operating.

Use of public participation methods is consistent with a variety of initiatives being undertaken both within NRC and at other Federal agencies regarding stakeholder involvement in the decommissioning process. Examples of community involvement at NRC-licensed sites being decommissioned under the SDMP are described above in Section IV.E.2.2. Similarly, several Federal agencies (including EPA, DOE, the Department of Defense (DOD)) that make up the Federal Facilities Environmental Restoration Dialogue Committee, in their evaluation of the cleanup of Federal facilities, have prepared a set of "Principles for Environmental Cleanup of

Federal Facilities," dated August 2, 1995. Principle No. 14 notes the need for agencies to provide for involvement of public stakeholders from affected communities in facility cleanup decisionmaking. It also notes that rather than being an impediment, meaningful stakeholder involvement has, in many instances, resulted in significant cleanup cost reductions.

The Commission envisions that a process for obtaining advice from affected interests would provide the opportunity for public involvement in the important issues related to restricted use of a site similar to those described in Section IV.E.2.2. In particular, one of the important issues would likely be the unavailability of the site for full unrestricted public use. In its deliberations on the rule, the Commission has envisioned that the following should occur:

(a) The licensee would present information to, and seek advice from, affected parties on the rationale for seeking restricted use, provisions for limiting the dose to meet the criteria in the rule (e.g., limiting use to commercial/industrial use with elimination of the resident pathway), how the restrictions would be enforced (e.g., use of deed restrictions, engineered barriers, State or Federal control or ownership), the effect on the community, and the adequacy of the level of financial assurance (e.g., sufficient funds for maintenance of the deed or of fencing). The information presented would be similar to that which the rule would require the licensee to prepare and submit to NRC to demonstrate the appropriateness and safety of seeking restricted use.

As an example, in the specific case where the nuclides involved are relatively short-lived (e.g., Co-60 and Cs-137), as discussed in Section IV.B.3, calculations could demonstrate that it is preferable to restrict use of the site for a finite time period to allow for radioactive decay than it is

to ship large quantities of soil. These calculations would also show the length of time that the restrictions would need to remain in force to allow for radioactive decay to reduce residual levels below the unrestricted dose criterion. In addition, these calculations could show that restricting the site to industrial use through deed restrictions during this time period would eliminate or decrease certain pathways and limit the dose to less than the 0.25 mSv/y (25 mrem/y) dose criteria in the rule. Finally, such an analysis could indicate that continued use of the site for an industrial purpose similar to its currently existing use should not adversely impact the community. Consideration of community advice on appropriate institutional controls for controlling access to the site during this decay period would provide the licensee with useful information in developing the necessary institutional controls.

For more complex cases where large volumes of uranium/thorium contamination would remain under a form of restricted use, the long-lived nature of these nuclides would result in the restrictions having to remain in force in the community for a long period of time. The information presented by the licensee would be similar to that for shorter-lived nuclides, including the rationale for the use of restrictions; the elimination of pathways (e.g., for uranium, elimination of the resident farmer pathway greatly reduces the dose because most of the dose received from uranium is through the agricultural pathway); the nature of the institutional controls expected to restrict use over extended time periods (e.g., deed restrictions, engineered barriers such as fencing, restricted cells, etc., and/or government control of the restricted area); and other special provisions such as periodic rechecks of the restricted area and the continued effectiveness of institutional controls (see Section IV.B.3). As discussed previously in Section

IV.E.2.2, above, because some community involvement already exists either formally or informally at a number of complex sites, this provision would not change the situation at these sites significantly.

(b) Following solicitation of advice from affected parties, the licensee will include the recommendations from these parties in the LTP or decommissioning plan and indicate how those recommendations were addressed along with the technical basis for addressing them. The technical basis for dealing with the recommendations would presumably derive from the presentation made to the affected parties described above and is the type of analysis that would be necessary to demonstrate to the NRC the acceptability of restricted use provisions.

Based on the above, it appears reasonable to retain the requirement for sites to seek advice from individuals and institutions in the community who may be affected by the decommissioning where restricted use is proposed. However, the Commission has decided to modify the rule to delete the specific reference as to how that advice is to be obtained (the proposed rule in § 21.1406(b) indicates that it must be by convening an SSAB). Instead, provisions have been included that will ensure that such advice is sought on the fundamental performance objective of institutional controls, namely that they function to provide reasonable assurance that the TEDE does not exceed the dose criteria of the rule, that they are enforceable, and that they will not impose undue burdens on the local community. The rationale for this decision derives from the discussion above on site flexibility, protecting public health and safety, and ensuring community involvement. Specifically, it is anticipated that these requirements will contain the beneficial provisions of ensuring timely and meaningful opportunity for public

involvement and will allow licensees additional flexibility in determining the best methods for obtaining that advice based on site-specific considerations. Licensees who propose to use restricted use will be required to seek advice regarding the proposed decommissioning from individuals and institutions in the community affected by the decommissioning, as well as to document how that advice was sought. Such documentation will result in a publicly available summary of the results of such discussions in the licensee's LTP or decommissioning plan. Appropriate mechanisms for seeking this advice could include a public meeting or series of meetings, a specific process for obtaining written or computerized public comment by internet or web-site means, or by convening small groups such as an SSAB. Any of these processes would result in an opportunity for a comprehensive, collective discussion of the issues by the affected parties. All of these approaches have been utilized in prior decommissionings. Advice sought in this manner would be considered in development of the LTP or decommissioning plan.

The Commission considered retaining a specific requirement for use of an SSAB to seek advice from affected interests in the community. However, the Commission has decided that the criteria in the final rule are an appropriate means to assure that the advice of affected interests will be considered in assuring that the performance objective of institutional controls is met. In addition, there may be situations where the creation of an SSAB may not be appropriate; for example, where an existing organization is already in place to assume this role, or where it is clear that the community is willing to rely on local government institutions to interact with the licensee. The criteria of the final rule provide flexibility in dealing with these and a variety of other situations.

E.3.3 Summary of rule revisions on SSABs. Specific text referring to SSABs has been replaced with a requirement that licensees seek community involvement and advice on the restricted use process for decommissioning through a variety of methods, and document the method used for seeking that advice in the LTP or decommissioning plan.

E.4 Specific questions on functioning of SSABs.

E.4.1 Comments. A number of specific comments were received on the functioning of SSABs including their responsibilities, membership, independence and support, meetings, and results.

(a) Some commenters recommended that SSABs should be given responsibilities beyond those specified in proposed § 20.1407(a). Other commenters stated that the rule should restrict SSAB activities to a specific mission which is advisory only and nontechnical;

(b) With regard to membership in SSABs, a number of comments recommended specifically how the SSAB and its membership should be constituted. Some commenters stated that many of the proposed SSAB issues that are listed appear to require specialized expertise that members of the general public might not have. Some commenters questioned whether NRC and other Government agencies should be prohibited from participating in SSABs because of conflict of interest questions. Other commenters stated that the NRC should be officially represented on the SSAB;

(c) With regard to independence of and support for SSABs, some comments received stated that an SSAB should be selected and operated independently of the licensee. One commenter stated that the SSAB would be unique as presently proposed because it does not appear to be accountable to its employer. Comments were received regarding how SSAB costs would be contained and how they would be paid, including costs of technical consultants to the SSAB or independent SSAB labs and experts;

(d) With regard to SSAB meetings and records, comments were provided concerning frequency, advertisement and openness of meetings, and access to licensee official documents, both those that are part of the public docket and those that contain proprietary or other confidential information;

(e) With regard to use of SSAB results, comments were received concerning the actions expected to be taken by the licensee and the NRC on the advice or comments of the SSAB. These actions include a licensee's analysis of SSAB recommendations, the need to obtain the SSAB's consensus on aspects of the decommissioning plan, and the effect on time restraints of submitting a decommissioning plan reconciling SSAB advice.

E.4.2 Response. Based on the discussion in Section IV.E.3.2 regarding the need to explore site-specific alternatives as opposed to generally mandated SSABs, the rule contains broad provisions for obtaining community advice and recommendations through such bodies. The purpose of the requirements on public involvement is to obtain meaningful public input into preparation of the plan for decommissioning the site when restrictions on future use are planned. To allow for flexibility, Section IV.E.3.2 indicates that the final rule establishes general requirements for obtaining such advice. The details, such as issues of size, membership specifics, responsibilities, administration, meetings, and records requested in these comments are more appropriately contained in regulatory guidance. Therefore, paragraphs (c) through (f) of § 20.1407 of the proposed rule have been deleted and are not included in the final rule. With regard to issues of funding public involvement, reasonable efforts towards obtaining advice from affected parties should be undertaken by the licensee, such as sponsoring and holding community

meetings and distributing information at those meetings regarding the rationale for and nature of the restricted use. Examples of such meetings are those held for reactor facilities and those held for several SDMP sites, for example the Cushing site.

E.4.3 Summary of rule revisions on functioning of SSABs. Provisions in § 20.1407(c) through (f) of the proposed rule have been deleted from the final rule.

F. Other procedural and technical issues.

F.1 State and NRC compatibility.

F.1.1 Comments. Some commenters stated that States should have the authority to demand stricter radiation protection standards than the Federal Government. Some commenters recommended that States not be allowed to set less strict conditions. Other commenters stated that radiological criteria should be an area of strict compatibility and States should not be permitted to impose more stringent standards. Specific comments raised included questions as to which standard would apply if there was a conflict, whether a State would need NRC approval to require more strict standards, application of ALARA provisions, who should pay for costs if more strict State standards are applied, exemptions, and grandfathering provisions similar to those in Section IV.F.2, below.

F.1.2 Response. The proposed rule did not propose a compatibility determination because the Commission was in the process of developing a compatibility policy. Instead,

comments were requested on compatibility and the comments received were divided on this issue.

The current compatibility policy categorizes rules into four "divisions." Division 1 rules are those that Agreement States must adopt, essentially verbatim, into their regulations. These rules include provisions that form the basic language of radiation protection and include technical definitions and radiation protection standards such as occupational exposure limits and effluent release limits. Division 2 rules address basic principles of radiation safety and regulatory functions. Although Agreement States must address these principles in their regulations, the use of language identical to that in NRC rules is not necessary if the underlying principles are the same. Also, the Agreement States may adopt requirements more stringent than NRC rules.

Because the dose criterion in the rule is not a "standard" in the sense of the public dose limits of 10 CFR Part 20 but is a constraint within the public dose limits, it is reasonable that the rule would be a Division 2 level of compatibility under the current policy. This means the Agreement States would be required to adopt the regulation but would have significant flexibility in language, and would be allowed to adopt more stringent requirements.

The Commission has not yet approved a new final policy on compatibility that revises the current policy, although it is currently considering the implementing procedures for this policy (SECY-96-213 dated October 3, 1996). Until the new policy becomes effective, NRC will continue to apply the current Agreement State compatibility policy.

F.2. Grandfathering sites with previously approved plans (proposed rule § 20.1401(b)).

F.2.1 Proposed rule contents. Section 20.1401(b) of the proposed rule indicated that the criteria do not apply to sites already covered by a decommissioning plan approved by the Commission before the effective date of the final rule and in accordance with the criteria identified in the SDMP Action Plan of April 16, 1992 (57 FR 13389).

F.2.2 Comments. Some commenters supported the provision of grandfathering sites covered by a decommissioning plan approved by the Commission (and suggested extending it to plans under review) because it is consistent with previous NRC statements in the SDMP Action Plan. Some commenters suggested that criteria other than those in the SDMP Action Plan should also be used for grandfathering. Other commenters opposed grandfathering because criteria used in those cases would be different than those in the rule.

Commenters recommended that the rule address how the criteria would apply to portions of sites. Some commenters recommended that the grandfathering provision cover an NRC-approved decommissioning plan even if it is for a portion of a site.

F.2.3 Response. The Commission continues to believe that sites being decommissioned under previously approved decommissioning plans should be grandfathered from the provisions of the final rule. Similarly provisions should apply to licensees whose decommissioning plans are in the final stages of preparation or of NRC review. From a health and safety perspective, the NRC believes the criteria identified in the SDMP Action Plan are reasonably consistent with the final rule's dose criteria. The contamination levels defined in the SDMP Action Plan are within the range of measurable values that could be derived through the site-specific screening and modeling approaches defined in guidance supporting this final rule. The Commission believes

the grandfathering approach will facilitate the timeliness of decommissioning and ensure licensees that resources spent to develop and implement a decommissioning plan are justified.

With regard to criteria other than the SDMP Action Plan, the grandfathering provision in the proposed rule was conditioned on the license being terminated in accordance with the criteria identified in the SDMP Action Plan, because those criteria are consistent with the final rule. However, the grandfathering provision does not extend to any former decommissioning actions in general because that would not provide assurance that such actions were adequate to protect the public. As part of its overall upgrading of its oversight of decommissioning actions, NRC has conducted a systematic review of a large number of license terminations to identify sites with significant contamination and has identified a number of sites warranting additional NRC attention. Broadening the grandfathering exclusion in the rule would not be consistent with the objectives of this comprehensive agency review and is not supported by existing information and experience.

The NRC staff anticipates that grandfathering would occur as follows: (a) Licensees would have up to 12 months after the effective date of the rule to submit sufficient LTPs or decommissioning plans (if required) in accordance with the SDMP Action Plan criteria;

(b) The NRC staff would have up to 24 months after the effective date of the rule to approve those plans;

(c) Any plan submitted after 12 months or approved after 24 months of the effective date would have to be consistent with the new rule; and

(d) There would be provisions for day-for-day extension if an EIS is required in the submittal; i.e., if development of an EIS is required before NRC can reach a decision regarding the decommissioning, then the 12-month window for submitting an LTP or decommissioning plan would be extended by the same number of days required for the Commission to issue a record of decision.

With regard to portions of sites, in submitting the decommissioning plan for the licensed activities that are to cease, the licensee must identify the areas associated with the ceased operations. These areas must be remediated to achieve acceptable radiological criteria for release, either those in the final rule or previous acceptance criteria that would achieve comparable protection as the criteria in the final rule. The area for continuing licensed operations could continue to contain radioactivity above the radiological criteria. When the continuing operations cease, the radiological criteria of the final rule would then be required to be met for the portion of the site for which operations had most recently ceased. The decision on grandfathering previously released portions of the site depends on whether the criteria previously used are still acceptable (e.g., part of the SDMP Action Plan) and whether it can be demonstrated that these areas have not been affected by the continued operations.

Not all licensees are required to submit decommissioning plans, and instead, may submit appropriate documentation including a report of the results of the radiation survey of the premises (see, for example, 10 CFR 30.36). Because the rationale discussed above applies in general to all facilities, these grandfathering provisions apply to all licensees, independent of the type of documentation for license termination that has

received NRC approval.

An aspect of grandfathering is those sites that were not previously licensed but are discovered to have radioactivity levels that are licensable or are in excess of the levels presented here as appropriate for unrestricted site use. These cases have arisen as part of the SDMP and are described in NUREG-1444. It is intended that the criteria of this rule will also apply, as appropriate, to residual radioactivity at sites that were not previously licensed.

F.2.4 Summary of rule revisions on grandfathering. The final rule has retained the grandfathering provision. However, it has been modified to include facilities whose plans are in the final stages of decommissioning plan preparation and decision.

F.3 Finality of decommissioning and future site reopening (proposed rule § 20.1401(c)).

F.3.1 Proposed rule contents. Proposed § 20.1401(c) stated that after a site has been decommissioned and the license terminated in accord with the criteria of the proposed rule, the Commission will require additional cleanup only if, based on new information, it determined that residual radioactivity remaining at the site could result in significant public risk.

F.3.2 Comments. Some commenters stated that decommissioning a nuclear facility and releasing a site should be accomplished as a final regulatory action unless new information indicates there is a significant health and safety risk and net benefit to future cleanup. These commenters cited financial reasonableness, the low risk associated with the criteria, and the incentive to complete decommissioning. Other commenters stated that they did not agree that

these actions should be final and that the site should be cleaned up to account for mistakes, discovery of contamination, or new health findings. It was noted that the terms "significant public risk" and "new information" used in proposed § 20.1401(c) needed to be explained and appropriately defined.

F.3.3 Response. The wording of final § 20.1401(c) states that the Commission will require additional cleanup only if, based on new information, it determines that residual radioactivity remaining at the site could result in significant public risk. The low level of estimated risk associated with the final rule's dose criteria, coupled with the conservatisms in the methodologies that convert these dose criteria to levels of measurable contamination in the environment, should minimize the likelihood that new information, including errors during the decommissioning processes, would significantly impact the protection of public health and safety or the environment.

The Commission believes the fundamental reason for requiring additional cleanup would hinge on the public risk associated with the remaining radioactivity at the site. The existence of additional contamination or noncompliance with the decommissioning plan at a level in excess of the dose criteria but less than the public dose limits in 10 CFR Part 20 would not, by themselves, be sufficient to invalidate the finality provision. Therefore, the wording of § 20.1401(c) captures the fundamental issue.

The Commission believes the terms "significant public risk" and "new information," as used in § 20.1401(c), do not require specific definition or clarification. The reason lies in the fact that under the provisions of the rule, a licensee is allowed to demonstrate compliance with the

dose criteria through use of several screening and modeling approaches. Each approach has a degree of conservatism associated with the relationship of the measurable level of a contaminant in the environment to the final rule's dose criterion. Because of the surveys required of the licensee and confirmatory surveys routinely performed by NRC, the chances of previously unidentified contamination being discovered would be expected to be small. Also, contamination that would pose a significant public risk above the levels implied by the dose criterion is expected to be smaller still.

Another possibility is that ongoing studies will lead to the conclusion that an increased risk associated with a given exposure to radiation exists. Although such an increase can occur as indicated by the continuing studies of Japanese atomic bomb survivors, the Commission believes that demographic studies of populations exposed to differing background exposure levels provide a defensible bound on the magnitude of any increase in the dose to risk conversion factor. Taken alone, any such increase would not be expected to affect finality decisions.

Thus, because any challenge to finality is likely to involve some unexpected combination of factors, the Commission believes that attempting to specifically define what constitutes "new information" or "significant public risk" is ill-advised because the determination would be made on a case-by-case basis.

As noted in Section IV.A.2.2 and IV.D.2.2, there are issues that have been raised by EPA regarding the acceptability of the unrestricted dose criterion as well as the inclusion of a separate groundwater standard. As noted in those sections, during the public comment period EPA indicated that it preferred a 0.15 mSv/y (15 mrem/y) TEDE dose criterion for unrestricted use

and a separate groundwater standard as were proposed in NRC's proposed rule. However, for the reasons described in some detail in Sections IV.A.2.2 and IV.D.2.2, the Commission has modified the rule by including in the final rule a 0.25 mSv/y (25 mrem/y) dose criterion and by deleting the separate groundwater standard. There is some potential that these revisions may raise issues as to whether EPA would consider the final rule sufficient under EPA's CERCLA regulations, and whether EPA would reconsider its current policy of exempting NRC sites from EPA's National Priorities List (NPL). Any such reconsideration could result in additional EPA review of sites whose licenses have been terminated by NRC.

As described in some detail in Sections IV.A.2.2 and IV.D.2.2, the Commission believes that the overall approach to license termination in this final rule (that includes unrestricted and restricted use dose criteria and ALARA considerations) protects public health and safety, and that the approach to drinking water protection in the final rule provides an appropriate and more consistent level of protection of public health and safety than use of MCLs. In addition, as is further described in those sections, it is anticipated that in the large majority of situations the combination of ALARA considerations, the nature of the concrete and soil removal processes, the use of restrictions on site use where appropriate, and the effects of radionuclide decay and transport mechanisms in the environment will result in the large majority of NRC licensees meeting the criteria preferred by EPA and avoiding the problems of being placed on the NPL and the resultant dual regulation.

Thus the Commission believes that the criteria of this final rule provides protection comparable to that preferred by EPA and that therefore it would be reasonable for EPA to find NRC's rule sufficiently protective.

Nevertheless, licensees should be aware that if they terminate a license using the criteria of this rule, there is some potential that, the license termination may be revisited as part of an EPA proceeding, although such an action would not seem reasonable for the same reasons that site cleanups noted above would not be revisited, i.e., it is not believed that significant public risk would be determined to exist.

F.3.4 Summary of rule revisions on finality. Based on this discussion, the rule has not been changed with regard to the finality issue.

F.4 Minimization of contamination (proposed rule §§ 20.1401(d) and 20.1408).

F.4.1 Proposed rule contents. Proposed § 20.1401(d) indicated that applicants for licenses, other than renewals, would be required to describe in the application process how facility design and procedures for operation will minimize contamination of the facility and the environment, facilitate eventual decommissioning, and minimize the generation of radioactive waste.

F.4.2 Comments. Some commenters recommended that the requirements for describing facility design and procedures for waste minimization should apply to all license applicants and

not only to applicants for new licenses. One commenter recommended that the rule remain as proposed and not apply to renewal licenses.

F.4.3 Response. The intent of this provision is to emphasize to a license applicant the importance, in an early stage of planning, for facilities to be designed and operated in a way that would minimize the amount of radioactive contamination generated at the site during its operating lifetime and would minimize the generation of radioactive waste during decontamination. Applicants and existing licensees, including those making license renewals, are already required by 10 CFR Part 20 to have radiation protection programs aimed towards reducing exposure and minimizing waste. In particular, § 20.1101(a) requires development and implementation of a radiation protection plan commensurate with the scope and extent of licensed activities and sufficient to ensure compliance with the provisions of 10 CFR Part 20. Section 20.1101(b) requires licensees to use, to the extent practicable, procedures and engineered controls to achieve public doses that are ALARA. In addition, lessons learned and documented in reports such as NUREG-1444 have focused attention on the need to minimize and control waste generation during operations as part of development of the required radiation protection plans. Furthermore, the financial assurance requirements promulgated in the January 27, 1988 (53 FR 24018), rule on planning for decommissioning require licensees to provide adequate funding for decommissioning. These funding requirements create great incentive to minimize contamination and the amount of funds set aside and expended on cleanup.

Thus, current requirements require both applicants and existing licensees, including renewals, to minimize contamination. Specific minimization requirements contained in the

proposed rule are directed towards those making application for a new license because it is more likely that consideration of design and operational aspects that would reduce dose and minimize waste can be cost-effective at that time compared to such considerations during the license renewal stage where the existing design and previous operations may be major constraints. The Commission continues to believe that the emphasis should continue to be directed at such new designs and, as such, the requirement for minimization has been retained as proposed.

F.4.4 Summary of rule revisions on minimization of contamination. The requirement in the proposed rule for imposition of the requirement on applicants for new licenses has been retained in the final rule in § 20.1406 but has not been further extended.

F.5 Provisions for readily removable residual radioactivity.

F.5.1 Proposed rule contents. Proposed § 20.1403(c) indicated that licensees are to take reasonable steps to remove all readily removable residual radioactivity from the site.

F.5.2 Comments. Some commenters recommended either deletion, modification, or clarification of the provision for readily removable residual radioactivity.

F.5.3 Response. The provision for removal of "readily removable" residual radioactivity was intended to provide guidance on what materials should be removed even if the removal would have little effect on dose. The intent of this provision is to define the basic remedies that are a matter of "good practice" such as common housekeeping techniques (e.g., washing with moderate amounts of detergent and water) that do not generate large volumes of radioactive

waste requiring subsequent disposal. As noted in the preamble to the proposed rule, removal of this material is considered a necessary and reasonable step toward ensuring that doses to the public from residual radioactivity are ALARA. These considerations should be considered as part of an ALARA evaluation for planning decommissioning activities in a licensee's radiation protection program as required by § 20.1101(b).

F.5.4 Summary of rule revisions for readily removable radioactivity. Because there is no purpose in duplicating an already existing requirement for ALARA, the specific provision regarding "readily removable" has been deleted from the final rule.

F.6 Separate standard for radon.

F.6.1 Proposed rule contents. Proposed § 20.1404(a) did not contain a separate standard for radon.

F.6.2 Comments. Some commenters indicated that the rule should specifically include reference to radon whereas other commenters stated that the rule should not include standards for radon or expressed concerns about the complications introduced by these considerations and the fact that background radon levels are so high.

F.6.3 Response. Following the approach taken in the proposed rule this final rule includes radiological criteria for residual radioactivity that is distinguishable from background. Wide variation in local concentrations of naturally occurring radon have been observed in all regions of the United States, including in soils and buildings. These variations make it very

difficult to distinguish between naturally occurring radon and radon resulting from licensed material. Because of these variations and the limitation of measurement techniques the Commission believes that it is not practical to distinguish between naturally occurring radon and elevated radon concentrations from licensed activities at levels which would result in doses comparable to the dose criteria included in the final rule. Consequently, in implementing the final rule, licensees will not be expected to demonstrate that radon from licensed activities is indistinguishable from background on a site-specific basis. This will be the case when radium, the principal precursor to radon, is indistinguishable from background or reduced to levels which meet the 25 mrem/y criterion for unrestricted release. In some instances it may not be reasonable to achieve levels of residual concentrations of radon precursors within the limit for unrestricted use. Restrictions would be applied to limit the effects of precursors but doses would also be reduced based on ALARA principles. In developing guidance on the application of ALARA in such cases, the Commission will also consider the practicality of employing radon mitigation techniques in existing or future structures.

F.6.4 Summary of rule revisions. No change to the final rule has been made.

F.7 Calculation of TEDE over 1000 years to demonstrate compliance with dose standard (proposed rule § 20.1403(a)).

F.7.1 Proposed rule contents. Proposed § 20.1403(a) stated that when calculating the TEDE, the licensee shall base estimates on the TEDE expected within the first 1000 years after decommissioning.

F.7.2 Comments. Some commenters objected to the proposed 1000-year time frame for calculating dose and wanted it lengthened to better predict health effects over the hazardous life of each isotope. Other commenters wanted the proposed 1000-year time frame shortened because it is inconsistent with 10 CFR Part 40, Appendix A, and 10 CFR Part 61 that use times of 200 - 500 years.

F.7.3 Response. As previously discussed in the preamble to the proposed rule, the Commission believes use of 1000 years in its calculation of maximum dose is reasonable based on the nature of the levels of radioactivity at decommissioned sites and the potential for changes in the physical characteristics at the site over long periods of time. Unlike analyses of situations where large quantities of long-lived radioactive material may be involved (e.g., a high-level waste repository) and where distant future calculations may provide some insight into consequences, in the analysis for decommissioning, where the consequences of exposure to residual radioactivity at levels near background are small and peak doses for radionuclides of interest in decommissioning occur within 1000 years, long term modeling thousands of years into the future of doses that are near background may be virtually meaningless. In 10 CFR Part 40, Appendix A makes reference to both a 200-year and 1000-year time frame. In 10 CFR Part 61 references the design of a physical barrier rather than a calculation of exposure.

F.7.4 Summary of rule revisions. This provision has been retained in § 20.1401(d) of the final rule.

G. Other comments.

G.1 Definitions (proposed rule § 20.1003).

G.1.1 Comments. There were comments on several definitions in § 20.1003 of the proposed rule including the following:

(a) With regard to the definition of background radiation, several commenters opposed defining "background radiation" in terms of currently existing levels and proposed defining it at the level existing when human beings and other organisms evolved; i.e., man-made sources of radiation should not be considered to be a part of "background radiation." One commenter suggested that the term "naturally occurring radioactive material," that is used in the definition of "background radiation," should also be defined. This commenter also suggested that the word "like," that precedes "Chernobyl," should be replaced with the words "such as" to clearly indicate that an example is being provided.

(b) With regard to the definition of decommissioning, several commenters recommended that license termination not be specified in the definition of decommissioning because it is a separate issue from decommissioning. Some commenters stated that licenses should be terminated only when sites are given unrestricted release and that restricted use should not be permitted or included in the definition.

(c) Other comments were also received requesting clarification of other definitions contained in the rule, including inclusion of radon in the definition of background and the definitions of critical group, restricted use, release of portions of sites, indistinguishable from background, readily removable radioactivity, and SSABs.

G.1.2 Response. The only modification that the proposed rule made to the existing definition of background in 10 CFR Part 20 was the inclusion of the phrase "or from past nuclear accidents like Chernobyl that contribute to background radiation and are not under the control of the licensee." The reason for this modification was to further clarify the existing requirement with regard to sources of radiation and radionuclides that can be excluded from licensee evaluation. After review of the comments, the Commission continues to believe that the inclusion in background of global fallout from weapons testing and accidents such as Chernobyl is appropriate. No compelling reason was presented that would indicate that remediation should include material over that the licensee has no control and that is present at comparable levels in the environment both on and offsite.

The existing definition of decommissioning in 10 CFR Parts 30, 40, 50, 70, and 72 was incorporated into the regulations on June 27, 1988 (53 FR 24018). The Commission continues to believe that "decommissioning" is a term for a process which ultimately leads to termination of an NRC license for unrestricted use. The only change to the existing definition made by the proposed rule would be adding "release of property under restricted conditions" to the process of termination of the license. In response to commenters who disagreed with permitting restricted use, Section IV.B contains a detailed review of issues on acceptability of restricted use. Based on

that review, the final rule continues to permit restricted use. Therefore, the definition in the proposed rule is not changed.

The rest of comments on definitions reflect specific technical concerns regarding use of the terms rather than the definition itself. These concerns are discussed in detail in the responses to technical issues addressed in previous sections.

G.1.3 Summary of rule revisions. The only change to § 20.1003 is a change in the wording of the definition of background to replace the word "like" with the words "such as" before "Chernobyl" as suggested by a commenter.

G.2 Need for regulatory guidance.

G.2.1 Comments. Commenters requested that additional regulatory guidance be provided on a number of subjects including decommissioning planning for sites and portions of sites, methods for demonstrating compliance with the dose criteria and with ALARA, means for complying with restricted use provisions (including SSAB operations), and contents of a public participation plan. Specific comments were received regarding need for guidance on modeling (including methods for translating contamination levels to dose) and surveys (including measurement of contamination at low levels), and clarification of several terms.

G.2.2 Response. Regulatory guidance is being developed in the areas requested. Regulatory guidance being prepared on dose calculations and surveys for radiological criteria for decommissioning describes acceptable survey methods that licensees can use. This guidance

describes methods that licensees can use to convert site contamination to dose for the purpose of compliance with the rule criteria and for estimating ALARA. The guidance is the further development of NUREG-1500 issued with the proposed rule and presents an approach for assessing dose coupled with the ability to incorporate site-specific parameters. Further guidance on public participation and restricted use is also being considered to support this rule.

G.3 Need for flexibility.

G.3.1 Comments. Commenters indicated that it is important to provide flexibility in compliance with rule requirements by use of site-specific conditions, ALARA, and exemptions in implementation of the criteria.

G.3.2 Response. Use of site-specific conditions, especially in calculation of acceptable contamination levels based on site-specific parameters, contamination levels and volumes, and usage of the site, is permitted in complying with the regulations. This will be discussed more fully in the regulatory guidance. Furthermore, the final rule provides for establishing alternate license termination criteria based on site-specific considerations.

G.4 Consistency with NRC's timeliness rule.

G.4.1 Comments. Some commenters indicated that the rule is inconsistent with NRC's timeliness rule (59 FR 36026; July 15, 1994).

G.4.2 Response. The timeliness rule requires licensees to notify the Commission promptly when a decision is made to permanently cease principal activities or whenever principal activities have ceased for 24 months. Further, it requires licensees to complete decommissioning within 24 months. The Commission may approve an alternate schedule to complete decommissioning provided sufficient justification is provided by the licensee.

Although this rule includes options for license termination or transfer to another entity, licensees will still be expected to initiate and complete decommissioning in a timely manner. If a licensee intends to use the restricted release option, the licensee is expected to promptly assess its site characteristics, submit a decommissioning plan if required, provide financial assurance, and include appropriate public participation in its decisionmaking. Because the requirements allow licensees 12 months to submit this information to the Commission, sufficient time should be available. The Commission may grant additional time if the licensee demonstrates that the relief is not detrimental to the public health and safety and is in the public interest. If a licensee is unable to demonstrate that release of a site would not prevent a member of the public from receiving a dose in excess of the public dose limit, the site would not be released but would be transferred to a Government entity or maintained under license. These cases are expected to be rare and will be handled on a case-by-case basis.

G.5 Comments from power reactor decommissioning rulemaking.

G.5.1 Comments. Comments were received on the power reactor decommissioning rule that was recently finalized and published on July 29, 1996 (61 FR 39278), requesting that the Commission consider the elimination of the environmental review requirement at the license termination stage (§ 50.82(a)(9)(ii)(G) and § 51.53(b)) for decommissioning to unrestricted release conditions. In response, the Commission indicated that it would consider these comments in the rulemaking on radiological criteria for decommissioning.

G.5.2 Response. The Commission has considered the elimination of the supplemental environmental review requirement for a licensee that intends to decommission to unrestricted release conditions as required in this final rule and has decided to continue to retain this requirement. The Commission considers this necessary for any particular site to determine if the generic analysis encompasses the range of environmental impacts at that particular site. The rationale for retaining this requirement was explained in the preamble to the proposed rule and has not changed.

G.6 Mixed waste, hazardous waste, and naturally occurring and accelerator-produced radioactive material.

G.6.1 Comments. Some commenters stated that the rule should address the cleanup of sites with mixed wastes. Other commenters recommended that NRC should not regulate any nonradioactive hazardous material beyond its authority. There was disagreement over whether NRC's approval of a licensee's decommissioning activities should be dependent on the licensee fulfilling other agencies' obligations, especially where accelerator produced materials may exist. Some commenters stated that the rule criteria are incompatible with naturally occurring and accelerator-produced radioactive material (NARM).

G.6.2 Response. The final rule on radiological criteria for decommissioning applies to residual radioactivity from all licensed and unlicensed sources used by the licensee but excludes background radiation. As such, the NRC or Agreement State, whether acting as the lead or

cooperating agency in working with the licensee to ensure appropriate remediation of a contaminated site, would not release a site from its license unless the rule's radiological criteria were met.

NRC responsibility for license termination at a site with hazardous or mixed waste onsite is principally to determine that the radiological component of the mixed waste (e.g., contaminated soil) complies with the rule's radiological criteria. Other regulatory agencies are responsible for control of the hazardous constituents and must be notified and accept responsibility for appropriate management of the released site. The same approach would be followed in potentially releasing a site with groundwater contamination exceeding applicable maximum contaminant levels of nonradiological substances. Note that under the Uranium and Mill Tailings Recovery and Control Act (UMTRCA), NRC is responsible for the regulation of certain nonradioactive hazardous materials.

With regard to NARM, NRC's legislative and regulatory authority extends to those materials and facilities under the Atomic Energy Act of 1954, as amended, and not to accelerator produced materials or naturally occurring radioactive material, except as it is defined as source material in Section 40.4 of 10 CFR Part 40. Section IV.A, above, notes that, although some commenters questioned the relationship of this rule to NARM, the criteria of this rule apply to residual radioactivity from activities under a licensee's control and not to background radiation (that includes radiation from naturally occurring radioactive material (NORM)). There are a wide variety of sites containing NORM subject to EPA jurisdiction and not licensed by the NRC. The extent to which the criteria in this rule would apply to these sites would be based on a

separate evaluation. However, the considerations and analyses done for this rulemaking in the Final GEIS and regulatory analysis regarding large fuel cycle and non-fuel-cycle facilities containing large quantities of naturally occurring nuclides such as uranium and thorium are appropriate for certain NORM sites, and the broad provisions of the rule (such as control of sites with restrictions imposed, use of alternate cap values, use of alternate criteria, and public participation aspects) may be useful in considerations regarding NORM sites.

G.7 Recycle.

G.7.1 Comments. Commenters recommended that recycling of equipment or materials be addressed in more depth in the final rule. Several commenters stated that recycling of contaminated materials that results in increased exposures to members of the public is unacceptable. Other commenters favored establishment of criteria for recycled materials.

G.7.2. Response. The proposed rule did not specifically address the recycle of material or equipment decontaminated as a result of the decommissioning process. The Commission has a separate consideration underway of the issues related to cases when the licensee proposes to intentionally release material containing residual radioactivity that could become available for reuse or recycle.

Because current NRC regulations do not contain explicit radiological criteria for release of equipment and materials, release from licensed facilities is currently determined by NRC on a case-by-case basis using existing guidance and practices. Current practices include radiation

surveys to document the absence of licensed radioactive material, general guidance for reactors contained in Regulatory Guide 1.86 or similar guidance issued for materials facilities, and site-specific technical specifications and license conditions. Although these criteria were not originally derived for the case of recycle, they have been applied for many years in a wide variety of contexts.

Continuation of the case-by-case procedure in the future may not be practical because of increased quantities of material expected from larger facility decommissionings. Also, interest in recycling slightly contaminated material is growing both in the United States and in other countries as a means of conserving resources by limiting the amount of new raw materials that are necessary to produce new products and equipment and by reducing the costs of disposing of large volumes of slightly contaminated material that may pose very small risks to the general public. Codifying criteria would allow NRC to more effectively deal with these issues. Regulatory action separate from this decommissioning action by NRC, that would provide clear, consistent criteria in this area, is being considered. Specifically, the NRC is cooperating with the EPA in developing the technical basis for a recycle rulemaking. At present, the EPA is developing its plans for such a rulemaking. The NRC will determine what course of action it will take regarding rulemaking related to recycle after consideration of EPA plans. Full opportunity for early public involvement and comment regarding that regulatory action is anticipated. Because of this background, no revision to this decommissioning rule to consider recycling is being made.

G.8 The rulemaking process.

G.8.1 Comments. Several commenters expressed satisfaction with the enhanced rulemaking process undertaken by the NRC for the decommissioning rule. Of those commenters who opposed the proposed decommissioning standards for not being sufficiently restrictive, some were critical of the rulemaking process and suggested that the NRC had ignored their earlier participation. Other commenters expressed dissatisfaction with the proposed standards because they are overly restrictive. The DOE stated that it supported the NRC effort to promulgate the rule and the joint efforts of the EPA and the NRC to coordinate their respective rulemaking proceedings.

G.8.2 Response. The NRC has conducted what it considers to be an extensive effort at enhancing participation in the early stages of this rulemaking process through a series of workshops and environmental impact statement scoping meetings for affected interests that solicited public comment with regard to radiological criteria for decommissioning. The extent of these meetings was discussed in the preamble to the proposed rule.

The workshops and the scoping meetings were not designed to seek "consensus" in the sense that there is agreement on how each issue should be resolved, but rather to ensure that, with informed discussion, relevant issues have been identified and information exchanged on these issues.

Subsequent to the workshops and scoping meetings, the Commission developed the policies and requirements that were deemed appropriate for a rule on radiological criteria for

decommissioning. Information and concepts developed in the workshops were factored into this process. For example, a number of themes from the workshops, such as consideration of restricted use options, increased public participation in the site decommissioning process, and a desire to return sites to levels indistinguishable from background, were considered during the rulemaking. The Commission also considered the approaches of scientific bodies such as the ICRP and NCRP, precedents of its other rulemakings with regard to radiation protection such as 10 CFR Part 20, input from EPA with regard to appropriate risk levels, technical input from NRC contractors regarding capability to measure at low radiation levels, and the costs and impacts of achieving alternate levels.

Preliminary conclusions regarding this effort were contained in the NRC staff's draft rule (59 FR 4868, February 2, 1994) that was sent to Agreement States, workshop participants, and other interested parties. The intent of this informal comment period in advance of a proposed rule was to provide an opportunity for interested parties to comment on the adequacy of the draft criteria.

Resolution of comments from the workshops and from circulation of the NRC staff draft was discussed in the Supplementary Information of the proposed rule published on August 22, 1994 (59 FR 43200). That document indicates the evolution of the NRC's approach to this rulemaking as a result of the workshops and the other activities noted above.

Clearly, there are a number of specific areas which remain difficult to resolve or on which to reach a "consensus." These areas include the precise level of permissible radiological criteria for decommissioning, restricted use as a means for terminating a license, and the extent of public

participation. It is the NRC's consideration that the rulemaking process has allowed an airing of differing opinions with regard to these as well as other issues.

V. Agreement State Compatibility

The Commission has determined that this rule will be a Division 2 matter of compatibility. For the discussion on the basis for this determination, see Section IV.F.1.

VI. Relationship Between the Generic Environmental Impact Statement and Site-Specific Decommissioning Actions

The Generic Environmental Impact Statement (GEIS) prepared by the Commission on this rulemaking evaluates the environmental impacts associated with the remediation of several types of NRC-licensed facilities to a range of residual radioactivity levels. The Commission believes that the generic analysis will encompass the impacts that will occur in most Commission decisions to decommission an individual site where the licensee proposes to release the site for unrestricted use. Therefore, the Commission plans to rely on the GEIS to satisfy its obligations under the National Environmental Policy Act in regard to individual decommissioning decisions that meet the 0.25 mSv/y (25 mrem/y) criterion for unrestricted use. However, the Commission will still initiate an environmental assessment in regard to any particular site, for which a

categorical exclusion is not applicable, to determine if the generic analysis encompasses the range of environmental impacts at that particular site.

The rule also provides for the termination of the license and the release of a site under restricted use conditions if the licensee can demonstrate that land use restrictions or other types of institutional controls will provide reasonable assurance that the 0.25 mSv/y (25 mrem/y) limit can be met. The types of controls and their contribution to providing reasonable assurance that the 0.25 mSv/y (25 mrem/y) limit can be met for a particular site will differ for each site in this category. Similarly, the rule also provides that termination of the license under alternate criteria will be considered by the Commission in certain site-specific situations that would also differ for each site in this category. Therefore, the environmental impacts for these cases cannot be analyzed on a generic basis and the Commission will conduct an independent environmental review for each site-specific decommissioning decision where land use restrictions or institutional controls are relied on by the licensee or where alternate criteria are proposed.

The GEIS indicates that the decommissioning for certain classes of licensees (e.g., licensees using only sealed sources) will not individually or cumulatively have a significant effect on the human environment. Therefore, for these categories of licensees, the Commission is amending § 51.22 of the Commission's regulations to specify that the decommissioning of these types of licenses are actions eligible for categorical exclusion from the Commission's environmental review process.

VII. Final Generic Environmental Impact Statement: Availability

As required by the National Environmental Policy Act of 1969, as amended, and the Commission's regulations in Subpart A of 10 CFR Part 51, the NRC has prepared a final generic environmental impact statement (NUREG-1496) on this proposed rule.

The final generic environmental impact statement is available for inspection in the NRC Public Document Room, 2120 L Street NW. (Lower Level), Washington, DC. Single copies of the final generic environmental impact statement (NUREG-1496) may be obtained by written request or telefax
(301-415-2260) from: Office of Administration, Attention: Distribution and Services Section, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001.

Background documents on the rulemaking, including the text of the final rule, the final GEIS, and the regulatory analysis, are also available for downloading and viewing on the NRC Enhanced Participatory Rulemaking on Radiological Criteria for Decommissioning Electronic Bulletin Board, 1-800-880-6091 (see 58 FR 37760 (July 13, 1993)). The bulletin board may be accessed using a personal computer, a modem, and most commonly available communications software packages. The communications software should have parity set to none, data bits to 8, and stop bits to 1 (N,8,1) and use ANSI or VT-100 terminal emulation. For more information call Ms. Christine Daily, U.S. Nuclear Regulatory Commission, Washington, DC 20555. Phone (301) 415–6026; FAX (301) 415-5385.

VIII. Paperwork Reduction Act Statement

This final rule amends information collection requirements that are subject to the Paperwork Reduction Act of 1995 (44 U.S.C. 3501 et seq.). These requirements were approved by the Office of Management and Budget, approval number 3150-0014.

The public reporting burden for this collection of information is estimated to average 31.6 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments on any aspect of this collection of information, including suggestions for reducing the burden, to the Information and Records Management Branch (T-6 F33), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by Internet electronic mail to BJS1@NRC.GOV; and to the Desk Officer, Office of Information and Regulatory Affairs, NEOB-10202, (3150-0011 and 3150-0093), Office of Management and Budget, Washington, DC 20503.

Public Protection Notification

The NRC may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid OMB control number.

IX. Regulatory Analysis

The Commission has prepared a regulatory analysis on this final regulation. The analysis examines the costs and benefits of the alternatives considered by the Commission. The analysis is available for inspection in the NRC Public Document Room, 2120 L Street NW. (Lower Level), Washington, DC. Single copies of the analysis may be obtained by written request from the Radiation Protection and Health Effects Branch (RPHEB) Secretary, Office of Nuclear Regulatory Research, U.S. Nuclear Regulatory Commission, Washington, DC 20555.

Background documents on the rulemaking, including the text of the final rule, the final GEIS, and the regulatory analysis are also available for downloading and viewing on the NRC Enhanced Participatory Rulemaking on Radiological Criteria for Decommissioning Electronic Bulletin Board (see Section VII, above).

X. Regulatory Flexibility Certification

As required by the Regulatory Flexibility Act of 1980, 5 U.S.C. 605(b), the Commission certifies that this rule, if adopted, will not have a significant economic impact upon a substantial number of small entities. Although the final rule would cover all 22,000 licensees regulated by the NRC and Agreement States, small entities covered by this rule are primarily licensees that possess and use only materials with short half-lives or materials only in sealed sources. Decommissioning efforts for these licensees are simple and require only that sealed sources are properly disposed of or that short-lived materials are allowed to decay. Complete details of the cost analysis are contained in the regulatory analysis.

XI. Backfit Analysis

The NRC has determined that the backfit rule, 10 CFR 50.109, does not apply to this final rule and therefore, a backfit analysis is not required for this final rule because these amendments do not involve reactor operations and therefore do not involve any provisions that would impose backfits as defined in 10 CFR 50.109(a)(1).

XII. Small Business Regulatory Enforcement Fairness Act

In accordance with the Small Business Regulatory Enforcement Fairness Act of 1996, the NRC has determined that this action is not a "major" rule and has verified this determination with the Office of Information and Regulatory Affairs, Office of Management and Budget.

List of Subjects

10 CFR Part 20

Byproduct material, Criminal penalties, Licensed material, Nuclear materials, Nuclear power plants and reactors, Occupational and public dose limits, Occupational safety and health, Packaging and containers, Permissible doses, Radiation protection, Reporting and recordkeeping requirements, Respiratory protection, Special nuclear material, Source material, Surveys and monitoring, Waste treatment and disposal.

10 CFR Part 30

Byproduct material, Criminal penalties, Government contracts, Intergovernmental relations, Isotopes, Nuclear materials, Radiation protection, Reporting and recordkeeping requirements.

10 CFR Part 40

Criminal penalties, Government contracts, Hazardous materials transportation, Nuclear materials, Reporting and recordkeeping requirements, Source material, Uranium.

10 CFR Part 50

Antitrust, Classified information, Criminal penalties, Fire protection, Intergovernmental relations, Nuclear power plants and reactors, Radiation protection, Reactor siting criteria, Reporting and recordkeeping requirements.

10 CFR Part 51

Administrative practice and procedure, Environmental impact statements, Environmental regulations, assessments and reports, NEPA procedures, Nuclear materials, Nuclear power plants and reactors, Reporting and recordkeeping requirements.

10 CFR Part 70

Criminal penalties, Hazardous materials transportation, Material control and accounting, Nuclear materials, Packaging and containers, Radiation protection, Reporting and recordkeeping requirements, Scientific equipment, Security measures, Special nuclear material.

10 CFR Part 72

Manpower training programs, Nuclear materials, Occupational safety and health, Reporting and recordkeeping requirements, Security measures, Spent fuel.

For the reasons set out in the preamble and under the authority of the Atomic Energy Act of 1954, as amended; the Energy Reorganization Act of 1974, as amended; and 5 U.S.C. 552 and 553; the NRC is adopting the following amendments to 10 CFR Parts 20, 30, 40, 50, 51, 70, and 72.

PART 20 - STANDARDS FOR PROTECTION AGAINST RADIATION

1. The authority citation for Part 20 continues to read as follows:

AUTHORITY: Secs. 53, 63, 65, 81, 103, 104, 161, 182, 186, 68 stat. 930, 933, 935, 936, 937, 948, 953, 955, as amended (2 U.S.C. 2073, 2093, 2095, 2111, 2133, 2134, 2201, 2232, 2236), secs. 201, as amended, 202, 206, 88 stat. 1242, as amended, 1244, 1246, (42 U.S.C. 5841, 5842, 5846).

2. In § 10 CFR 20.1003, "Definitions," the definition of *Background radiation* is revised and new definitions Critical Group, Decommission, Distinguishable from background, and Residual radioactivity are added in alphabetical order to read as follows:

§ 20.1003 Definitions.

* * * * *

Background radiation means radiation from cosmic sources; naturally occurring radioactive material, including radon (except as a decay product of source or special nuclear

material); and global fallout as it exists in the environment from the testing of nuclear explosive devices or from past nuclear accidents such as Chernobyl that contribute to background radiation and are not under the control of the licensee. "*Background radiation*" does not include radiation from source, byproduct, or special nuclear materials regulated by the Commission.

* * * * *

Critical Group means the group of individuals reasonably expected to receive the greatest exposure to residual radioactivity for any applicable set of circumstances.

* * * * *

Decommission means to remove a facility or site safely from service and reduce residual radioactivity to a level that permits--

(1) Release of the property for unrestricted use and termination of the license; or

(2) Release of the property under restricted conditions and termination of the license.

* * * * *

Distinguishable from background means that the detectable concentration of a radionuclide is statistically different from the background concentration of that radionuclide in the vicinity of the site or, in the case of structures, in similar materials using adequate measurement technology, survey, and statistical techniques.

* * * * *

Residual radioactivity means radioactivity in structures, materials, soils, groundwater, and other media at a site resulting from activities under the licensee's control. This includes radioactivity from all licensed and unlicensed sources used by the licensee, but excludes

background radiation. It also includes radioactive materials remaining at the site as a result of routine or accidental releases of radioactive material at the site and previous burials at the site, even if those burials were made in accordance with the provisions of 10 CFR Part 20.

* * * * *

3. In § 20.1009, paragraph (b) is revised to read as follows:

§ 20.1009 Information collection requirements: OMB approval.

* * * * *

(b) The approved information collection requirements contained in this part appear in §§ 20.1003, 20.1101, 20.1202, 20.1203, 20.1204, 20.1206, 20.1208, 20.1301, 20.1302, 20.1404, 20.1405, 20.1407, 20.1408, 20.1501, 20.1601, 20.1703, 20.1901, 20.1902, 20.1904, 20,1905, 20.1906, 20.2002, 20.2004, 20.2006, 20.2102, 20.2103, 20.2104, 20.2105, 20.2106, 20.2107, 20.2108, 20.2110, 20.2201, 20.2202, 20.2203, 20.2204, 20.2205, 20.2206, 20.2301, and Appendices F and G to 10 CFR Part 20.

* * * * *

4. A new Subpart E entitled "Radiological Criteria for Decommissioning," is added to 10 CFR Part 20 to read as follows:

Subpart E--Radiological Criteria

for Decommissioning

Sec.

§ 20.1401 General provisions and scope.

(a) The criteria in this subpart apply to the decommissioning of facilities licensed under Parts 30, 40, 50, 60, 61, 70, and 72 of this chapter, as well as other facilities subject to the Commission's jurisdiction under the Atomic Energy Act of 1954, as amended, and the Energy Reorganization Act of 1974, as amended. For high-level and low-level waste disposal facilities (10 CFR Parts 60 and 61), the criteria apply only to ancillary surface facilities that support radioactive waste disposal activities. For uranium and thorium recovery facilities already subject to Appendix A to 10 CFR Part 40 and uranium solution extraction facilities, cleanup of radionuclides other than radium from buildings and soils must result in a dose no greater than the dose resulting from cleanup of radium contaminated soil to the standard specified in Criterion 6(6), Appendix A of 10 CFR Part 40. Groundwater protection and decontamination at uranium and thorium recovery facilities subject to Appendix A to 10 CFR Part 40 shall be governed solely by the applicable requirements of Appendix A to 10 CFR Part 40.

(b) The criteria in this subpart do not apply to sites which:

(1) have been decommissioned prior to the effective date of the rule in accordance with criteria identified in the Site Decommissioning Management Plan (SDMP) Action Plan of April 16, 1992 (57 FR 13389);

(2) have previously submitted and received Commission approval on a license termination plan (LTP) or decommissioning plan that is compatible with the SDMP Action Plan criteria; or

(3) submit a sufficient LTP or decommissioning plan before [insert a date 12 months after effective date of the rule] and such LTP or decommissioning plan is approved by the Commission before [insert date 24 months after effective date of the rule] and in accordance with the criteria identified in the SDMP Action Plan, except that if an EIS is required in the submittal, there will be a provision for day-for-day extension.

(c) After a site has been decommissioned and the license terminated in accordance with the criteria in this subpart, the Commission will require additional cleanup only if, based on new information, it determines that the criteria of this subpart were not met and residual radioactivity remaining at the site could result in significant threat to public health and safety.

(d) When calculating TEDE to the average member of the critical group the licensee shall base estimates on the greatest annual TEDE dose expected within the first 1000 years after decommissioning. Estimates must be substantiated using actual measurements to the maximum extent practical.

§ 20.1402 Radiological criteria for unrestricted use.

A site will be considered acceptable for unrestricted use if the residual radioactivity that is distinguishable from background radiation results in a TEDE to an average member of the critical group that does not exceed 25 mrem (0.25 mSv) per year, including that from groundwater sources of drinking water, and the residual radioactivity has been reduced to levels that are as low as reasonably achievable (ALARA). Determination of the levels which are ALARA shall take into account consideration of any detriments, such as deaths from transportation accidents, expected to potentially result from decontamination and waste disposal.

§ 20.1403 Criteria for license termination under restricted conditions.

A site will be considered acceptable for license termination under restricted conditions if--

(a) The licensee can demonstrate that further reductions in residual radioactivity necessary to comply with the provisions of § 20.1402 would result in net public or environmental harm or were not being made because the residual levels associated with restricted conditions are as low as reasonably achievable (ALARA). Determination of the levels which are ALARA must take into account consideration of any detriments, such as traffic accidents, expected to potentially result from decontamination and waste disposal; and

(b) The licensee has made provisions for legally enforceable institutional controls that provide reasonable assurance that the TEDE from residual radioactivity distinguishable from background to the average member of the critical group will not exceed 25 mrem (0.25 mSv) per year; and

(c) The licensee has provided sufficient financial assurance to enable an independent third party, including a governmental custodian of a site, to assume and carry out responsibilities for any necessary control and maintenance of the site. Acceptable financial assurance mechanisms are--

(1) Funds placed into an account segregated from the licensee's assets and outside the licensee's administrative control as described in § 30.35(f)(1) of this chapter;

(2) Surety method, insurance, or other guarantee method as described in § 30.35(f)(2) of this chapter;

(3) A statement of intent in the case of Federal, State, or local Government licensees, as described in § 30.35(f)(4) of this chapter, or;

(4) When a governmental entity is assuming custody and ownership of a site, an arrangement that is deemed acceptable by such governmental entity;

and

(d) The licensee has submitted a decommissioning plan or License Termination Plan (LTP) to the Commission indicating the licensee's intent to decommission in accordance with §§ 30.36(d), 40.42(d), 50.82(a) and (b), 70.38(d), or 72.54 of this chapter, and specifying that the licensee intends to decommission by restricting use of the site. The licensee shall document in the LTP or decommissioning plan how the advice of individuals and institutions in the community who may be affected by the decommissioning has been sought and incorporated, as appropriate, following analysis of that advice. Licensees proposing to decommission by

restricting use of the site shall seek advice from such affected parties regarding the following matters concerning the proposed decommissioning--

(1) Whether provisions for institutional controls proposed by the licensee;

(i) Will provide reasonable assurance that the TEDE from residual radioactivity distinguishable from background to the average member of the critical group will not exceed 25 mrem (0.25 mSv) TEDE per year;

(ii) Will be enforceable; and

(iii) Will not impose undue burdens on the local community or other affected parties.

(2) Whether the licensee has provided sufficient financial assurance to enable an independent third party, including a governmental custodian of a site, to assume and carry out responsibilities for any necessary control and maintenance of the site; and

(e) Residual radioactivity at the site has been reduced so that if the institutional controls were no longer in effect, there is reasonable assurance that the TEDE from residual radioactivity distinguishable from background to the average member of the critical group is as low as reasonably achievable and would not exceed either--

(1) 100 mrem (1 mSv) per year; or

(2) 500 mrem (5 mSv) per year provided the licensee--

(i) Demonstrates that further reductions in residual radioactivity necessary to comply with the 100 mrem/y (1 mSv/y) value of paragraph (e)(1) of this section are not technically achievable, would be prohibitively expensive, or would result in net public or environmental harm;

(ii) Makes provisions for durable institutional controls;

(iii) Provides sufficient financial assurance to enable a responsible government entity or independent third party, including a governmental custodian of a site, both to carry out periodic rechecks of the site no less frequently than every 5 years to assure that the institutional controls remain in place as necessary to meet the criteria of § 20.1403(b) and to assume and carry out responsibilities for any necessary control and maintenance of those controls. Acceptable financial assurance mechanisms are those in paragraph (c) of this section.

§ 20.1404 Alternate criteria for license termination.

The Commission may terminate a license using alternate criteria greater than the dose criterion of § 20.1402 and § 20.1403(b) and § 20.1403(d)(1), if the licensee--

(a) Provides assurance that public health and safety would continue to be protected, and that a total dose from all sources of more than the 1 mSv/y (100 mrem/y) limit of Subpart D would be unlikely, by submitting an analysis of possible sources of exposure;

(b) Has employed to the extent practical restrictions on site use according to the provisions of § 20.1403 in minimizing exposures at the site; and

(c) Reduced doses to ALARA levels, taking into consideration any detriments such as traffic accidents expected to potentially result from decontamination and waste disposal.

§ 20.1405 Public notification and public participation.

Upon the receipt of an LTP or decommissioning plan from the licensee, or a proposal by the licensee for release of a site pursuant to §§ 20.1403 or 20.1404, or whenever the Commission deems such notice to be in the public interest, the Commission shall:

(a) Notify and solicit comments from local and State governments in the vicinity of the site and any Indian Nation or other indigenous people that have treaty or statutory rights that could be affected by the decommissioning; and

(b) Publish a notice in the Federal Register and in a forum, such as local newspapers, letters to State or local organizations, or other appropriate forum, that is readily accessible to individuals in the vicinity of the site, and solicit comments from affected parties.

§ 20.1406 Minimization of contamination.

Applicants for licenses, other than renewals, after [insert effective date of rule], shall describe in the application how facility design and procedures for operation will minimize, to the extent practicable, contamination of the facility and the environment, facilitate eventual decommissioning, and minimize, to the extent practicable, the generation of radioactive waste.

5. In §20.2402, paragraph (b) is revised to read as follows:

(b) The regulations in §§20.1001 through 20.2402 that are not issued under Sections 161b, 161i, or 161o for the purposes of Section 223 are as follows: §§20.1001, 20.1002, 20.1003, 20.1004, 20.1005, 20.1006, 20.1007, 20.1008, 20.1009, 20.1405, 20.1704, 20.1903, 20.1905, 20.2002, 20.2007, 20.2301, 20.2302, 20.2401, and 20.2402.

PART 30--RULES OF GENERAL APPLICABILITY TO DOMESTIC LICENSING OF BYPRODUCT MATERIAL

6. The authority citation for Part 30 continues to read as follows:

Authority: Secs. 81, 82, 161, 182, 183, 186, 68 Stat. 935, 948, 953, 954, 955, as amended, sec. 234, 83 Stat 444, as amended (42 U.S.C. 2111, 2112, 2201, 2232, 2233, 2236, 2282); secs. 201, as amended, 202, 206, 88 Stat. 1242, as amended, 1244, 1246, (42 U.S.C. 5841, 5842, 5846).

Section 30.7 also issued under Pub. L. 95-601, sec. 10, 92 Stat. 2951 as amended by Pub. L. 102-486, sec. 2902, 106 Stat 3123, (2 U.S.C. 5851). Section 30.34(b) also issued under sec. 184, 68 Stat. 954, as amended (42 U.S.C. 2234). Section 30.61 also issued under sec. 187, 68 Stat. 955 (42 U.S.C. 2237).

7. In § 30.4, "Definitions," the definition of Decommission is revised to read as follows:

§ 30.4 Definitions.

* * * * *

Decommission means to remove a facility or site safely from service and reduce residual radioactivity to a level that permits--

(1) Release of the property for unrestricted use and termination of the license; or

(2) Release of the property under restricted conditions and termination of the license.

* * * * *

8. In § 30.35, paragraph (f)(5) is added and paragraph (g)(3)(iv) is revised to read as follows:

§ 30.35 Financial assurance and recordkeeping for decommissioning.

* * * * *

(f) * * *

(5) When a governmental entity is assuming custody and ownership of a site, an arrangement that is deemed acceptable by such governmental entity; and

(g) * * *

(3) * * *

(iv) All areas outside of restricted areas that contain material such that, if the license expired, the licensee would be required to either decontaminate the area to meet the criteria for decommissioning in 10 CFR 20, subpart E, or apply for approval for disposal under 10 CFR

20.2002.

* * * * *

9. In § 30.36, the introductory text of paragraph (j)(2) and paragraph (k)(3) are revised to read as follows:

§ 30.36 Expiration and termination of licenses and decommissioning of sites and separate buildings or outdoor areas.

* * * * *

(j) * * *

(2) Conduct a radiation survey of the premises where the licensed activities were carried out and submit a report of the results of this survey, unless the licensee demonstrates in some other manner that the premises are suitable for release in accordance with the criteria for decommissioning in 10 CFR Part 20, subpart E. The licensee shall, as appropriate--

* * * * *

(k) * * *

(3)(i) A radiation survey has been performed which demonstrates that

the premises are suitable for release in accordance with the criteria for decommissioning in 10 CFR Part 20, subpart E; or

(ii) Other information submitted by the licensee is sufficient to demonstrate that the premises are suitable for release in accordance with the criteria for decommissioning in 10 CFR Part 20, subpart E.

* * * * *

PART 40--DOMESTIC LICENSING OF SOURCE MATERIAL

10. The authority citation for Part 40 continues to read as follows:

Authority: Secs. 62, 63, 64, 65, 81, 161, 182, 183, 186, 68 Stat. 932, 933, 935, 948, 953, 954, 955, as amended, secs. 11e(2), 83, 84, Pub. L. 95-604, 92 Stat. 3033, as amended, 3039, sec. 234, 83 Stat. 444, as amended (42 U.S.C. 2014(e)(2), 2092, 2093, 2094, 2095, 2111, 2113, 2114, 2201, 2232, 2233, 2236, 2282); sec. 274, Pub. L. 86-373, 73 Stat. 688 (42 U.S.C. 2021); secs. 201, as amended, 202, 206, 88 Stat. 1242, as amended, 1244, 1246 (42 U.S.C. 5841, 5842, 5846); sec. 275, 92 Stat. 3021, as amended by Pub. L. 97-415, 96 Stat. 2067 (42 U.S.C. 2022).

Section 40.7 also issued under Pub. L. 95-601, sec. 10, 92 Stat. 2951 as amended by Pub. L. 102-486, sec. 2902, 106 Stat. 3123, (42 U.S.C. 5851). Section 40.31(g) also issued under sec. 122, 68 Stat. 939 (42 U.S.C. 2152). Section 40.46 also issued under sec. 184, 68 Stat. 954, as

amended (42 U.S.C. 2234). Section 40.71 also issued under sec. 187, 68 Stat. 955 (42 U.S.C. 2237).

11. In § 40.4, "Definitions," the definition of Decommission is revised to read:

§ 40.4 Definitions.

* * * * *

Decommission means to remove a facility or site safely from service and reduce residual radioactivity to a level that permits--

(1) Release of the property for unrestricted use and termination of the license; or

(2) Release of the property under restricted conditions and termination of the license.

* * * * *

12. In § 40.36, paragraph (e)(5) is added and paragraph (f)(3)(iv) is revised to read as follows:

§ 40.36 Financial assurance and recordkeeping for decommissioning.

* * * * *

(e) * * *

(5) When a governmental entity is assuming custody and ownership of a site, an arrangement that is deemed acceptable by such governmental entity; and

(f) * * *

(3) * * *

(iv) All areas outside of restricted areas that contain material such that, if the license expired, the licensee would be required to either decontaminate the area to meet the criteria for decommissioning in 10 CFR Part 20, subpart E, or apply for approval for disposal under 10 CFR 20.2002.

* * * * *

13. In § 40.42, the introductory text of paragraph (j)(2) and paragraph (k)(3) are revised to read as follows:

§ 40.42 Expiration and termination of licenses and decommissioning of sites and separate buildings or outdoor areas.

* * * * *

(j) * * *

(2) Conduct a radiation survey of the premises where the licensed activities were carried out and submit a report of the results of this survey, unless the licensee demonstrates in some other manner that the premises are suitable for release in accordance with

the criteria for decommissioning in 10 CFR Part 20, subpart E. The licensee shall, as appropriate-

-

* * * * *

(k) * * *

(3)(i) A radiation survey has been performed which demonstrates that the premises are suitable for release in accordance with the criteria for decommissioning in 10 CFR Part 20, subpart E; or

(ii) Other information submitted by the licensee is sufficient to demonstrate that the premises are suitable for release in accordance with the criteria for decommissioning in 10 CFR Part 20, subpart E.

* * * * *

PART 50--DOMESTIC LICENSING OF PRODUCTION AND UTILIZATION FACILITIES

14. The authority citation for Part 50 continues to read as follows:

Authority: Secs. 102, 103, 104, 105, 161, 182, 183, 186, 189, 68 Stat. 936, 937, 938, 948, 953, 954, 955, 956, as amended, sec. 234, 83 Stat. 1244, as amended (42 U.S.C. 2132, 2133, 2134, 2135, 2201, 2232, 2233, 2236, 2239, 2282); secs. 201, as amended, 202, 206, 88 Stat. 1242, as amended, 1244, 1246 (42 U.S.C. 5841, 5842, 5846).

Section 50.7 is also issued under Pub. L 95-601, sec. 10, 92 Stat. 2951 as amended by Pub. L. 102-486, sec. 2902, 106 Stat. 3123, (42 U.S.C. 5851). Section 50.10 also issued under

secs. 101, 185, 68 Stat. 936, 955, as amended (42 U.S.C. 2131, 2235); sec. 102, Pub. L. 91-190, 82 Stat. 853 (42 U.S.C. 4332). Sections 50.13, 50.54(dd), and 50.103 also issued under sec. 108, 68 Stat. 939, as amended (42 U.S.C. 2138).

Sections 50.23, 50.35, 50.55, and 50.56 also issued under sec. 185, 68 Stat. 955 (42 U.S.C. 2235). Sections 50.33a, 50.55a and Appendix Q also issued under sec. 102, Pub. L. 91-190, 83 Stat. 853 (42 U.S.C. 4332). Sections 50.34 and 50.54 also issued under sec. 204, 88 Stat. 1245 (42 U.S.C. 5844). Sections 50.58, 50.91, and 50.92 also issued under Pub. L. 97-415, 96 Stat. 2073 (42 U.S.C. 2239). Section 50.78 also issued under sec. 122, 68 Stat. 939 (42 U.S.C. 2152). Sections 50.80-50-81 also issued under sec. 184, 68 Stat. 954, as amended (42 U.S.C. 2234). Appendix F also issued under sec. 187, 68 Stat. 955 (42 U.S.C. 2237).

15. In § 50.2, "Definitions," the definition of Decommission is revised to read:

§ 50.2 Definitions.

* * * * *

Decommission means to remove a facility or site safely from service and reduce residual radioactivity to a level that permits--

(1) Release of the property for unrestricted use and termination of the license; or

(2) release of the property under restricted conditions and termination of the license.

* * * * *

16. In § 50.82, paragraphs (a)(11)(ii) and (b)(6)(ii) are revised to read as follows:

§ 50.82 Termination of license.

* * * * *

(a) * * *

(11) * * *

(ii) The terminal radiation survey and associated documentation demonstrates that the facility and site are suitable for release in accordance with the criteria for decommissioning in 10 CFR Part 20, subpart E.

(b) * * *

(6) * * *

(ii) The terminal radiation survey and associated documentation demonstrate that the facility and site are suitable for release in accordance with the criteria for decommissioning in 10 CFR Part 20, subpart E

* * * * *

PART 51--ENVIRONMENTAL PROTECTION REGULATIONS FOR DOMESTIC LICENSING

AND RELATED REGULATORY FUNCTIONS

17. The authority citation for Part 51 continues to read as follows:

Authority: Sec. 161, 68 Stat. 948, as amended (42 U.S.C 2201); secs. 201, as amended, 202, 88 Stat. 1242, as amended, 1244 (42 U.S.C. 5841, 5842).

Subpart A also issued under National Environmental Policy Act of 1969, secs. 102, 104, 105, 83 Stat. 853-854, as amended (42 U.S.C. 4332,4334, 4335); and Pub. L. 95-604, Title II, 92 Stat. 3033-3041; and sec. 193, Pub. L. 101-575, 104 Stat. 2835 (42 U.S.C. 2243). Sections 51.20, 51.30, 51.60, 51.61, 51.80, and 51.97 also issued under secs. 135, 141, Pub. L. 97-425, 96 Stat. 2232, 2241, and sec 148, Pub. L. 100-203, 101 Stat. 1330-223 (42 U.S.C. 10155, 10161, 10168). Section 51.22 also issued under sec. 274, 73 Stat. 688, as amended by 92 Stat. 3036-3038 (42 U.S.C. 2021) and under Nuclear Waste Policy Act of 1982, sec. 121, 96 Stat. 2228 (42 U.S.C. 10141). Sections 51.43, 51.67, and 51.109 also issued under Nuclear Waste Policy Act of 1982, sec. 114(f), 96 Stat. 2216, as amended (42 U.S.C. 10134(f)).

18. In § 51.22, paragraph (c)(20) is added to read as follows:

§ 51.22 Criterion for categorical exclusion; identification of licensing

and regulatory actions eligible for categorical exclusion or otherwise not requiring environmental review.

* * * * *

(c) * * *

(20) Decommissioning of sites where licensed operations have been limited to the use of--

(i) Small quantities of short-lived radioactive materials; or

(ii) Radioactive materials in sealed sources, provided there is no evidence of leakage of radioactive material from these sealed sources.

* * * * *

PART 70--DOMESTIC LICENSING OF SPECIAL NUCLEAR MATERIAL

19. The authority citation for Part 70 continues to read as follows:

Authority: Secs. 51, 53, 161, 182, 183, 68 Stat. 929, 930, 948, 953,954, as amended, sec. 234, 83 Stat. 444, as amended (42 U.S.C. 2071, 2073, 2201, 2232, 2233, 2282); secs. 201, as amended, 202, 204, 206, 88 Stat. 1242, as amended, 1244, 1245, 1246 (42 U.S.C. 5841, 5842, 5845, 5846).

Sections 70.1(c) and 70.20a(b) also issued under secs. 135, 141, Pub. L. 97-425, 96 Stat. 2232, 2241 (42 U.S.C. 10155, 10161). Section 70.7 also issued under Pub. L. 95-601, sec. 10, 92 Stat. 2951 as amended by Pub. L. 102-486sec. 2902, 106 Stat. 3123 (42 U.S.C. 5851). Section

70.21(g) also issued under sec. 122, 68 Stat. 939 (42 U.S.C. 2152). Section 70.31 also issued under sec. 57d, Pub. L. 93-377, 88 Stat. 475 (42 U.S.C. 2077). Sections 70.36 and 70.44 also issued under sec. 184, 68 Stat. 954, as amended (42 U.S.C. 2234). Section 70.61 also issued under secs. 186, 187, 68 Stat. 955 (42 U.S.C. 2236, 2237). Section 70.62 also issued under sec. 108, 68 Stat. 939, as amended (42 U.S.C. 2138).

20. In § 70.4, "Definitions," the definition of Decommission is revised to read as follows:

§ 70.4 Definitions.

* * * * *

Decommission means to remove a facility or site safely from service and reduce residual radioactivity to a level that permits--

(1) Release of the property for unrestricted use and termination of the license; or

(2) Release of the property under restricted conditions and termination of the license.

* * * * *

21. In § 70.25, paragraph (f)(5) is added and paragraph (g)(3)(iv) is revised to read as follows:

§ 70.25 Financial assurance and record keeping for decommissioning.

* * * * *

(f) * * *

(5) When a governmental entity is assuming custody and ownership of a site, an arrangement that is deemed acceptable by such governmental entity; and

(g) * * *

(3) * * *

(iv) All areas outside of restricted areas that contain material such that, if the license expired, the licensee would be required to either decontaminate the area to meet the criteria for decommissioning in 10 CFR Part 20, subpart E, or apply for approval for disposal under 10 CFR 20.2002.

* * * * *

22. In § 70.38, the introductory text of paragraph (j)(2) and paragraph (k)(3) are revised to read as follows:

§ 70.38 Expiration and termination of licenses and decommissioning of sites and separate buildings or outdoor areas.

* * * * *

(j) * * *

(2) Conduct a radiation survey of the premises where the licensed activities were carried out and submit a report of the results of this survey, unless the licensee demonstrates in some other manner that the premises are suitable for release in accordance with the criteria for decommissioning in 10 CFR Part 20, subpart E. The licensee shall, as appropriate--

* * * * *

(k) * * *

(3)(i) A radiation survey has been performed which demonstrates that the premises are suitable for release in accordance with the criteria for decommissioning in 10 CFR Part 20, subpart E; or

(ii) Other information submitted by the licensee is sufficient to demonstrate that the premises are suitable for release in accordance with the criteria for decommissioning in 10 CFR Part 20, subpart E.

* * * * *

PART 72--LICENSING REQUIREMENTS FOR THE INDEPENDENT STORAGE OF SPENT NUCLEAR FUEL AND HIGH-LEVEL RADIOACTIVE WASTE

23. The authority citation for Part 72 continues to read as follows:

Authority: Secs. 51, 53, 57, 62, 63, 65, 69, 81, 161, 182, 183, 184, 186, 187, 189, 68 Stat. 929, 930, 932, 933, 934, 935, 948, 953, 954, 955, as amended, sec. 234, 83 Stat. 444, as amended (42 U.S.C. 2071, 2073, 2077, 2092, 2093, 2095, 2099, 2111, 2201, 2232, 2233, 2234, 2236, 2237, 2238, 2282); sec. 274, Pub. L. 86-373, 73 Stat. 688, as amended (42 U.S.C. 2021); sec. 201, as amended, 202, 206, 88 Stat. 1242, as amended, 1244, 1246 (42 U.S.C. 5841, 5842, 5846); Pub. L. 95-601, sec. 10, 92 Stat. 2951 as amended by Pub. L. 102-486, sec. 2902, 106 Stat. 3123 (42 U.S.C. 5851); sec. 102, Pub. L. 91-190, 83 Stat. 853 (42 U.S.C. 4332). Secs. 131, 132, 133, 135, 137, 141, Pub. L. 97-425, 96 Stat. 2229, 2230, 2232, 2241, sec. 148, Pub. L. 100-203, 101 Stat. 1330-235 (42 U.S.C. 10151, 10152, 10153, 10155, 10157, 10161, 10168).

Section 72.44(g) also issued under secs. 142(b) and 148(c), (d), Pub. L. 100-203, 101 Stat. 1330-232, 1330-236 (42 U.S.C. 10162(b), 10168(c), (d)). Section 72.46 also issued under sec. 189, 68 Stat. 955 (42 U.S.C. 2239); sec. 134, Pub. L. 97-425, 96 Stat. 2230 (42 U.S.C. 10154). Section 72.96(d) also issued under sec. 145(g), Pub. L. 100-203, 101 Stat. 1330-235 (42 U.S.C. 10165(g)). Subpart J also issued under secs. 2(2), 2(15), 2(19), 117(a), 141(h), Pub. L. 97-425, 96 Stat. 2202, 2203, 2204, 2222, 2244, (42 U.S.C. 10101, 10137(a), 10161(h)). Subparts K and L are also issued under sec. 133, 98 Stat. 2230 (42 U.S.C. 10153) and Sec. 218(a)96 Stat. 2252 (42 U.S.C. 10198).

24. In § 72.3, "Definitions," the definition of Decommission is revised to read as follows:

§ 72.3 Definitions.

* * * * *

Decommission means to remove a facility or site safely from service and reduce residual radioactivity to a level that permits--

(1) Release of the property for unrestricted use and termination of the license; or

(2) Release of the property under restricted conditions and termination of the license.

* * * * *

25. In § 72.30, paragraph (c)(6) is added to read as follows:

§ 72.30 Financial assurance and recordkeeping for decommissioning.

* * * * *

(c) * * *

(6) When a governmental entity is assuming custody and ownership of a site, an arrangement that is deemed acceptable by such governmental entity; and

* * * * *

26. In § 72.54, the introductory text of paragraph (l)(2) and paragraph (m)(2) are revised to read as follows:

§ 72.54 Application for termination of licenses and decommissioning of sites and separate buildings or outdoor areas.

* * * * *

(l) * * *

(2) Conduct a radiation survey of the premises where the licensed activities were conducted and submit a report of the results of this survey, unless the licensee demonstrates in some other manner that the premises are suitable for release in accordance with the criteria for decommissioning in 10 CFR Part 20, subpart E. The licensee shall, as appropriate--

(m) * * *

(2)(i) A radiation survey has been performed which demonstrates that the premises are suitable for release in accordance with the criteria for decommissioning in 10 CFR Part 20, subpart E; or

(ii) Other information submitted by the licensee is sufficient to demonstrate that the premises are suitable for release in accordance with the criteria for decommissioning in 10 CFR Part 20, subpart E.

Dated at Rockville, Maryland, this ____ day of _____ 1997.

For the Nuclear Regulatory Commission.

_____

John C. Hoyle,
Secretary of the Commission.

Enclosure 3

Specific Response to EPA Groundwater Issues

The staff has analyzed recent information (letter from L. Weinstock of EPA to B. Morris of NRC dated 11/26/96) provided to the NRC by EPA regarding the issue of whether a separate groundwater standard should be retained in NRC's final rule. EPA's comments reflect to some extent an ongoing dialog on this issue between EPA and NRC staff which involved EPA's consideration of such a standard in its own cleanup rule. EPA asserted in the recent information and during the dialog two major points:

(1) that no cost benefit analysis of a groundwater protection standard is needed because such a standard already exists (i.e. at 40 CFR 300.430 (e)(1)(B) and through NRC's use of such a standards at a number of sites), and

(2) that concerns about difficulties in implementing a separate groundwater standard can be largely alleviated by incorporation of the concepts of TI waivers and ACL's as part of such a standard

The staff has considered these points as well as the other information provided by EPA and has reached the following conclusions.

First, the existence of 40 CFR 300 does not justify in and of itself promulgation of similar or equivalent standards under the AEA. The requirements of 40 CFR 300 are not generally applicable, but only apply to sites that have been included on the National Priorities List for remediation under Superfund. Very few NRC sites are included on this list, and therefore the requirement for groundwater protection at drinking water levels does not already exist. In addition, NRC had applied the drinking water standards "as reference points" consistent with the EPA's Groundwater Protection Strategy, but that is not consistent with how EPA proposed to apply the drinking water standards under its draft cleanup rule and does not support EPA's assertion that the drinking water standards already apply for the purpose of groundwater protection.

Second, the AEA authorizes the NRC or EPA to promulgate regulations to protect public health and safety (without considerations of costs) and to further minimize danger (taking costs into account). The staff in developing the current version of the NRC final cleanup rule is proposing that a 25 mrem/y cleanup criterion will provide a sufficient degree of assurance on a generic basis (without further site specific analysis) that exposure to the site in combination with exposures to other sources other than medical or NORM will not exceed the basic safety standard of 100 mrem/y. This and other provisions of the rule provide for adequate protection of public health and safety.

Given this, the staff sees no need for a separate groundwater standard to be included to protect public health and safety.

However, because NRC agrees with EPA that groundwater is an important resource deserving protection, groundwater has been specified in the final rule as a required pathway for analysis as an added measure of assurance that this pathway is adequately considered in demonstrating that the 25 mrem/y criterion is met. Furthermore, the staff has acknowledged that there may be special circumstances where it would be appropriate to consider groundwater cleanup as a reasonable measure to achieve exposures which are ALARA. For this reason the staff is proposing to include these cases as part of the ALARA guidance to be developed in support of the final rule.

Given the approach to the NRC final rule described above, flexibility which could be afforded by allowing TI waivers or establishing ACL's as part of a separate groundwater standard in NRC's rule is no longer a relevant issue. However as an additional perspective, the staff analysis of the burden of a rule including a separate ground water standard concluded that the benefits of allowing TI waivers and ACL's were somewhat diminished because of the demonstrations and monitoring associated with these approaches in the EPA framework and because of their limited applicability. Specifically, these measures would be allowed only in cases where costs of meeting MCL's were

excessive or where there would be net harm from meeting MCL's or where it would be technically impractical to do so.

Furthermore, the use of ACL's under CERCLA (121(d)(2)(B)(ii) is only allowed when there are known or projected points of entry of groundwater into surface water and the licensee can control access to groundwater between the site boundary and the surface water discharge point(s). This may minimize the utility of ACL's at many NRC sites.

ENCLOSURE 4

Staff Responses to SRM Questions on Institutional Controls

The Commission requested the staff to determine the effect that institutional controls might have on other NRC regulations and policies and the role that DOE may play in providing long-term oversight of these sites. Responses to these questions are provided below.

1. The effect that institutional controls might have on other NRC regulations and policies.

Other NRC programs that could potentially be affected by the Commission's greater reliance on institutional controls in decommissioning of facilities are the high-level waste (HLW), low-level waste (LLW), and uranium mill tailings programs. For uranium mill tailings, the current program has extensive long-term institutional controls, and thus any increased reliance in decommissioning would tend to be more consistent with uranium mill tailings. In fact, the mill tailings program provides a model and a basis for increased reliance on these controls. Therefore, little impact, if any, is expected on the uranium mill tailings program.

The staff does not believe that greater reliance on institutional controls for decommissioning would necessarily be a relevant precedent for greater reliance on such controls for HLW disposal. The staff would examine the relative hazards and circumstances of the two waste problems in determining whether to treat them consistently.

It should be noted that the treatment of, and reliance upon, institutional controls in NRC's HLW program is already under review by the NRC staff and may require revision in order to comply with statutory direction in the Energy Policy Act of 1992 (EnPA). Pursuant to this statute, NRC's HLW regulations must be revised for consistency with environmental standards that have yet to be promulgated by EPA for a proposed repository at Yucca Mountain, Nevada. EnPA also directs the Department of Energy to establish post-closure oversight of the repository, based on active institutional controls, and directs NRC to assume, to the extent consistent with recommendations of the National Academy of Sciences, that such oversight taken together with engineered barriers will be effective. Contrary to the tacit assumption of the statute, the National Academy of Sciences, in 1995, found that it is not reasonable to assume that post-closure oversight, based on active institutional controls will be effective, over the long term, to prevent breach of repository barriers or prevent radiation exposure in excess of allowable limits. NRC's statutory obligations, given these conflicting approaches to regulatory reliance on institutional controls, have yet to be definitively analyzed.

NRC's current regulations at Part 60 assume that casual intrusion into a repository, which is located at a remote location, and constructed deep underground in accord with extensive design criteria, is highly unlikely. Permanent closure represents the end of active human intervention with respect to the engineered barrier system. In general, the regulations mandate the establishment of certain passive institutional controls but do not require the maintenance of

active institutional controls over long periods of time. In promulgating these regulations, which, currently, are predicated on a regulatory time frame of 10,000 years, the NRC acknowledged that the probability of some degree of intrusion cannot be ruled out and that some provision, subject to appropriate bounding assumptions, should be made to allow for consideration of intrusion, should passive measures fail. Among these is an assumption that the technical ability required to intrude into a repository would coexist with institutions that could identify the risk and mitigate the consequences of an intrusion should it occur.

There could be impacts on the LLW disposal program, however. The existing NRC regulations in 10 CFR Part 61 do not rely on institutional controls after 100 years (passive controls are assumed to be in place after this time, but are not relied on in safety analyses), and precedents in other programs for longer periods of control and more extensive controls could cause a re-examination of the approach in Part 61 to rely less on conservative performance assessments of future site performance and more on institutional controls.

2. The role DOE may have in providing long-term oversight of these sites.

DOE has the authority under Section 151(b) of the Nuclear Waste Policy Act of 1982 to take ownership of "low level radioactive waste and the land on which such waste is disposed of" if the owner requests it and if NRC makes certain determinations. NRC must determine that: (1) applicable decommissioning requirements are satisfied, including financial assurance; (2) Title and custody will be transferred to the Secretary without cost to the Federal Government; and (3) Federal ownership and management are necessary or desirable to protect the public and the environment.

The staff is working with DOE staff to develop a Memorandum of Understanding (MOU) on implementation of this section of the statute for certain facilities that would be decommissioned under the restricted release criteria. The staff will consult with the Commission on this topic when a draft MOU has been developed.

ENCLOSURE 5

NUREG-1496
Vol. 1

Generic Environmental Impact Statement in Support of Rulemaking on Radiological Criteria for Decommissioning of NRC-Licensed Nuclear Facilities

Main Report

Final Report

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Manuscript Completed:
Date Published:

Division of Regulatory Applications
Office of Nuclear Regulatory Research
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

ABSTRACT

The action being considered in this final generic environmental impact statement (GEIS) is an amendment to the Nuclear Regulatory Commission's (NRC) regulations in 10 CFR Part 20 to include radiological criteria for decommissioning of lands and structures at nuclear facilities. Under the National Environmental Policy Act (NEPA), all Federal agencies must consider the effect of their actions on the environment. To fulfill NRC's responsibilities under NEPA, the Commission is preparing this GEIS which analyzes alternative courses of action and the costs and impacts associated with those alternatives.

In preparing the final GEIS, the following approach was taken: (1) a listing was developed of regulatory alternatives for establishing radiological criteria for decommissioning; (2) for each alternative, a detailed analysis and comparison of incremental impacts, both radiological and nonradiological, to workers, members of the public, and the environment, and costs, were performed; and (3) based on the analysis of impacts and costs, conclusions on radiological criteria for decommissioning were provided. Contained in the GEIS are results and conclusions related to achieving, as an objective of decommissioning ALARA, reduction to preexisting background, the radiological criterion for unrestricted use, decommissioning ALARA analysis for soils and structures containing contamination, restricted use and alternative analysis for special site specific situations and groundwater cleanup. In its analyses, the final GEIS includes consideration of comments made on the draft GEIS (NUREG-1496, August 1994) during the public comment period.

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SUMMARY

Background

The Nuclear Regulatory Commission (NRC) has the statutory responsibility for protecting health and safety and the environment related to the possession and use of source, byproduct, and special nuclear material under the Atomic energy Act. The NRC believes that one portion of this responsibility is to assure safe and timely decommissioning of the nuclear facilities used in conjunction with NRC-licensed activities. This responsibility can be partially fulfilled by providing guidance to licensees on how to plan for and prepare their sites for decommissioning.

Once licensed activities have ceased, existing NRC regulations require licensees to decommission their facilities so that their licenses can be terminated and the property released for unrestricted use. This requires that radioactivity in buildings, equipment, soil, groundwater, and surface water resulting from the licensed operation be reduced to levels low enough to allow license termination. Licensees must then demonstrate by a site radiological survey that residual contamination in all facilities and environmental media has been properly reduced to acceptable levels. The NRC conducts confirmatory surveys, where appropriate, to verify that sites meet NRC radiological criteria for decommissioning.

The action considered in this final Generic Environmental Impact Statement (GEIS) is an amendment to the Nuclear Regulatory Commission's regulations in 10 CFR Part 20 to include radiological criteria for decommissioning of lands and structures at nuclear facilities.

Need for the Rulemaking Action

The 1988 Amendments (NRC 1988a) to NRC's regulations do not contain explicit radiological criteria for decommissioning. Instead the NRC continues to use criteria and practices described in several NRC guidance documents which have been in use for a number of years. This approach ensures protection of public health and safety by guiding decommissioning decisions and generally keeping potential radiological doses to a small fraction of NRC's public dose limit given in 10 CFR Part 20. However, both the number and complexity of facilities that will require decommissioning are expected to increase. Therefore, the NRC believes that it is necessary for radiological criteria for decommissioning to be codified in its regulations to allow it to more effectively carry out its function of protecting public health and the environment at decommissioned sites by providing a clear and consistent regulatory basis for determining the extent to which radioactive contamination must be removed or reduced in lands and structures before a site can be released and the license terminated.

Purpose of this GEIS

Under the National Environmental Policy Act (NEPA), all Federal agencies must consider the effect of their actions on the environment. It is the intent of NEPA to have Federal agencies incorporate consideration of environmental issues into their decision-making process. To fulfill NRC's responsibilities under NEPA, the Commission has prepared this GEIS which analyzes alternative courses of action and the costs and impacts associated with those alternatives.

Scope of the Generic Environmental Impact Statement

This GEIS analyzes regulatory alternatives for establishing radiological criteria for decommissioning structures and lands of licensed facilities. The alternative regulatory courses of action analyzed in the GEIS include a "no regulatory change" alternative and rulemaking alternatives to amend the NRC's regulations in 10 CFR Part 20. These rulemaking alternatives include setting residual criteria at certain limits or goals using a risk basis, requiring that a site's residual contamination be returned to background conditions, requiring that there be restrictions on future use of sites, and requiring the use of best available remediation technologies.

The scope of the GEIS includes nuclear facilities licensed by the NRC that require decommissioning including those involved with the nuclear fuel cycle and those licensed to use nuclear material for other non-fuel cycle related purposes. The types of nuclear fuel cycle facilities that require decommissioning include nuclear power plants, nonpower reactors, fuel fabrication plants, uranium hexafluoride production plants, and independent spent fuel storage installations. Non-fuel cycle facilities include universities, medical institutions, radioactive source manufacturers, and companies that use radioisotopes for industrial purposes (about 75% of NRC's non-fuel-cycle materials licensees use either sealed radioactive sources or small amounts of short-lived radioactive materials).

The scope of the GEIS considers both radiological and nonradiological impacts on human health and safety, including radiation exposure resulting from occupancy of site buildings and residence on site lands and radiation exposure during decommissioning and waste transport for disposal. Nonradiological impacts on humans, such as those resulting from conventional workplace accidents and from traffic accidents during transport of decommissioning wastes for disposal, are also considered. Waste disposal impacts, as well as impacts on biota, economic impacts, societal impacts, and land use impacts are addressed.

The GEIS does not analyze site-specific issues which may arise in the decommissioning process. Instead, its principal intent is to provide a decision analysis leading to establishment of technical requirements for acceptable residual radioactive contamination levels for decommissioning. Depending on the particulars of the specific facility, portions of the GEIS analysis may be applicable to the NEPA process for a specific site.

Approach in Preparing the GEIS

In preparing the GEIS, the NRC has presented the decision bases, analyses, and preliminary conclusions and recommendations regarding a preferred regulatory alternative for establishing radiological criteria for decommissioning. In summary, the approach is as follows:

(1) A reasonable listing is developed of alternative regulatory actions to establish radiological criteria for decommissioning. The regulatory alternatives considered are listed above.

(2) For each of the regulatory alternatives, the GEIS presents a detailed analysis and comparison of: (1) incremental impacts, both radiological and nonradiological, to workers, members of the public, and the environment, resulting from each alternative, and (2) the incremental costs associated with each regulatory alternative.

(3) Based on the analyses of impacts and costs, the GEIS provides conclusions on radiological criteria for decommissioning.

Conclusions

The following principal conclusions, discussed below, are presented in the GEIS:

(1) Definition of Decommissioning

The definition of decommissioning should provide that, at the end of operations and completion of decommissioning activities, the license must be terminated and the facility released for either unrestricted use or release of property under restricted conditions (see Item #2(c) below).

(2) Establishment of Radiological Criteria for Decommissioning

A tiered approach should be used for establishing radiological criteria for decommissioning. This tiered approach would combine elements of both unrestricted and restricted use alternatives. This tiered approach is outlined below.

a) Achieving, as an Objective of Decommissioning ALARA, Reduction to Pre-Existing Background - The objective of returning a site to pre-existing background conditions is consistent with the concept of returning a site to the condition that existed before its use. However, the question of whether this objective as a goal of decommissioning, and in particular the ALARA aspects of decommissioning, should be codified by rule depends on a variety of factors, including cost, practicality of achieving the objective, and the type of facility involved. Decommissioning is expected to be relatively easy for a certain class of nonfuel-cycle nuclear facilities (i.e., those that use either sealed radioactive

sources or small amounts of short-lived nuclides), because there is usually no residual radioactive contamination to be cleaned up and disposed of, or if there is any, it should be localized or it can be quickly reduced to low levels by radioactive decay. Achieving an objective of returning these facilities to background would not appear to be an unreasonable objective of ALARA. However, in general, for those nuclear facilities where contamination exists in soils and/or structures, achieving an ALARA decommissioning objective of "return to a pre-existing background" is not reasonable from a net detriment standpoint or cost vs. impacts standpoint because detriments and costs of remediation and surveys tend to increase significantly at low levels, while benefits tend to decrease at criteria near background.

b) Setting a residual Dose Criterion - Given the range of possible parameters, scenarios, and site specific situations, there is a wide range of cost-benefit results among the different facilities and within facility types and there is no unique algorithm which decisively is the most beneficial result for all facilities which could be established. National and international radiation standards setting bodies, including the International Commission on Radiation Protection (ICRP) and the National Council on Radiation Protection and Measurements (NCRP), note in their most recent documents (ICRP 60 and NCRP No. 116) that, although the limit for the public dose should be 100 mrem/y from all man-made sources combined, it would seem appropriate that the amount that a person would receive from any one source should be held to a fraction of the limit to account for the potential that an individual may be exposed to more than one source of man-made radioactivity, thus limiting the potential that an individual would receive a dose at the public dose limit. Considering potential sources, the dose from decommissioned sources should be held to 25 percent of the public dose limit which would provide a sufficient and ample margin for protection of public health and safety.

c) Decommissioning ALARA analyses - As indicated above, for the generic scenarios considered, there is a wide range of possible cost-benefit results for different facilities. Therefore, ALARA analyses should be part of the radiological criteria for decommissioning.

d) Restricted use and Alternate Site Specific Cases - There can be situations where restricting site use to achieve a TEDE of 25 mrem/y is a more reasonable and cost-effective option than unrestricted use. In this manner, restrictions can provide protection of public health and safety at reasonable cost by limiting the time period that an individual spends onsite or restricting agricultural or drinking water use. For many facilities, the time period needed for restrictions can be fairly short, i.e., enough to allow radioactive decay to reduce radioactivity to levels which permit release for unrestricted use. Thus restricted use, accompanied by provisions which assure the restrictions remain in place, should have a part in a license termination approach. There may be several existing licensed sites where the public health and the environment may best be protected

by alternate means and it may be reasonable to anticipate that there may be site specific special circumstances, not analyzed in this Final GEIS because of their specific situation, which need particular analysis.

(3) Groundwater Cleanup

The provisions of item #2 above are intended to protect the public from radiation from all of the pathways that they could be exposed to from a decommissioned facility (e.g., direct exposure to radiation from material on the soil surface, ingestion of food grown in the soil and from fishing, inhalation of dust from soil surfaces, and drinking water obtained from surface waters and from groundwater). Such criteria would thus limit the amount of radiation that a person could potentially receive from all possible sources (i.e., "all-pathways") at a decommissioned facility.

Because equivalent doses received through any of these pathways would involve equivalent risks to the person exposed, it would appear that, with regard to the need to set a separate standard for groundwater, there appears to be no reason from the standpoint of protection of public health and safety to have a separate, lower, criterion for one of the pathways (e.g., drinking water) as long as, when combined, they don't exceed the total dose standard established in the rule. Thus, while it is evident that exposures from drinking contaminated groundwater need to be controlled and that the environmental integrity of the nation's groundwater resources needs to be protected, it is also evident that protection of public health and safety is fully afforded by limiting exposure to persons from all potential sources of radioactive material at a decommissioned facility.

As is noted in Item #2 above, given the range of possible parameters, scenarios, and site specific situations, licensees should consider, as appropriate, in an ALARA analysis site specific conditions which could impact groundwater dose estimates.

(4) Citizen Participation

The public should not only be fully informed of the decommissioning actions at a particular site but also be able to effectively participate in site decommissioning decisions. In particular, for decommissioning where the licensee does not propose to meet the conditions for unrestricted use, licensees should seek community involvement and advice through a variety of methods regarding the proposed decommissioning.

It is recognized that special environmental or cultural issues may be associated with a particular decommissioning action which would require more stringent implementation of the requirements. Sites on or contiguous to historical sites or Native American lands that contain religious or sacred areas are examples of such special issues. These issues can best be handled on a site-by-site basis as part of the decommissioning plan review

process, and as part of the NRC's environmental review under NEPA. Where necessary, the provisions for public comment and for seeking community involvement and advice would provide a mechanism for addressing these issues.

(5) Minimization of Contamination

There should be specific attention given to design features and procedures that facilitate decommissioning the site, reduce the amount of radioactive waste, and minimize the overall public risk associated with decommissioning.

FOREWORD

The information in this report is being considered by the U.S. Nuclear Regulatory Commission staff in the development of amendments to its regulations in 10 CFR Part 20 to include radiological criteria for decommissioning of lands and structures at nuclear facilities. This report documents the potential environmental consequences of proposed regulatory alternatives.

This report contains the analysis of environmental impacts for rulemaking on radiological criteria for decommissioning that is being considered by the NRC. The results, approaches and/or methods described in this NUREG are provided for information only. Publication of this report does not necessarily constitute NRC approval or agreement with the information contained herein.

Cheryl A. Trottier, Acting Chief
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ACKNOWLEDGEMENTS

This Final Generic Environmental Impact Statement was prepared principally by the U.S. Nuclear Regulatory Commission staff in the Division of Regulatory Applications, Office of Nuclear Regulatory Research. In preparing this report, the staff relied heavily on contractor inputs in specific technical areas from Battelle Pacific Northwest Laboratory, Richland, Washington, from Oak Ridge Institute of Science and Education, Oak Ridge, Tennessee, from Environmental Measurements Laboratory, New York, New York, from Sandia National Laboratory, Albuquerque, New Mexico, from Sanford Cohen and Associates, Inc., and from Advanced Systems Technologies, Inc., Atlanta, Georgia.

1. Introduction

1.1 Description of the Rulemaking Action

The action being considered in this final generic environmental impact statement is an amendment to the Nuclear Regulatory Commission's regulations in 10 CFR Part 20 to include radiological criteria for decommissioning of lands and structures at nuclear facilities. This action would provide a clear and consistent regulatory basis for determining the extent to which radioactive contamination must be removed or reduced in lands and structures before a site can be released and the license terminated.

1.2 Background

The Nuclear Regulatory Commission (NRC) has the statutory responsibility for protecting health and safety and the environment related to the possession and use of source, byproduct, and special nuclear material under the Atomic Energy Act. The NRC believes that one portion of this responsibility is to assure safe and timely decommissioning of the nuclear facilities used in conjunction with NRC-licensed activities. This responsibility can be partially fulfilled by providing guidance to licensees on how to plan for and prepare their sites for decommissioning. Decommissioning was defined in amendments made in 1988 (NRC 1988a) to the NRC's regulations in 10 CFR 30.4, 40.4, 50.2, 70.4, and 72.3, to mean to remove nuclear facilities safely from service and to reduce residual radioactivity to a level that permits release of the property for unrestricted use and termination of the license.

During licensed operations, radioactive contamination may be spread into various areas within the facility by the movement of water or other fluids containing the radioactive materials through or along piping, equipment, walls, floors, drains, etc. In addition, areas surrounding buildings could become contaminated by the movement of materials, equipment, and people into and out of the areas containing the radioactive material, although NRC's contamination control requirements tend to limit such spread of material. In addition to contamination, some licensed operations (for example, nuclear reactors) can produce radioactive materials through the process of activation.

The 1988 amendments (NRC 1988a) to the NRC regulations required licensees who had ceased licensed activities to decommission their facilities so that their licenses could be terminated and the property released for unrestricted use. This required that radioactivity in buildings, equipment, soil, groundwater, and surface water resulting from the licensed operation be reduced to levels low enough to allow license termination. Licensees would then demonstrate by a site radiological survey that residual contamination in all facilities and environmental media had been properly reduced to acceptable levels. The NRC conducts confirmatory surveys, where appropriate, to verify that sites meet NRC radiological criteria for decommissioning.

Nuclear facilities licensed by the NRC, or used by licensees in their activities, that require decommissioning include those that are part of the nuclear fuel cycle (activities related to the generation of electricity through nuclear power generation) and those used in licensed activities for purposes other than fuel cycle activities (e.g., health care, research, and manufacturing). The types of nuclear fuel cycle facilities that require decommissioning include nuclear power plants, nonpower (research and test) reactors, fuel fabrication plants, uranium hexafluoride production plants, and independent spent fuel storage installations. Some effort to reduce radioactive contamination to acceptable levels will generally be necessary at these facilities before the license can be terminated. Non-fuel-cycle materials facilities include universities, medical institutions, radioactive source manufacturers, and companies that use radioisotopes for industrial purposes. About 75% of NRC's non-fuel-cycle materials licensees use either sealed radioactive sources or small amounts of short-lived radioactive materials. Decommissioning of these facilities should be relatively easy because there is usually little or no residual radioactive contamination to be removed and disposed of. Of the remaining 25 percent, a small number (e.g., radioactive source manufacturers, research and development laboratories, and radioactive ore processors) conduct operations that could produce substantial radioactive contamination in portions of the facility. As at fuel cycle facilities, efforts will be needed to reduce contamination levels at these facilities during decommissioning.

Several hundred NRC licenses are currently terminated each year. Most of these licenses cover limited operations that produce little or no radioactive contamination and do not present complex decommissioning problems or potential risks to public health or the environment from residual contamination.

1.3 Need for the Rulemaking Action

The current regulatory structure for decommissioning was described in Chapter 2 of the Draft GEIS. Specifically, that chapter noted that current NRC regulations do not contain explicit radiological criteria for decommissioning. At present, the NRC continues to use on a case-by-case basis criteria and practices described in several NRC guidance documents which have been in use for a number of years.

1. Policy and Guidance Directive FC 83-23, "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of License for Byproduct, Source, or Special Nuclear Material Licenses," August 1987 (most recent revision).

2. Branch Technical Position, "Disposal or Onsite Storage of Thorium and Uranium Wastes from Past Operations" (46 FR 52061, October 1981).

3. (a) Regulatory Guide 1.86, "Termination of Operating Licenses for Nuclear Reactors," June 1974.

(b) Letter to Stanford University from James Miller, Chief, Standardization and Special Projects Branch, Division of Licensing, Office of Nuclear Reactor Regulations, USNRC, April 21, 1982.

4. 40 CFR Part 141, "National Primary Drinking Water Standard," U.S. EPA.

5. "Persons Exposed to Transuranium Elements in the Environment" (42 FR 60956, November 1977), U.S. EPA.

This approach of using these criteria and guidance ensures protection of public health and safety by guiding decommissioning decisions and generally keeping potential radiological doses to a small fraction of NRC's public dose limit given in 10 CFR Part 20. However, more of the older and larger nuclear facilities are reaching the end of their useful lives and need to be decommissioned. Because both the number and complexity of facilities that will require decommissioning are expected to increase, the NRC believes it is necessary to codify, and provide consistency in, radiological criteria for decommissioning.

The NRC believes that radiological criteria for decommissioning should be codified in its regulations so the Commission can more effectively protect public health and the environment at decommissioned sites by providing for:

(1) more efficient use of NRC and licensee resources;

(2) consistent application across all types of licensees;

(3) a predictable basis for decommissioning planning;

(4) the elimination of protracted delays in decommissioning which result as licensees wait for generic regulatory criteria before proceeding with decommissioning of their facilities; and

(5) a reassessment of the basis for the residual contamination levels contained in existing guidance in light of changes in basic radiation protection standards and decommissioning experience gained during the past 15 years.

1.4 Purpose of This Environmental Impact Statement

Under the National Environmental Policy Act (NEPA), all Federal agencies must consider the effect of their actions on the environment. Section 102(1) of NEPA requires that the policies, regulations, and public laws of the United States be interpreted and administered in accordance with the policies set forth in NEPA. It is the intent of NEPA to have Federal agencies incorporate consideration of environmental issues into their decisionmaking process. NRC regulations implementing NEPA are contained in 10 CFR Part 51. To fulfill NRC's

responsibilities under NEPA, the Commission is preparing this final generic environmental impact statement (GEIS) which analyzes courses of action which NRC would take in establishing radiological criteria for decommissioning and the costs and impacts associated with those alternatives.

1.5 Activities Conducted in Preparation of the Final GEIS

In preparing this Final GEIS, the NRC conducted a number of activities including:

(1) In accord with 10 CFR 51.26 and 10 CFR 51.27, a notice of intent announcing a GEIS scoping process was published in the Federal Register on June 18, 1993 (58 FR 33570). The notice of intent (referred to as an FRN) included a discussion of the proposed action, the bases for preparation of the GEIS, and the scoping process. The FRN also invited comment either by oral comment at any of eight public scoping meetings or by written comment on the scope of the GEIS by describing then current preliminary NRC staff views on the scope and major topics to be dealt with in the GEIS including: (1) the facilities to be considered; (2) the affected environment; 3) the regulatory alternatives to be considered; (4) the methods of analysis of regulatory alternatives; (5) impacts (both radiological and nonradiological) and costs associated with the regulatory alternatives; and (6) areas considered to be outside the scope of the GEIS.

Oral comments presented at the scoping meetings and written comments submitted subsequent to the scoping meetings came from members of the general public, interest groups, Federal agencies, licensees, and industry organizations. A summary was prepared of the comments received during the scoping process and of the determinations and conclusions reached, including the significant issues identified. This summary is contained in Appendix E.

(2) Based on the scoping process and analysis of alternative actions, the NRC issued the Generic Environmental Impact Statement (GEIS) on Radiological Criteria for Decommissioning (NUREG-1496) in August 1994. This draft GEIS accompanied a proposed rule on radiological criteria for decommissioning which was also issued in August 1994 (59 FR 43200, August 22, 1994).

Public comments, including those from the EPA, on both the proposed rule and on the draft GEIS were received during the public comment period which closed in January 1995. The comments received on the proposed rule and draft GEIS are summarized in NUREG/CR-5383. The comments received on the draft GEIS are presented in Appendix H of the final GEIS along with responses to the comments. In addition, Chapters 2-5 and Appendices A, B, C, D, and G of this final GEIS indicate how these comments were incorporated into the analysis of the final GEIS.

As discussed in those chapters and appendices, the NRC has carefully considered the numerous comments made in the analysis of the draft GEIS. This was previously noted in a Federal Register notice issued in August 1995 (60 FR 40117, August 7, 1995), which announced that the NRC was delaying completion of this rulemaking to allow it to more fully consider the comments received. In addition, the Commission held a workshop in September 1995 (announced in August 1995, 60 FR 42193), which discussed survey methods appropriate for decommissioning, the considerations of which were used in development of Appendix D of this final GEIS.

1.6 Content of the Final Environmental Impact Statement

Based on the scoping process and the review of public comments received on the Draft GEIS, this Final GEIS analyzes regulatory alternatives for establishing radiological criteria for decommissioning structures and lands of licensed facilities. The scope of this GEIS includes the licensed nuclear fuel cycle and non-fuel-cycle facilities noted in Section 1.2 and described more fully in Chapter 3. This Final GEIS considers environmental effects on human health and safety, especially radiation exposure resulting from occupancy of site buildings and residence on site lands and radiation exposure during decommissioning and waste transport. In addition, nonradiological impacts on humans, impacts on biota, economic impacts, societal impacts, and land use impacts are addressed.

In the Draft GEIS, a range of reasonable regulatory alternatives associated with the proposed action, including "no regulatory change," risk-based limits or goals, use of best available technology, return of the site to preexisting background conditions, and restrictions on future use of the site were analyzed to determine the impact and costs associated with the proposed action. In its evaluation of these regulatory alternatives, the Draft GEIS considered each alternative's radiological and nonradiological impacts and the costs associated with implementation.

The results of the draft GEIS were that it was appropriate to consider a dose criterion for release of a decommissioned site for unrestricted use, and to also consider a dose criterion for restricted use of the site and that, in particular, a dose criterion of 15 mrem/y TEDE was generally not unduly burdensome or would not pose undue environmental harm. This final GEIS reviews and analyzes the public comment received on the dose criterion and on a range of alternative dose criteria suggested by the commenters.

The GEIS does not attempt to analyze site-specific issues which may arise in the decommissioning process; rather, its principal intent is to provide a decision analysis leading to establishment of technical requirements for acceptable residual radioactive contamination levels for decommissioning. However, depending on the particular regulatory alternative that is ultimately selected, portions of the GEIS analysis may be applicable to the NEPA process for a specific site. Application of the GEIS to the site-specific NEPA process is described in Chapter 7.

As described in the Draft GEIS, certain issues have been analyzed previously in NUREG-0586, the "Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities" (NRC 1988). The issues from NUREG-0586 include: (1) planning necessary to conduct decommissioning operations safely; (2) assurance that sufficient funds are available to pay for decommissioning; (3) the time period in which decommissioning should be completed; and (4) whether facilities should not be abandoned but instead have remaining contamination reduced to appropriate levels. Requirements related to these issues were instituted in the Commission's regulations in an earlier rulemaking entitled "General Requirements for Decommissioning Nuclear Facilities" (53 FR 24018, June 28, 1988). Although the GEIS does not analyze these issues in detail, it does consider how current issues being addressed could affect the conclusions made in NUREG-0586 (NRC, 1988) and in the rulemaking. In addition, requirements were recently published in a separate rulemaking regarding timeliness of decommissioning for 10 CFR Parts 30, 40, and 70 licensees which are not addressed in detail in the GEIS.

The GEIS does not address the issues where licensees propose to release equipment, components, piping, and other similar material containing residual radioactivity intentionally for reuse or recycle either as part of decommissioning or ongoing operations. It is planned that these issues will be considered separately. Chapter 4 of this GEIS does note that the scenarios and assumptions used in the GEIS to estimate public doses from decommissioned lands and structures are considered sufficiently conservative that future inadvertent recycle of soils or structures following decommissioning of a site would not affect the conclusions made in this GEIS regarding public health.

1.7 Approach to Preparing the GEIS

In preparing this Final GEIS, the NRC has presented the decision bases, analyses, and conclusions and recommendations regarding a preferred regulatory alternative for establishing radiological criteria for decommissioning. In summary, the approach is as follows:

(1) As noted above, the Draft GEIS presented and analyzed alternative regulatory actions to establish radiological criteria for decommissioning. The alternatives analyzed in the Draft GEIS include continuation of existing decommissioning practices (i.e., the "no-action" alternative) and rulemaking alternatives that could amend the NRC's regulations in 10 CFR Part 20, including setting residual criteria at certain limits or goals, requiring that a site's residual contamination be returned to background, requiring restrictions on the use of sites, and requiring the use of best available remediation technologies.

The result of the draft GEIS was proposal of a dose criterion of 15 mrem/y TEDE for both unrestricted and restricted uses of sites as a value that would not cause undue environmental harm.

(2) Based on the public comments received on the results of the draft GEIS for this alternative dose criterion, the Final GEIS presents a detailed analysis and comparison of: (1) incremental impacts, both radiological and nonradiological, to workers, members of the public, and the environment, resulting from each alternative and (2) incremental costs associated with each regulatory alternative dose criteria. As described in chapters 4 and 5, and Appendices B and C, the analysis of impacts and costs considers in detail specific comments made by the commenters on the analysis approach, assumptions, parameters and methods used.

(3) Based on the analyses of impacts and costs, the Final GEIS provides a conclusion regarding radiological criteria for decommissioning, in accord with the requirements of 10 CFR 51.72.

1.8 Structure of the GEIS

The GEIS has been prepared in accordance with requirements of NEPA and with Council on Environmental Quality (CEQ) regulations for preparation of environmental impact statements. In addition, the GEIS has been prepared in accordance with NRC's implementing regulations set forth in 10 CFR Part 51 and, in particular, the format requirements for an EIS in Appendix A to 10 CFR Part 51.

The EIS is divided into two volumes. Volume 1 contains the summary and seven technical chapters which are listed and summarily described below.

Chapter 1 - "Introduction" describes the rulemaking action and presents background information, and the purpose, scope, and structure of the GEIS. In particular, it describes the general approach taken in preparing the GEIS.

Chapter 2 - "Regulatory Alternatives and Analysis Approach" describes specific regulatory alternatives analyzed with Final GEIS and the approach used in analyzing those alternatives.

Chapter 3 - "Description of the Affected Environment" describes the reference facility buildings and lands covered by the GEIS and the contamination levels existing at the facilities and sites when operations cease and decommissioning begins.

Chapter 4 - "Impacts of Each Reference Facility" evaluates the health impacts from both radiation exposure and traffic/construction accidents for each type of reference facility addressed in the GEIS. It also evaluates the other environmental impacts besides human health and includes biological, socioeconomic, and physical environmental impacts.

Chapter 5 - "Costs Associated with Each Reference Facility" assesses costs associated with the decontamination and disposal of residual radioactivity on building structures and in

soil and the costs associated with termination surveys for each type of facility addressed in this GEIS.

Chapter 6 - "Comparison of Impacts and Costs for Regulatory Alternatives" compares costs and impacts for the regulatory alternatives.

Chapter 7 - "Conclusions and Recommendation Regarding Course of Action" describes the conclusions that can be drawn from the analysis of alternatives and, in accordance with 10 CFR 51.71(e), provides a recommendation on the action to be taken.

Volume 2 contains the following supporting appendices:

Appendix A: Natural Background Radiation as a Residual Radioactivity Criterion

Appendix B: Impact and Cost Analysis

Appendix C: Decommissioning Cost Analysis Considerations and Methodology, and Detailed Cost Analysis Calculations

Appendix D: Termination Survey Considerations and Detailed Analysis of Costs of Termination Surveys

Appendix E: Summary of Comments Received During the Scoping Process and of the Determinations and Conclusions Reached, Including Significant Issues Identified

Appendix F: Mechanisms for Restricted Use of Facilities That Have Had Their Licenses Terminated by the NRC

Appendix G: Evaluation of the Planned Disposal Capacity for Decommissioning and Normal Operation Waste

Appendix H: Comments and Responses on the Draft GEIS

2. Regulatory Alternatives and Analysis Approach

2.1 Regulatory Alternatives Analyzed

The National Environmental Policy Act requires all Federal agencies to consider the effect of their actions on the environment. The draft GEIS analyzed the costs and impacts of five regulatory alternatives for establishing radiological criteria for decommissioning including:

(1) Alternative 1a - continue the current NRC practice of using existing NRC guidance on a case-by-case basis in decommissioning licensed facilities, and do not issue amended regulations containing explicit radiological criteria for decommissioning (the "no regulatory change" alternative).

Alternative 1b - retain the current values for the radiological criteria but codify them in a regulation.

(2) Alternative 2 - issue a rule containing radiological criteria leading to unrestricted use of sites on the basis of risk, either as a limit or a goal. This alternative has sub-alternatives corresponding to various levels of risk.

(3) Alternative 3 - issue a rule containing radiological criteria based on emphasizing the use of "best" available technology.

(4) Alternative 4 - issue a rule containing radiological criteria based on return to background levels.

(5) Alternative 5 - issue a rule similar to alternative 2, but allow restricted use of facilities and sites.

Not considered in the Draft GEIS is an alternative in which a licensee would abandon or leave a facility after the end of operations without some facility and/or site remediation and survey or other demonstration that the levels of radioactivity have been reduced. In NUREG-0586, "Generic Environmental Impact Statement for Decommissioning of Nuclear Facilities," and in a 1988 rulemaking, "General Requirements for Decommissioning of Nuclear Facilities" (53 FR 24018), this alternative was considered and rejected because it could result in an unreasonable risk to the public. Thus, licensees are not permitted simply to abandon facilities without some actions to remediate the site and/or demonstrate that the site is safe. To enforce this prohibition, current NRC regulations in 10 CFR Parts 30, 40, 50, 70, and 72 require licensees, when their operations cease, to request license termination, to present a plan for reducing radioactivity, or to demonstrate that the radioactivity at their facilities has been reduced. These same regulations also require certain licensees to maintain funding provisions
such as sureties or trust funds to ensure that adequate funds will be available for safe decommissioning.

2.2 Results of Draft GEIS Analysis of Alternatives and Preliminary Recommendation Regarding Alternatives

The draft GEIS indicated that because of the problems associated with alternatives 1a and 1b, separate detailed analyses of their impacts and costs were not made in the GEIS. Continued retention of current criteria and guidance either on a case-by-case basis (Alternative 1a) or in amended regulations (Alternative 1b) would require a detailed reassessment of their scientific basis. As was described more fully in discussions of the other regulatory alternatives, the draft GEIS contained an evaluation of impacts and costs for a range of residual radioactivity levels. Because the levels permissible under current guidance are encompassed by that range, the analysis was considered sufficient to address the "no action" or "no regulatory change" approach. And therefore, a separate analysis of Alternatives 1a and 1b was not performed in the draft GEIS.

In Alternative 2, a revised and uniform risk basis for radiological criteria would be used for release of facilities to unrestricted use. This basis would use a risk limit or a risk goal approach.

With regard to Alternative 2, the risk-goal or risk-limit approach, the draft GEIS noted that because the residual dose criteria are measures of risk, both the risk limit and goal approaches of Alternative 2 are evaluated in terms of residual dose. For both the risk limit and risk goal approach, the draft GEIS evaluated incremental impacts for a subset of residual radioactivity dose/risk criteria to persons living and/or working on the site after the license is terminated. These levels included a range of 100 mrem/y to 0.03 mrem/y which correspond to a range of lifetime risks of excess fatal cancer of approximately 2 in 1000 to 1 in 1,000,000. The draft GEIS also evaluated incremental impacts to persons involved in the decommissioning of the site and the transport of wastes to achieve these residual dose criteria, as well as the incremental costs to achieve these dose levels.

Based on its detailed analysis of impacts and costs of the range of dose criteria considered, the results of the draft GEIS were that generally the costs of achieving a 15 mrem/y limit would not be unduly burdensome on licensees. Thus, the preliminary recommendation of the draft GEIS was that 15 mrem/y, based on the costs-benefit analysis of the draft GEIS as well as other considerations indicated, including level of risk and considerations related to exposures to multiple sources, was an appropriate dose criterion for unrestricted use.

The draft GEIS also noted that in those cases where 15 mrem/y may present an unreasonable burden, release of the site with restrictions placed on its use represents a means for providing similar levels of protection but reducing the impact and cost.

As also noted in the draft GEIS, in addition to setting a limit, it is reasonable that licensees should also reduce contamination below the 15 mrem/y limit to levels that are as low as reasonably achievable (ALARA). Use of ALARA allows reduction in the contamination remaining by taking into account economics and concomitant risk reduction for site-specific

situations. Analyses in the draft GEIS indicate that there may be reductions in impacts which could be achieved below 15 mrem/y at reasonable cost for some facilities.

Alternative 3, in which radiological criteria are based on what is achievable using the "best" available technology during decommissioning, was not recommended by the draft GEIS. In the alternative, a site would be released for unrestricted use only if residual radioactivity remaining at the site cannot be removed or measured using this technology. This objective would be technology driven. The draft GEIS found that since the objective of the alternative is technology driven, impact and cost are not factors. In fact, application of the best available technology at some sites could result in higher rather than lower impacts. Although in theory a technology-based criteria could lead to removal of all radioactivity, there are difficulties related to such removal such as increased impacts from the removal and transport. A technology-based regulation could also result in disagreements between the licensee and the NRC over which technology is best for a particular site, leading to cleanup delays and misdirected resources. Moreover, technologies are likely to change in the future, potentially resulting in further ambiguity.

Alternative 4, which would establish criteria requiring the removal of all radioactivity attributable to licensed activities, was examined in detail in the draft GEIS. A site would be released for unrestricted use only after all radioactivity has been removed and background levels have been achieved.

Appendix A reviewed in detail sources of natural background in the U.S. As noted there, these sources of natural background are highly variable between locations (spatial) and also over time at the same place (temporal). Appendix A also analyzed impacts and costs associated with achieving a dose criterion of "0" mrem/y above background.

As discussed in Appendix A, a "return-to-background" regulatory alternative which requires removal of all residual radioactivity attributable to licensed activities would have a dose criterion value of "0" mrem/y above background. A "0" mrem/y above background alternative was not explicitly studied, but impacts and costs were analyzed for residual dose criteria ranging from 100 mrem/y to 0.3 mrem/y above background. However, impacts and costs for a "0" mrem/y above background alternative can be analyzed by inference based on information collected for the dose range of 100 mrem/y to 0.3 mrem/y above background. According to data in the Appendix (based on analysis of information in Appendices B and C) the rate of reduction in health impacts below 3 mrem/y tends to become smaller or negative (a detriment). This trend in the data is expected to continue to "0" mrem/y and suggests that there is not necessarily a further health and safety benefit in establishing a return-to-background alternative that is on the order of "0" mrem/y above background. The results in the draft GEIS also suggest that expenditures made to reduce impacts to a dose criterion of "0" mrem/y above background may be very large.

A significant consideration in determining the effectiveness of a return-to-background alternative is whether available radiological survey instruments and procedures can measure "0" mrem/y

above background at NRC-licensed sites being decommissioned. This determination must account for the sensitivity of the measurement technique in the presence of widely varying radiation levels of background. Information contained in Appendix A and Appendix D of the draft GEIS indicates that significant resources and sophisticated measurement techniques must be applied to measure very low concentrations of residual radioactivity in the presence of background.

In conclusion, when health impacts and cost are taken into account for a "0" mrem/y above background regulatory alternative for the principal radionuclides studied, decommissioning costs increase significantly but health impacts are not necessarily reduced. Furthermore, due to technological limitations with available radiological measurement techniques in the dose rate range of 3 mrem/y to 0.03 mrem/y above background, a "0" mrem/y above background regulatory alternative could present significant implementation difficulties. Thus, the preliminary recommendation of the draft GEIS was that the sites not be required to be returned to background is also recommended in this GEIS, although it does recognize this as a general objective of decommissioning when reasonable.

Alternative 5 would establish criteria that would allow for land use restrictions after decommissioning to ensure protection of humans and the environment by limiting exposure to residual radioactivity. In the restricted use mode, the NRC license would be terminated as part of decommissioning, but restrictions would apply to future use of the site.

This alternative would be a departure from NRC's current requirements given in 10 CFR Parts 30, 40, 50, 70, and 72, which require that sites be released for unrestricted use following completion of decommissioning activities and termination of a license. Restricted use after termination of the NRC license is not an option in the current regulations. These regulations define decommissioning as a process that reduces residual radioactivity to a level that "permits release of the property for unrestricted use and termination of license." In addition, each of the 10 CFR Parts indicates that the NRC will terminate a license if the NRC determines that the licensee's premises are "suitable for release for unrestricted use."

The draft GEIS provided a preliminary result and recommended that restricting site use could provide considerable flexibility in the regulatory process, particularly in view of the potential range of site-specific situations. This alternative would allow for additional options for reducing impacts and costs, particularly when the impacts of decontaminating a site exceed the impacts of the residual levels of radioactivity, or when decontamination costs become financially prohibitive. The restricted use alternative could provide additional flexibility in optimizing the expenditure of resources to protect public health and safety.

On the other hand, the draft GEIS noted the restricted use alternative raises the question of the permanency of the restrictions. It is important to ensure that the restrictions will remain in place far into the future, especially for sites contaminated with long-lived radionuclides. The

discussion of restriction mechanisms in Appendix F of the draft GEIS suggests that restrictions can be viable, but the operation and maintenance costs of these restrictions need to be funded.

Public comments were received on the restricted use mode questioning its applicability, appropriateness, and durability. Other comments were received favoring restricted use but suggesting that it be allowed more circumstances and that the dose criterion be raised from the preliminary recommendation of 15 mrem/y in the draft GEIS.

In response to these comments, this final GEIS contains an analysis of the restricted use taking into account both the specific comments made on restricted use and the general comments made on the draft GEIS and discussed elsewhere in this final GEIS.

2.3 Comments on Preliminary Recommendations of Draft GEIS

A number of comments were received on the preliminary recommendation of the draft GEIS. These comments addressed a variety of concerns including a general disagreement with the recommendation of 15 mrem itself (some commenters thought the recommended dose criterion should have higher values, including 25, 30 or 100 mrem, and some commenters thought the recommended dose criterion should be lower, including a dose criterion of "0" mrem/y). Other commenters disagreed with the overall approach used in making the recommendation. Some of these commenters stated a cost analysis should not be used at all in deciding upon the criterion, while others agreed with the cost-benefit approach but disagreed with the method of analysis itself. These commenters disagreed with the approach in the draft GEIS which combined soils and structures in one analysis, and one commenter provided data and analysis illustrating a separate analysis for soils and structures.

Some commenters provided specific comments on specific parameters and assumptions used in the draft GEIS, including such things as cost of waste disposal, cost of surveys, and the volumes and extent of contamination used for the reference facilities. These comments are summarized in NUREG/CR-5383. Responses to these comments are provided in Appendix H of the final GEIS.

2.4 Final GEIS Method of Analysis of Public Comments on Draft GEIS Recommendations

2.4.1 Introduction

The public comments in the recommendation of the draft GEIS were received, and the comments were considered in detail in the analysis of the final GEIS. Based on the comments received, Alternatives 1, 3, and 4 were not considered further in the final GEIS. Alternatives 2 and 5 were reevaluated in the final GEIS based on the comments received by reconsidering the alternative dose criteria of the draft GEIS for unrestricted and restricted use between 100 mrem (the public

dose-limit of 10 CFR Part 20) and 3 mrem above preexisting natural background (see Appendix A for using 3 mrem lower dose value).

Chapters 4 and 5 illustrate the kinds of impacts and costs considered for these alternative residual dose criteria. The bases for selecting the alternative residual dose criteria are discussed in Chapters 3 and 7 of the final GEIS. Based on these analyses, Chapter 6 compares the incremental costs incurred and risk reduction obtained in achieving these alternative residual dose criteria as a means of evaluating Regulatory Alternatives 2 and 5. Specific areas where the comments (described in 2.3) are addressed are described in Chapters 4, 5, 6, and 7 and in Appendices B, C, D and H.

Impacts evaluated include (1) radiation exposure to members of the general public that live on or work on the site after decommissioning; (2) radiation exposures to decontamination workers that perform the site decommissioning and to transport workers and the public resulting from transport of decommissioning waste to licensed disposal sites; and (3) nonradiological impacts such as conventional workplace and transportation accidents that could occur during decommissioning.

Costs expected to be sensitive to radiological criteria for decommissioning include the costs of decontamination of soil and building materials, the cost of disposal of the contaminated waste, and the cost of performing radiological surveys to demonstrate that the desired levels of residual radioactivity have been achieved.

The analysis of cost versus impacts was performed in the following three steps:

1. Reference facilities were defined and characterized for the NRC licensees expected to be affected by the rulemaking.

2. For each reference facility and for alternative residual dose criteria, impacts and decommissioning costs were estimated.

3. Each regulatory alternative has an implied risk reduction which can be expressed in terms of residual dose. Based on the impacts and costs evaluated in step 2, each regulatory alternative was assessed by comparing the impacts and costs of these implied risk reductions for all reference facilities. In addition, ease of implementation was assessed across the entire spectrum of licensees.

2.4.2 Identification of Reference Facilities

To account for differences in the facilities covered by this rulemaking, the draft GEIS used reference facilities in estimating impacts and costs. This use of reference facilities is similar to the approach used in the 1988 GEIS (NUREG-0586) which supported the rulemaking on decommissioning funding, planning, and timing. These reference facilities were considered to be

sufficiently representative of facilities licensed by NRC to serve as a basis for assessing impacts and costs associated with the regulatory alternatives being evaluated. Reference facilities are divided into fuel cycle and non-fuel-cycle groups. Fuel cycle facilities include power, test, and research reactors; uranium fuel fabrication plants; uranium hexafluoride conversion facilities; and independent spent fuel storage installations (ISFSI). Non-fuel-cycle facilities include sealed source manufacturers, research and development laboratories, and rare metal refineries. Uranium mills (land and structures), which were considered in the draft GEIS, are no longer considered in the final GEIS because these are considered to be more appropriately covered by 10 CFR 40, Appendix A, which is already covers mill tailings which the dominant radiological health and safety concern.

Based on the evaluation and results of the draft GEIS, the final GEIS has simplified the analysis by consolidating the reference facilities and reducing the number to be analyzed but still maintaining the validity of the analysis. This consolidation was done by combining facilities by common characteristics of contaminant radionuclides and as described in Chapter 3 of this NUREG for reference purposes, Appendix C of the draft GEIS has been included as Attachment D to Appendix C of this GEIS and includes information on the 10 reference facilities included in the draft GEIS.

2.4.3 Determination of Impacts and Costs of Decommissioning for Reference Facilities

Each reference facility discussed in Chapter 3 is characterized by a unique configuration of radioactive contamination resulting from its operation. Differential impacts and costs of decommissioning related to residual dose criteria are determined by estimating the impacts and costs associated with reducing the contamination at the reference facility to the residual dose criteria.

2.4.3.1 Factors Affecting Impacts and Costs

In assessing the impacts and costs corresponding to each residual dose criterion, it was necessary first to identify the major factors affecting impacts and costs of decommissioning and then to determine which of those factors are sensitive to the specific value of the residual dose criterion.

As discussed in Chapter 3, the level of residual contamination in NRC-licensed facilities varies widely, and hence the extent and complexity of the cleanup can show large variations. Remediation for cleanup can be very simple at facilities where only sealed sources or short-lived radionuclides are handled. Decontamination actions at small research reactors or small laboratories can be straightforward, while extensive remediation may be required at large reactors, fuel production facilities, or rare-earth processing facilities. Although residual contamination and decommissioning complexity can vary, major decommissioning activities remain the same. These are:

1. Engineering and planning;

2. Radiological characterization survey;

3. General cleanup of facility, system draining, etc.;

4. For components, equipment, ductwork, piping, etc.:
   (a) Decontamination and disassembly;
   (b) Transport and disposal of any wastes;

5. For concrete, other building materials, and soil:
   (a) Decontamination and removal of contaminated materials (if necessary);
   (b) Shipment and disposal of contaminated materials and soil (if necessary);

6. Interaction with regulatory agencies;

7. Termination survey.

For approximately 75 percent of NRC licensees whose decommissioning would involve only the shipment of sealed sources or allowing short-lived radionuclides to decay, the impacts and costs associated with decommissioning would be limited to those associated with items #6 and #7 which should not be significant.

Items #1, #3, #4, and #6 are largely insensitive to the level of the residual dose criterion for structures and lands. For example, the impacts and costs associated with the removal of a large steam generator at a power reactor should be the same regardless of the residual dose criterion for lands and structures. Therefore, impacts and costs related to these items are not sensitive to the residual dose criterion selected or to the choice of the alternative rulemaking and, accordingly, are not addressed in the GEIS. These overall impacts and costs are presented in NUREG-0586, "Generic Environmental Impact Statement for Decommissioning of Nuclear Facilities," (NRC, 1988) prepared in support of a 1988 rulemaking "General Requirements for Decommissioning of Nuclear Facilities" (53 FR 24018).

The impacts and costs of items #2, #5, and #7 are sensitive to the residual radioactivity criteria for structures and soil. The required sensitivity of survey instruments and the extensiveness of sampling and laboratory analyses needed depend on the level of the residual dose criterion, and these affect the costs of decommissioning. Also, the quantity of building materials and soil requiring remediation is a function of the residual dose criterion. Both the impacts and costs of decommissioning are obviously sensitive to these quantities.

Therefore, the assessment of impacts illustrated in Chapter 4 and the assessment of costs illustrated in Chapter 5 focus on differential impacts and costs associated with cleaning, removing, and disposing of concrete and soil and on radiological surveys required to assess the site and demonstrate compliance. In particular, those chapters focus on the differential in

impacts and costs resulting from the promulgation of alternative residual dose criteria for lands and structures.

The impacts and costs of decontaminating buildings and soils to various levels of residual radioactivity are difficult to analyze because of a lack of relevant data. Decommissioning studies previously conducted by Battelle Pacific Northwest Laboratories under contract with the NRC (NRC, 1977; 1978a-c; 1979 a-d; 1980a-b) did not relate decommissioning impacts and costs to residual contamination levels. In addition, survey costs at very low levels of radioactivity are uncertain.

Accordingly, in support of this GEIS, new studies of the impacts and costs associated with items #2, #5, and #7, are presented in Appendices C and D. Based on the information contained in these appendices, representative contamination levels in structures and soils at the reference facilities are quantified and summarized in Chapter 3. Chapter 4 presents illustrations of the results of the evaluation of the health impacts and other consequences associated with the decontamination of the reference facilities to residual levels of contamination within the range of the residual dose criteria. Chapter 5 presents illustrations of the results of the evaluation of the costs associated with the decontamination and radiological survey of the reference facilities.

2.4.3.2 Impact Analysis.

Impacts were evaluated quantitatively, wherever possible, and qualitatively when quantitative analyses were not possible or warranted by the magnitude of the effects. Human health effects were evaluated quantitatively. These evaluations included the following:

- impacts to people residing on the site after decommissioning and license termination and, therefore, subject to radiation exposure principally caused by residual radioactivity in soil;

- impacts to people working in site buildings after decommissioning and license termination and therefore subject to radiation exposure principally caused by residual radioactivity on building surfaces;

- impacts to workers who are exposed to radioactivity as they perform the decommissioning activities and transport waste resulting from decommissioning to licensed disposal sites;

- impacts to workers performing decontamination and transporting waste to disposal sites who are subject to conventional decommissioning-related work-place and traffic accidents during decommissioning; and

- impacts to members of the public who are exposed to radioactivity and traffic accidents resulting from the transportation of waste to licensed disposal sites.

Quantitative impacts are described in more detail and are estimated in Chapter 4 and in Appendix B.

Other environmental impacts evaluated qualitatively in Chapter 4 include the following:

- impacts to plant and animal populations;
- socioeconomic impacts, including land use changes;
- impacts on the physical environment, including noise and aesthetic impacts; and
- impacts on low-level waste disposal capacity.

These impacts were evaluated and discussed in the 1988 Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities (NRC, 1988). Many of the same issues and conclusions are relevant to the present evaluation because decommissioning an entire facility encompasses activities associated with removing residual radioactivity from structures and soil. The qualitative impact evaluation in the GEIS uses some of the information contained in NUREG-0586 (NRC, 1988).

2.4.3.3 Cost Analysis.

Decommissioning costs expected to be sensitive to residual radioactivity criteria are associated with cleaning, removal, and disposal of contaminated concrete and soil, and the performance of the radiological surveys needed to demonstrate that the target residual criterion has been achieved. Illustrations of these results are presented in Chapter 5 for each reference facility and for each rulemaking alternative. The analyses of decontamination costs are described in detail in Appendix C. Appendix D describes the derivation of the survey costs, which were based upon survey methods presented in NUREG/CR-5849 (NRC 1992a).

2.4.3.4 Evaluation of Implementation of Regulatory Alternatives.

The impact and cost associated with the various dose levels which can be obtained by the different regulatory alternatives are considered and are discussed in Chapter 6.

3. Description of the Affected Environment

3.1 Introduction

The affected environment and population include approximately 7,000 NRC-licensed and 15,000 Agreement State-licensed nuclear facilities, several thousand workers engaged in decontamination activities, local residents and communities, and the natural environment in the vicinity of the licensed facilities. The facilities, located throughout the United States and the Territories, include small laboratories in office or health unit complexes, large laboratories in major industrial buildings, and large power reactor units where most of the radiation is confined to the buildings. They also include large fuel cycle or non-fuel-cycle facilities with radiation contamination occurring in structures and on adjacent facility lands.

3.2 NRC-Licensed Facilities

The final GEIS analyzes the impacts and costs associated with alternative regulatory dose criteria decommissioning. When a nuclear facility operates, it can generate radioactive contamination. Decommissioning operations reduce the contamination to an acceptable level. This section describes the NRC-licensed facilities covered by this GEIS and the nature and the level of contamination existing at these facilities at the end of their operations which must be subsequently reduced during decommissioning.

Because of the variety of facilities, the draft GEIS and this final GEIS use reference facilities in analyzing impacts and costs associated with regulatory alternatives. This use of reference facilities is similar to the approach used in the 1988 GEIS (NUREG-0586) which supported the rulemaking on decommissioning funding, planning, and timing. These reference facilities of the draft GEIS were considered to be sufficiently representative of those licensed by the NRC to support an assessment of the impacts and costs associated with the regulatory alternatives being considered.

As described in Appendix C, public comments were received which questioned the accuracy of the referenced facilities of the draft GEIS. Specifically, these comments indicated that the volume of containment material and the extent of the contamination; i.e., the profile of the contamination with depth in the soil and concrete was not accurate. These comments indicated that the volumes of waste in the draft GEIS were underestimated and that the contamination profile in the soil was deeper than that estimated in the draft GEIS. This chapter of the GEIS describes how the reference facilities and associated contamination levels have considered the public comments received.

3.2.1 Facilities Covered

As previously discussed, the proposed radiological criteria to be amended in 10 CFR Part 20 would apply to the decommissioning of nearly all of the facilities and sites licensed by the NRC.

The licensed nuclear facilities that will require decommissioning and would be affected by this action include the following:

1. Facilities involved in the nuclear fuel cycle:
   a. nuclear power plants
   b. nonpower (research and test) reactors
   c. fuel fabrication plants
   d. uranium hexafluoride production plants
   e. independent spent fuel storage installations

2. Non-fuel-cycle nuclear materials facilities. These materials licensees include universities, medical institutions, radioactive source manufacturers, and companies that use radioisotopes for industrial purposes. About 75 percent of NRC's approximately 7,000 materials licensees use either sealed radioactive sources or small amounts of short-lived radioactive materials. Decommissioning of these facilities should be relatively easy since there is usually little or no residual radioactive contamination to be cleaned up and disposed of. Of the remaining 25 percent, a small number (e.g., radioactive source manufacturers, radiopharmaceutical producers, and radioactive ore processors) conduct operations that could produce considerable radioactive contamination in portions of the facility.

The amended Part 20 would not apply to the disposition of uranium mill or mill tailings, low-level waste, or high-level waste because these have already been addressed in separate regulatory actions but would apply to surface facilities at the disposal sites.

The draft GEIS described the referenced fuel cycle and nonfuel cycle facilities considered in the analysis. These descriptions have not changed in the final GEIS although the final GEIS does consider the comments on contamination volumes and extent in Section 3, below.

As noted above, this final GEIS has consolidated the reference facilities to simplify the analysis and the results while maintaining their validity. Specifically, the reference power reactor is used in the final GEIS as reference for the power reactor, test reactor, research reactor and ISFSI because the principal containment nuclides contributing to the residual dose (Co 60 and Cs 137) are common for these facilities and the power reactor is a bounding analysis for these cases. The uranium fabrication facility is used as the reference for both the fabrication and the hexaflouride plant. The sealed source manufacturer and broad R&D facility, are treated in one analysis. The remaining reference facility is the rare metal processing facility. Of the 7000 NRC licensed facilities which must terminate their licenses, these reference facilities are considered to be the approximately 500-700 facilities which can have low to medium to significant contamination. These reference facilities, and the contamination levels used is this final GEIS are described in detail in Appendix C. A summary of the contamination is contained in Table 3-1 of this chapter.

The draft GEIS noted that the majority of NRC's 7,000 materials licensees use either sealed radioactive sources or small amounts of short-lived radioactive materials in their business operations. Typically, these facilities can be categorized in the following manner:

1. A sealed source is defined in 10 CFR Part 30 as any byproduct material that is encased in a capsule designed to prevent leakage or escape of the byproduct material. Sealed source users are licensed under 10 CFR Parts 30, 33, and 35 and include medical users of sealed sources (teletherapy, brachytherapy), users of industrial gauges, well loggers, radiographers, and irradiators. Nuclides contained in the capsules and used by sealed source users include Co-60, Cs-137, I-125, Ir-192, Sr-90, and Am-241. The sealed sources are designed and tested according to the requirements of industrial standards and radiation safety criteria set out in the regulations to prevent leakage.

   As a result of the nature of the sealed source design, testing, and operation, it is expected that contamination of facility structures and soils would not result from routine operations.

   Recent experience indicates that the frequency of leakage of sealed sources is very low. Leaking sources are taken out of service and returned to another specific licensee (typically the manufacturer) for disposal. Sealed source contamination would most likely be contained within the device or otherwise localized, and remediation would be straightforward and localized. When operations using the sealed source cease, the sealed source would be returned to a specific licensee authorized to possess the source or sent to licensed disposal site for proper disposal. It is expected that decontamination of the building or of soils would not be needed. Currently, 10 CFR 30.36 requires that sealed source licensees properly dispose of the source, submit form NRC-314, and either conduct a radiation survey or demonstrate that the premises are suitable for license termination by other means.

2. Licensees using short-lived byproduct radionuclides are licensed under 10 CFR Parts 30, 33, and 35 and use short-lived nuclides for specific reasons, primarily in the area of medical diagnostics. Short-lived nuclides licensed for such use include Tc-99m, I–131, and I-123.

   The nature of operations using short-lived nuclides, makes the contamination of facility structures and soils unlikely. Contamination (if any) would likely be confined to localized areas in buildings. Any such contamination would be diminished by radioactive decay, and no long-term contamination would remain after license termination. Cleanup would be straightforward and localized. The predominant means for decommissioning of facilities that use short-lived nuclides is "decay-in-storage." In terminating the license, the licensee follows the same procedure required under 10 CFR 30.36 as noted above for sealed sources, i.e., any byproduct material is properly disposed of, form NRC–314 is submitted indicating disposition of any licensed material, and either a radiation survey is conducted or there is a demonstration that the premises are suitable for license termination by other means (e.g., by calculation of the reduction in activity by radioactive decay). Based on use of "decay in storage" for the short-lived nuclides, and the time involved in submitting the information necessary to terminate a license, it is expected that

licensed material would reach sufficiently low levels such that decontamination of the building or of soils would not be needed.

Based on the preceding discussion, decommissioning of these facilities should be relatively easy because there is usually little or no radioactive contamination to be cleaned up and disposed of. As noted above, decommissioning operations will generally consist of disposing of a sealed source or allowing licensed short-lived nuclides to decay in storage, submitting form NRC-314, and demonstrating compliance with the requirements for license termination. Because the impacts and costs for these facilities are expected to be minimal, detailed reference facilities are not characterized, and impacts and costs are not analyzed in Chapters 4 and 5. However, information from those chapters is used to provide a qualitative analysis of impacts and costs for this class of facilities in Section 7.2.2.

3.2.2 Contamination Distribution

The operation of reference facilities discussed above results in radionuclide contamination at the facility requiring cleanup to reach acceptable levels. This GEIS analysis focuses on the contamination levels in the reference facility building materials and in site soil, in those cases where contamination occurs.

3.2.2.1 Building Material Contamination Distribution.

Section 4 of Appendix C describes reference contamination levels on and within concrete and other building material surfaces for each of the reference facilities. Contamination on building surfaces occurs as a result of system leaks, minor spills, tracking of contamination, etc. The radionuclide contamination can spread readily onto the concrete surfaces and can also spread into the concrete either by diffusion directly into the concrete or by seepage into cracks in the concrete.

Analysis of impacts and costs of removal of concrete must consider both the level of contamination on the concrete surface and the profile of that contamination with concrete depth. This must be done to estimate the volume of material requiring removal and disposal to attain alternative residual dose criteria, and to estimate impacts and costs associated with removing and disposing of that material.

To estimate surface contamination levels on concrete surfaces, the draft GEIS assessed information on contamination levels in nuclear facilities, such as the Battelle PNL series of reports on the technology, safety, and costs of decommissioning (NRC, 1992b; 1978a-c; 1979a-d; 1980a-b), a study of source terms at operating facilities (NUREG/CR-4289), existing information on contamination levels, information from the Site Decommissioning Management Plan contained in NUREG-1444, and engineering judgment as to the areal extent and level of this contamination where detailed information is not available. The draft GEIS assessed the available data on distribution of radionuclides on concrete surfaces within the reference facilities and also

presented information on the concentration profiles of the contaminants with depth of concrete. The concentration profiles were based on actual data where available and on theoretical estimates based on calculated diffusivity coefficients for the various radionuclide species of interest in these analyses when actual data were not available.

Comments were received on the draft GEIS criticizing the assessment of concrete contamination on surfaces and with depth. However, in reviewing the comment letters and the current data, significant data to modify the analysis of building material contamination distribution was not found (see Appendix C). Hence, the analysis of building contamination in Appendix C of the final GEIS is largely the same as the draft GEIS.

3.2.2.2 Soil Radionuclide Contamination Distribution.

The draft GEIS also described and analyzed reference contamination levels on and under soil surfaces for each of the reference facilities. Contamination may occur in onsite soils outside building structures as a result of spills or specific operating methods. The extent of this contamination depends on the nature of operations. In addition, the distribution of contamination with depth of soil varies greatly because soil is a widely varied medium, and the penetration of individual radionuclides through this medium is highly individual and complex. Prediction of contamination profiles in soils from a knowledge of the surface source terms and penetration time requires considerable additional information on soil composition (clay, sand, humus), particle size distribution, pH, ion-exchange capacity, cumulative rainfall, and other factors.

Like the analysis for concrete, the analysis of impacts and costs of removal of soil must consider both the level of contamination on the soil surface and the profile of that contamination with soil depth. Both factors must be known to estimate the volume of material requiring removal and disposal to attain alternative residual dose criteria and the impacts and costs associated with removing and disposing of that material.

To estimate soil surface contamination levels, the draft GEIS assessed previous reports on the level and location of contamination in nuclear facilities, such as the Battelle series of reports on decommissioning technology, safety, and costs, NUREG/CR-4289 which contains source terms from operating facilities; existing information on contamination levels, NUREG-1444 (NRC, 1993), and engineering judgment as to the areal extent and level of this contamination where detailed information is not available. The draft GEIS presented available data on distribution of radionuclides on soil surfaces at the reference facilities.

As noted in the draft GEIS, little information is available on penetration of radionuclides into the soil or resultant profiles of contamination distribution with depth in soil. For the purposes of the draft GEIS, profiles of the contamination of the radionuclides in the soil were estimated based on the soil model of NUREG/CR-5512 (NRC, 1992c).

Comments were received on the draft GEIS criticizing the assessment of soil contamination on surfaces and, in particular, with depth. These comments indicated that soil contamination is more extensive than indicated in the draft GEIS, that soil contamination occurs for a variety of reasons, and that the profile of the contamination with depth is more complex than the diffusion model estimated for the reference facilities in the draft GEIS. These commenters indicted that because the containment depth profile is more pronounced than the draft GEIS estimates, larger soil volumes are required to be removed to reach the lower dose criteria, and thus, it costs more to achieve the alternative dose criteria than estimated in the draft GEIS.

Appendix C of this final GEIS assessed the information presented in these comments and also considered other available data to confirm the accuracy of the information provided in the public comment letters. Based in the analysis of Appendix C, this final GEIS includes in its analysis of impacts and costs a range of soil contamination levels, volumes, and profiles. This range includes the data in the draft GEIS (as still being representative of cases of relatively simple soil contamination) as well as contamination levels comparable to those suggested in the public comments.

3.2.2.3 Summary of Radionuclide Distribution at Reference Facilities.

Based on the above analyses of surface source terms and profiles of contamination with depth, source terms in the final GEIS for the reference facilities are developed according to the following general model:

1. The extent and profile of radionuclide surface and volumetric contamination levels in concrete and other building materials in various areas of the reference facilities are estimated;

2. For reactors, the extent and profile of the activated concrete in the reactor building are estimated;

3. Contamination levels in cracks and corners, and in other potential contamination hot spots in concrete and other building materials, are estimated;

4. The extent and profile of radionuclide surface and volumetric contamination levels in various areas of the onsite soils and soils beneath the facility buildings at the reference facilities are estimated.

Based on the discussion in this chapter and the analyses of Appendix C, and using the general model described above, the estimated areas of contamination and the principal dose contributing radionuclides in buildings and soils for each reference facility are summarized in Table 3-1. Table 3-1 also summarizes the building surface contamination levels used in the analyses of impacts and costs. Profiles of contamination with depth of concrete and soil are given in Appendix C.

3.3 Human and Natural Environments

3.3.1 Human Health and Safety

Impacts on human health and safety include both radiological and nonradiological health effects both on those who are involved in or exposed to activities occurring as part of the decommissioning process (such as decontamination of buildings or transport of wastes), and on those who occupy site buildings or lands following decommissioning and license termination.

3.3.2 Socioeconomic Environment

Locations of the facilities range from rural areas with a few residents per square mile to urban areas with populations of several million persons. Population data, including the location of the nearest residents and local population distribution within 80 km are required as part of licensing and will be available for the site-specific environmental review prior to decommissioning.

Although the facility sites are industrial, surrounding land uses may be industrial, agricultural, commercial, residential, range land, forest, or open-space.

The draft GEIS analyzed collective radiological exposure and resultant health impacts based on assumed post-decommissioning use of the facility. As noted above, there is a variety of potential post-decommissioning and license termination cases of these sites.

Public comments on the draft GEIS questioned the analysis of risk to populations, the length of exposure time, issues of transfer of risk, etc. This final GEIS includes the facility use characteristics of the draft GEIS, and also includes a range of alternate post-decommissioning uses of the site and the buildings. These uses are described in detail in Appendix B.

3.3.3 Biological Environment

3.3.3.1 Flora.

The areas of surface contamination will be within the facility boundaries and will usually have been disturbed to some degree during the licensed operations. Existing vegetation may be natural or introduced and include grasses, forbs, shrubs, and trees. Some of the areas may qualify as wetlands, especially in the vicinity of drainages and stormwater control basins.

3.3.3.2 Fauna.

Animals using the sites for habitat (resident or forage) may include small mammals, reptiles and amphibians, birds, and invertebrates. Species present at individual sites will depend on the ecological zone, site characteristics, and degree of human activity in the area.

3.3.4 Physical Environment

3.3.4.1 Soils.

Soils on the sites can be expected to include the full range of soil series found in the United States. Most of the sites requiring decontamination will have been disturbed to some degree during construction and operation of the facility. Contamination of these soils is generally most concentrated at the surface but may extend to several feet or more in depth at some sites.

3.3.4.2 Meteorological.

Meteorological conditions will be representative of those found throughout the United States. Major sites maintain monitoring stations and air quality records.

3.3.4.3 Water Resources.

Some of the facilities maintain surface water impoundments or drainage and stormwater control structures for compliance with State and Federal water quality standards. At some sites, impounded water may be contaminated and require treatment.

3.3.4.4 Cultural Resources.

Because of past operations and disturbance of the facility sites, it is expected that any cultural or historic resources present will either have been identified in site surveys or inadvertently removed.

3.3.4.5 Low-level Waste Storage Capacity.

Low-level waste generated by the decommissioning process will be disposed of in planned low-level waste burial facilities. The disposal capacity planned by the various compacts and States totals about 52×10^6 ft^3 (Appendix G). The waste volumes from decommissioning of lands and structures will fill up some of this planned capacity.

TABLE 3.1
Total and Contaminated Surface Areas for Structures and Soils at Reference Sites (1)

Reference Facility	Structures Radionuclide Activity (2), dpm/100 cm^2	Structures Surface Areas				Soil Surface Area, ft^2	
		ft^2		% Contaminated			
		Floor	Wall	Floor	Wall	Total Site	Contaminated
PWR	7.5×10^6 Co60 2.4×10^6 Cs137	250,000	300,000	10	2	50×10^6	3,000
Uranium Fuel Fab	18,000 U	240,000	240,000	50	5	4.7×10^6	100,000
Sealed Source Manufacturer	102,000 Co60 33,300 Cs137	6,000	4,600	10	5	40,000	5,000
Rare Metal Extraction	18,000 Thorium	150,000	180,000	40	10	740,000	100,000

(1) The estimated surface areas listed above (reproduced from Appendix C) are based on limited information and in many cases represent an engineering judgment based on the size of the building structural facilities and types of operation. These estimates are considered to be conservatively large, i.e., they probably overestimate the actual areas involved.

(2) Radionuclide activity shown is for building surfaces. Radionuclide activity for soil surfaces is given in Appendix C.

4. Impacts for Each Reference Facility

4.1 Purpose

This analysis evaluated human impacts over a range of residual dose rate levels for each of four reference facilities. The four reference facilities include a power reactor, uranium fuel fabrication facility, sealed source manufacturer, and rare metals processor. Chapter 3 describes the reference facilities, and Appendix C gives additional detail.

This analysis also evaluated environmental consequences other than those directly affecting human health. These include impacts on the biological, socioeconomic, and physical environments both from the decontamination activities and from residual radiation levels.

4.2 Human Health Impacts

4.2.1 Human Health Impacts Resulting from Decommissioning

This section provides an overview of the analysis of the impacts of those decommissioning activities necessary to bring the reference facilities into compliance with the residual dose criteria. The complete bases and the detailed results of the impact analyses are provided in Appendix B. As discussed in Chapter 2, this evaluation analyzes impacts and costs for each reference facility for a range of possible residual dose criteria. These residual dose criteria represent the exposure to an individual at the site following decommissioning. The criteria selected for these detailed analyses include: 100, 60, 25, 15 and 3 mrem per year. Consideration of the impacts of a limit of "0" above background are discussed in Appendix A. The impacts are as follows:

1. Impacts on persons living on the site after decommissioning and license termination - Individuals residing on the site after completion of decommissioning and termination of the facility license may be exposed via a variety of potential pathways. As described in NUREG/CR 5512, the pathways include: (1) external exposure to contaminated soil both indoors and outdoors, (2) internal exposure both indoors and outdoors due to inhalation of contaminated material that is resuspended, (3) direct and inadvertent ingestion of soil, (4) ingestion of drinking water from a source of groundwater contaminated by migration of radionuclides in soil, (5) ingestion of vegetable products grown in contaminated soil and/or irrigated with contaminated groundwater, (6) ingestion of food products from animals that consume contaminated feed and/or drink contaminated water, and (7) ingestion of fish products from a source of water contaminated with surface runoff from the site.

2. Impacts on persons working in the facility after decommissioning and license termination - Individuals working in the facility after completion of decommissioning and termination of the facility license may be exposed through a variety of potential pathways.

As described in NUREG/CR-5512, the pathways include: (1) external exposure to surface sources, (2) inhalation of resuspended surface contamination, and (3) inadvertent ingestion of surface contamination.

3. Impacts on persons resulting from decommissioning operations to reduce building and soil contamination to acceptable levels - These impacts have both radiological and nonradiological sources and affect both the public and decontamination workers. This human health impact is a result of the actions taken at each reference facility to reduce the building and soil contamination levels to achieve compliance with the alternative residual dose criteria specified above. The impacts are as follows:

   a. Radiological impacts to workers during decontamination and cleanup activities at the facility - These impacts are based upon the dose rates to which the workers are subjected and the collective effort required to reduce the residual contamination levels.

   b. Radiological impacts to workers and the general public incurred during transport and disposal of waste material generated during decontamination to a licensed disposal facility - These impacts are based upon the total volume of waste, number of shipments, and the collective exposure incurred in making a shipment of such radioactive waste.

   c. Nonradiological impacts (specifically, fatal transportation accidents) on workers and the general public incurred during transport of waste generated during decontamination to a licensed disposal facility - These impacts are based upon the total volume of waste, number of shipments, the distance to the disposal site, and the rate of fatal vehicular accidents.

   d. Nonradiological impacts (specifically, fatal construction accidents) on workers during decontamination and cleanup activities at the facility - These impacts are based upon the collective effort required to reduce the residual contamination levels and the rate of fatal construction accidents.

The GEIS does not include the radiological exposure impacts on offsite populations from routine and accidental decommissioning releases. These were addressed in the 1988 GEIS, NUREG-0586. Since decontaminating building surfaces and soil is a fraction of the entire decommissioning process, the impacts resulting from this part would be smaller than those described in NUREG-0586.

Also not specifically addressed in the GEIS are the impacts from future inadvertent recycling of contaminated building rubble and soil following decommissioning of a site. One could postulate that both building rubble and soil containing residual radioactivity could be inadvertently recycled into new construction material or used as fill, thus causing radiation exposures.

Although the analysis in this GEIS does not specifically take this recycling into account, the building occupancy and onsite residency scenarios and assumptions used in the GEIS to estimate public doses from decommissioned lands and structures are considered sufficiently conservative to encompass recycling of such material. The exposure mechanisms are the same, and the resulting individual doses could only be less than those evaluated because the contamination of the recycled material will be reduced through dilution with other raw materials. Thus, future inadvertent recycling of soils or structures following decommissioning of the reference sites would not affect the conclusions made in this GEIS regarding public health.

Although this GEIS quantifies the impacts from transporting decommissioning waste to a low-level waste disposal site, the GEIS does not consider in detail the impacts from the permanent placement of waste in the disposal facility. These impacts have already been described in the Final Environmental Impact Statement on 10 CFR Part 61 (NRC, 1982). Waste from decommissioning of lands and structures is a component of the entire waste placed within a disposal facility; therefore, the impact from this waste is a fraction of the entire disposal facility's impact. Because the estimated exposures from the entire waste disposal facility in the Part 61 GEIS are lower than those for the activities associated with decommissioning for the reference facilities illustrated in Tables 4-1 - 4-8, they would not affect the conclusions made regarding decommissioning impacts and costs in this GEIS. In addition, the analysis contained in Section 4.3.5 below indicates that the incremental effect of alternate residual dose criteria for lands and structures for the reference facilities should not result in the need for additional disposal capacity beyond that planned.

4.2.2 Analysis of Radiological and Nonradiological Human Health Impacts

In assessing human health impacts from decommissioning, the analysis considers risks to individuals expressed either in terms of mrem/year when radiation exposure is involved or in accident rates when nonradiological impacts are involved. The assessment also considers collective risk to the population engaged in various activities related to the decommissioning which result in both long-term and short-term impacts. These impacts are accrued differently with respect to the alternative residual dose criteria. Working and living on site after license termination results in long-term exposure to residual dose levels; therefore collective risk is reduced with decreasing residual dose criteria. The four decontamination-related impacts listed in item #3 of Section 4.2.1 are short-term in nature and consist of both radiological and nonradiological risks. In these cases, the activities necessary to achieve lower residual dose criteria result in an increase in collective risk to those engaged in those activities. Because these long-term and short-term impacts take place over different time periods and may affect different persons, a precise comparison or balancing is difficult. Nevertheless, the analysis in this GEIS estimates the individual risks and collective risks for these impacts separately and also presents a total collective risk for these disparate impacts. This approach is considered reasonable in that it permits assessments and conclusions to be made about all of the impacts that may result from a particular decommissioning alternative.

Individual and collective risks are determined by estimating the risk to individuals engaged in the activities listed in Section 4.2.1, the total number of persons engaged in those activities, and the time period over which the activities take place. Details of the methods for assessing the individual and collective risks for the activities are indicated in Section B.2 of Appendix B, and assumptions regarding numbers of persons, time periods for activities, and other parameters needed to assess collective risk from an activity are summarized in Table A of Attachment A to Appendix B.

For the impacts associated with working or living on the site following license termination, the analysis assumes exposure of individuals to the residual dose limit, corrected for radioactive decay, over a 1,000 year time period for soil and a 70-year time period for buildings which is assumed to be the lifespan of the building. Analysis of costs and impacts of building demolition are described in NUREG-0586 (NRC, 1988).

For the impacts on workers involved in decontamination operations to reduce contamination in structures and soils to the residual dose levels, the analysis is based upon the reference contamination levels in each reference facility, as given in Chapter 3 and in Appendix C. Appendix C shows the amount of concrete that must be removed to achieve the alternative residual radioactivity criteria. Based on that information, the evaluation determines the time spent and radiation exposure received in decontaminating the surfaces to these levels and in removing and transporting the contaminated concrete to a disposal site. Additionally, the analysis assesses the decontamination and transportation impacts for soil contamination.

The radionuclides used in the analysis of impacts in this section (and of costs in Chapter 6) are Co-60, Cs-137, U-nat, and Th-232. Dose conversion factors for these nuclides are calculated for several different pathways of exposure based on the analysis procedures of NUREG/CR-5512 (NRC, 1992c) which contains the NRC's technical bases for translating contamination levels to annual total effective dose equivalent. The radionuclides Co-60 and Cs-137 are of the type found in certain of the reference facilities listed in Chapter 3, and are representative of power reactors, research and test reactors, ISFSIs, sealed source manufacturers, and R&D facilities. Unat and Th-232 are of the type found at certain of the reference fuel cycle facilities listed in Chapter 3, including uranium fuel fabrication plants, UF_6 plants, and rare earth processors. While other radionuclides are also present at these facilities, the impacts and costs resulting from analysis of these radionuclides are considered sufficiently representative of the reference facilities for the generic analysis of this final GEIS. Specifically with regard to radon, radon concentrations in the air vary markedly due to site-specific geological and weather-related factors (see Appendix A). In addition, large variations in radon concentrations within structures occur because of building construction, geometry, terrain, and geologic compositions of the site. These variations make it very difficult to distinguish between naturally occurring radon and radon resulting from licensed material. Because of these variations and the limitation of measurement techniques it is not practical to distinguish between naturally occurring radon and elevated radon concentrations from licensed activities at levels which would result in doses comparable to the lower alternative

residual dose criteria considered in this GEIS. Therefore, the GEIS does not address this pathway explicitly, but focuses on the concentrations and impacts of radon precursors.

4.2.3 Results

Based upon the analyses in Appendix B, estimates of impacts are presented for illustrative purposes for each reference facility in Tables 4-1 through 4-8. These results are presented separately for soil and structure to highlight different impact considerations that arise. Only a combined analysis for soil and structure was presented in the Draft GEIS (although sufficient information was presented there for doing separate analysis). The reference facilities presented here are to illustrate the kinds of information presented in Appendix B. For structures, the analysis is for an industrial setting and illustrate impacts resulting from a specific case of reducing the residual dose below 60 mrem/y. For soil, the analysis is for a residential setting for a diffusion profile (the same as the Draft GEIS) for unwashed soil. All illustrations are for unrestricted use for high contamination levels. For the impacts incurred as a result of exposure to radiation (columns 2, 3, and 4), the table entries are estimated mortalities from radiation-induced cancer and are based on the cancer-to-dose relationships developed in the UNSCEAR and BEIR V reports (UNSCEAR 1988, BEIR 1990). For impacts incurred as a result of accidents while performing decontamination activities (column 5) or from accidents while transporting waste (column 6), the table entries are estimated accident mortalities and are based on published statistical data on accident rates. For each reference facility, the tables show the impacts as follows:

Column 1 - Residual dose rate criteria

Column 2 – Estimated mortalities for the public from radiation exposure while working on site following completion of decommissioning (soil contamination, Tables 4.1-4.4)

Column 2 - Estimated mortalities for the public from radiation exposure while living on site following completion of decommissioning (structure contamination, Tables 4.5-4.8)

Column 3 - Estimated mortalities for workers from radiation exposure while performing decontamination activities

Column 4 - Estimated mortalities for workers and the public from radiation exposure while transporting those waste materials generated during decommissioning operations

Column 5 - Estimated mortalities for workers from fatal accidents while performing decontamination activities

Column 6 - Estimated mortalities for workers and the public from fatal traffic accidents while transporting those waste materials generated during decommissioning operations

Column 7 - Estimated total mortalities from radiation exposure and accidents

Column 8 - Estimated mortalities from short-term decommissioning activities (decommissioning plus transportation) total of Columns 3, 4, 5, and 6

Results presented in Tables 4-1 through 4-8 are shown as calculated output and do not indicate precision to the number of significant figures shown.

4.2.4 Summary

Estimates of incremental impact reduction (i.e., incremental impact averted) realized in setting alternative dose criteria are considered in Chapter 6, as are considerations of costs involved in achieving the incremental reductions in impact.

4.2.5 Uncertainties in Assessing Generic Impacts for Reference Facilities.

There are several sources of uncertainty in the evaluation of the incremental impacts related to alternative residual radioactivity criteria. Of particular concern are the difficulties in making a generic evaluation of reference contamination levels on and within concrete and other building material, including contamination levels in cracks in the concrete and contamination hot spots. Another uncertainty in this generic evaluation stems from assumptions made about the areal extent and depth profile for soil contamination at reference facilities. These uncertainties are dealt with in the GEIS in the following manner:

1. Information about the level and location of contamination in concrete and other building material in nuclear facilities has been reviewed, and reference contamination levels are developed in the GEIS based on these data and on engineering judgment. These contamination levels may vary for specific sites. Reference contamination levels in concrete, based on an estimate of the range of contamination likely to occur in the buildings at the reference facilities, provide a reasonable estimate of the likely range of impacts that may result from decontamination operations at such facilities.

2. Information about concrete and other building material decontamination methods (including high-pressure water jet) and removal processes (including scabbling) has been reviewed and then used in the analysis of staff time necessary to remove contaminated concrete and soil removal.

3. Information as to the level and location of contamination in soil in nuclear facilities has been reviewed, and reference contamination levels are developed in the GEIS based on

these data and on engineering judgment. These contamination levels may vary for specific sites. The available information is limited; therefore, three sets of reference soil contamination levels have been developed for each of the reference facilities. The analysis evaluated these contamination levels, referred to as "high," "medium," and "low" soil contamination, to bound the problem and to estimate the range of impacts that may result from differing soil contamination levels. Such an evaluation is presented for the cost of soil removal in Appendix C. Appendix B uses the results of Appendix C but only for the high contamination case which is considered sufficiently representative. Based on the preceding, Chapter 6 presents a summary of the results of the analysis presented in Appendix B.

4.3 Other Environmental Consequences

Environmental consequences other than those directly affecting human health were also evaluated in the draft GEIS (NRC, 1994) (for ease of reference, that section of the draft GEIS is included here as Attachment C to Appendix B). These included impacts on the biological, socioeconomic, and physical environments both from the decontamination activities and from residual radiation levels. Specifically addressed were the physical and radiological impacts on plant and animal populations; land use changes; social, economic, and cultural resource impacts; noise; aesthetics; and impacts on planned low-level waste disposal capacity.

Impacts were previously evaluated for the entire decommissioning process and are described in NUREG-0586 (NRC, 1988) and supporting documents. Since the decontamination of building structures and areas of contaminated soils is a component of decommissioning, some of the same activities and impacts were discussed in that document. This GEIS focuses on both the costs and environmental effects attributable to activities required to achieve the residual dose criteria indicated in Section 4.2.1.

4.3.1 Biological Environment

During the decommissioning process, biological components of the environment may be affected by the physical removal of contaminated soils from site areas outside of structures and by exposure to any residual radiation. Estimated area of soil contamination for each category of reference facility are given in Table 3-1.

Decontamination activities would include physical removal of the contaminated soils to depths of a few inches to a foot or more, followed by conditioning and revegetating of the disturbed area. Where warranted, site surveys for State or Federally listed or candidate threatened or endangered species would be made prior to any land disturbance outside of the facility structures.

Analysis of the effects on these environmental components in the draft GEIS was qualitative because radionuclide impact analysis on human health will usually bound the impact on biota, and because the range of residual dose criteria being considered in the draft final GEIS is well

below the exposures where effects were observed on biota (SC&A, 1993). Also, issues related to biota may be very site-specific and will need to be addressed in an EIS prepared for a specific facility.

4.3.2 Socioeconomic Environments

Human social, cultural, and economic institutions exist in the vicinity of the nuclear facility during the time that the facility is operating. These institutions could be affected by specific decommissioning actions and the alternative regulatory approaches being considered,and new social, cultural, and economic institutions may come to exist following license termination. The analysis of the impacts on these environments in Attachment C to Appendix B is qualitative because, for the range of doses being considered, the differential impact on these institutions is not significant. Also, the socioeconomic impacts will be very site-specific and do not lend themselves to generic analysis. Attachment C to Appendix B does not specifically include the impacts on Native American tribal land use. The GEIS evaluation is based on reference facilities, which means that the average or more typical case is characterized. Tribal use is very specific, and impacts can most properly be assessed on a case-by-case basis. Impacts on Native American tribal use of site lands would be better addressed in an environmental impact statement or environmental assessment for a specific facility at the time of decommissioning of that facility.

4.3.3 Physical Environment

The physical environment (water, noise levels, air quality, aesthetics, and low-level waste capacity) could be affected by specific decommissioning actions and the alternative regulatory approaches being considered as part of license termination. Except for low-level waste capacity, analysis of the impacts on these components in Attachment C to Appendix B is qualitative because, for the range of doses being considered, the differential impact on these physical environments is not significant. Also, most of these impacts will be very site-specific and do not lend themselves to generic analysis. However, quantitative analysis of the adequacy and utilization of low-level waste capacity is provided. In addition, quantitative analysis of groundwater, which is also highly site specific, was not included in the Draft GEIS, however, Chapters 6 and 7 and Appendix C of this Final GEIS provide a quantitative analysis of remediation activities associated with groundwater (see Section 4.3.5).

4.3.3.1 Low-Level Waste Disposal Capacity.

The draft GEIS analysis assumed that the waste generated from the decontamination of buildings and soils for most of the reference facilities will be placed in offsite low-level waste disposal facilities. An analysis was performed which estimated the amount of available and planned disposal site capacity by compact and non-compact States. These data were compared to the estimated incremental quantities of waste generated by decontaminating the structures and soils for all of the licensed facilities. In performing this analysis, each licensed facility was assumed

to generate the same amount of waste as the corresponding reference facility described in the GEIS. The NRC has identified a number of facilities (47 sites) that warrant special attention. These sites are included in NRC's Site Decommissioning Management Plan (SDMP) program (NRC, 1993) and encompass contaminated buildings, soil, slag, former waste disposal areas, and tailing piles. These facilities are a distinct and separate category because much of their waste results from moving and processing large volumes of uranium- and thorium-bearing ores and their impact on disposal capacity is discussed in Appendix G.

4.3.4 Unavoidable Adverse Impacts

The conclusion of the draft GEIS were as follows:

4.3.4.1 Biological Environment.

No adverse impacts to any components of the biological environment are expected at residual dose levels of 100 mrem/y or less.

4.3.4.2 Land Use.

Certain land uses such as housing, schools, etc., may be precluded at the higher proposed levels of residual radiation. The effects of this would be local and could include higher land prices and less desirably located sites being used for these purposes.

4.3.4.3 Socioeconomic.

Land use restrictions at the higher proposed levels of residual radiation could preclude future industrial or commercial development of the site, thus reducing local employment and the tax base. This could cause a reduction in the local economy and services.

4.3.4.4 Noise and Aesthetics.

The levels of residual radiation allowable under the standards are not expected to result in noise or aesthetic impacts.

4.3.4.5 Low-Level Waste Disposal Capacity.

The incremental effect of alternative residual dose criteria for lands and structures for licensed facilities in the reference facility categories should not result in the need for additional disposal capacity beyond that planned. SDMP wastes do require significant capacity.

4.3.5 Public Comments on Consequences in the Biological, Socioeconomic, and Physical Environments

The public comment on this impact on biological environment, socioeconomic noise and esthetics, and physical impacts were not substantial enough to cause revision to the preliminary recommendations of the draft GEIS.

There were two areas where there was extensive comment. One was in the area of groundwater contamination. Some commenters indicated that there is no reason for the separate groundwater standard included in the proposed rule and indicated that the all pathways standard was sufficient and also that the proposed rule and draft GEIS should not include an analysis of impacts and costs to support such a separate standard. Other commenters, including the EPA, indicated that such a standard is appropriate to protect groundwater. In addition there was also comment on the analysis of low-level waste disposal capacity of Appendix G of the draft GEIS. Commenters suggested that the volumes for the reference facilities of the draft GEIS underestimated the actual

volumes and that the disposal capacity would be overtaxed by the decommissioning volumes resulting from achieving the dose criterion of the proposed rule.

In response to comments on the separate groundwater standard, Section 6.4 contains additional evaluation and analysis of the comments. In response to the comments on low-level capacity, Appendix G contains an updated analysis of the volumes and affect on capacity. That analysis is summarized below.

The disposal capacity planned for the compacts and States is estimated to total about 52 x 10^6 ft^3 (Table 4-9). Waste volumes from decommissioning of licensed facilities categorized by the reference facilities are estimated to total approximately 7 x 10^6 ft^3 at a residual dose criteria of 3 mrem/y (Table 4-10). This total was developed by taking the estimated volumes of building material and soil requiring disposal from each of the reference facilities (Appendix C) and multiplying by the number of facilities in those reference facility categories (see Appendix G). For conservatism, the volumes corresponding to high soil contamination given in Appendix C was used. Also, for conservatism the analysis of incremental volume effects has focused on the 100 to 3 mrem/y range and does not consider intermediate differences. As indicated in Attachments C and D of Appendix C, incremental waste volumes from decommissioning are estimated to vary by a 40 percent decrease in going from 100-25 mrem/y and a 250 percent increase in going from 100-.03 mrem/y. However, as already noted based on Attachments C and D of Appendix C, a very large cost is associated with a very small dose reduction in reducing the dose below 3 mrem/y, and no such a reduction is extremely unlikely. Waste from normal facility operations also goes to the licensed disposal sites, is mixed with decommissioning wastes, and contributes to the filling up of capacity. Currently, the annual average waste generation from normal operations is estimated to be about 0.7x10^6 ft^3 (see Appendix G, Section G.4.1). The disposition of SDMP sites, as estimated in Appendix G, consists mainly of wastes associated with movement and processing of large volume of uranium and throium and soil and such wastes may not go directly to planned disposal sites. For example, this type of waste may either be stabilized in place, or may be shipped to other disposal sites designed to handle large volumes of very low level radioactive waste. Also, some of these facilities could be placed into restricted use, and as described in Appendix C, this would result in reduction of soil volumes requiring disposal.

Based on the above estimates, overall, the estimated total waste volumes from decommissioning of lands and structures at the licensed facilities categorized by the reference facilities are about 13 percent of the total planned low-level waste disposal capacity (Table 4–11). While this analysis concludes that the incremental effect of alternative residual dose criteria for lands and structures should not result in the need for additional disposal capacity beyond that planned, there may be potential lags in the development and operation of regional compact disposal facilities. These may have an effect on site-specific decommissionings and result in the need for such actions as delaying completion of decommissioning at a particular facility. Impacts and costs would be analyzed as part of a decommissioning plan at a specific facility. In general, alternative residual

dose criteria for lands and structures should not be the cause of such lags, and hence the alternative criteria would not cause the need for such site-specific analysis of impacts or costs.

4.4 Comparison of Short-Term Uses and Long-Term Productivity

Decontamination and decommissioning of the site will make the lands available for other uses. Sites with restrictions on future uses because of residual radiation levels may be committed to wildlife habitat, open-space, industrial use, short-term recreation, or other similar uses.

Table 4-9
Estimated Low-Level Waste Disposal Capacity by Compacts and Non-Member States[a]

Compact/State	Assumed Generation (ft^3/yr.)	Facility Life or Projection (yr.)	Planned Disposal/ Storage Capacity (10^6 ft^3)	Provision for D&D (10^6 ft^3)	Out-of-Region Waste (10^6 ft^3)	Planned Capacity Waste (10^6 ft^3)
Appalachian	100,000	30	3.0	0.1	---	3.1
Central Interstate	25,000	30	2.5	---	---	2.5
Central Midwest	50,000	50	2.5	3.0	---	5.5
Midwest Interstate	75,000	20	1.5	$\leq$1.7	---	3.2
Northeast:						
Connecticut	10,000	50	0.5	0.96	---	1.5
New Jersey	37,000	50	1.0	1.7	---	2.7
Northwest	90,000	60	5.4	0.2	1.1	6.7
Rocky Mountain	16,000	60	0.96	0.14	---	1.1
Southeast	370,000	20	7.4	3.6	---	11.0
Southwestern	100,000	30	3.0	2.5	---	5.5
District of Columbia	1,000	n/a	---	---	---	---
Rhode Island	500	n/a	---	---	---	---
Massachusetts	20,000	30	0.6	0.45	---	1.1
Michigan	18,000	20	0.36	0.97	---	1.3
New Hampshire	500	n/a	---	---	---	---
New York	72,000	60	4.3	(3.4)	---	4.3
Puerto Rico	0	n/a	---	---	---	---
Texas Compact	26,000	50	1.3	1.5	---	2.8
Maine	6,300	50	0.11	0.10	---	0.21

Vermont	5,900	50	0.11	0.18	---	0.29
TOTAL						52.4

(a) See Appendix G for details and sources.

Table 4-10

Total Waste Volume Summary from Decommissioning of Lands and Structures for Reference Facility Categories by Compacts and Non-Member States(a)

Compact/State	Waste Volume (10^6 ft^3)					
	Power Plants	Research Reactors	Fuel Cycle	Dry Fuel Storage	Materials	Total Volume
Appalachian	0.104	0.015		0.483	0.0005	0.602
Central Interstate	0.056	0.013	0.120	0.423		0.611
Central Midwest	0.112	0.005	0.060	0.390	0.0005	0.568
Midwest	0.096	0.020	0.060	0.570	0.0015	0.748
Northeast	0.064		0.060	0.243		0.367
Northwest	0.016	0.023	0.060	0.368		0.466
Rocky Mountain	0.008	0.005		0.240	0.0005	0.254
Southeast	0.280	0.015	0.240	0.118	0.002	0.655
Southwestern	0.096	0.020	0.060	0.750	0.0005	0.927
District of Columbia		0.003		0.018		0.020
Maine	0.008			0.035		0.043
Massachusetts	0.016	0.010		0.130		0.156
Michigan	0.048	0.005		0.190	0.0005	0.244
New Hampshire	0.008			0.033		0.041
New York	0.064	0.010		0.475		0.549
Puerto Rico				0.000		0.000

Rhode Island		0.003		0.020		0.023
Texas	0.032	0.008		0.490		0.530
Vermont	0.008			0.013		0.021
Total	1.02	0.153	0.660	4.99	0.006	6.8

(a) See Appendix G for details

Table 4-11

Comparison of Estimated Low-Level Waste Disposal Capacity and Decommissioning Waste Volumes(a)

Compact/State	Waste Volume (10^6 ft^3)		Ratio Estimate Capacity(d)
	Total Planned Capacity	Reference Facility Categories Total Waste Volume(e) Estimates(c)	
Appalachian	3.10	0.60	0.19
Central Interstate	2.5	0.61	0.24
Central Midwest	5.5	0.57	0.10
Midwest	3.2	0.75	0.23
Northeast	4.2	0.37	0.09
Northwest	6.7	0.72	0.11
Rocky Mountain	(a)	---	---
Southeast	11.0	0.65	0.06
Southwestern	5.5	0.93	0.17
District of Columbia	---	0.02	---
Maine	(b)	---	---
Massachusetts	1.1	0.16	0.15
Michigan	1.3	0.24	0.18
New Hampshire	---	0.04	---
New York	4.3	0.55	0.13
Puerto Rico	---	0.00	---
Rhode Island	---	0.02	---
Texas	3.3	0.59	0.18
Vermont	(b)	---	---
Total	51.7	6.8	0.13

(a) See Appendix G for details.
(b) Numbers given are for total waste volume for decommissioning lands and structures at a residual dose criteria of 3 mrem/y. Incremental waste volumes would be approximately ± 30 percent of these values for residual dose criteria of 100 to .03 mrem/y.
(c) Does not include SDMP sites.
(d) Numbers given are for the ratio of total waste volume to capacity at a residual dose criteria of 3 mrem/y. Ratios for incremental waste volumes would be approximately ± 30 percent of these values.
(e) Included in total for the Northwest Compact.
(f) Included in total for Texas.

5. Costs Associated with Each Reference Facility

5.1 Introduction

Operation of each of the nuclear facilities identified in Chapter 3 results in varying levels of contamination. This contamination must be cleaned up as part of decommissioning to reach acceptable levels. Costs are incurred to achieve this acceptable level. Each of the regulatory alternatives being considered requires various expenditures.

Costs associated with the different rulemaking alternatives are considered in the GEIS to determine the incremental costs associated with reducing the level of contamination at the reference facilities to a range of potentially acceptable residual dose criteria. These residual dose criteria represent the exposure to an individual at the site following decommissioning. The alternative residual dose criteria used in these analyses include: 100, 60, 25, 15, and 3 mrem per year.

In assessing the differential in cost related to alternative residual dose criteria, it is necessary to first consider the major factors in the cost of decommissioning. Following this, the analysis evaluates the sensitivity of these factors to the dose criteria.

5.2 Major Costs of Decommissioning Sensitive to Alternative Residual Criteria

Section 2.4.3.1 lists the major decommissioning activities that are necessary at reference facilities to reduce the contamination to acceptable levels. As discussed, not all these costs are sensitive to alternative residual criteria for lands and structures. Section 2.4.3.1 lists the following decommissioning activities with costs that are sensitive to the alternative residual criteria:

1. Radiological characterization surveys;

2. Cleaning, removal, packaging, transportation, and disposal of concrete, other building materials, and soil; and

3. Termination surveys.

This assessment of the costs of decontaminating the reference facilities to alternative residual dose criteria focuses on the costs of these three activities and the differential in these costs for alternative residual dose criteria.

The difficulty in making a generic evaluation of contamination levels on and within concrete and other building material, including contamination levels in cracks in the concrete and contamination hot spots, complicates the assessment of costs. Another notable complication for this generic evaluation regards assumptions concerning the depth profile for soil contamination at reference facilities. Previous studies on technology, safety, and costs of decommissioning prepared by Battelle PNL for the NRC (NRC 1977; 1978a-c; 1979a-d; 1980a-b) did not relate

decommissioning costs to precise residual contamination levels. In addition, evaluation of costs of termination surveys at the low contamination levels proposed in the rulemaking alternatives raises questions about the ability to detect and discriminate radionuclides at very low levels.

Appendix C presents the results of analyses prepared partly in response to public comments on the draft GEIS to provide a technical basis for developing differential costs for cleaning, removal, packaging, transportation, and disposal of concrete, other building materials, and soil, while Appendix D gives the basis for radiological characterization and termination survey costs. The following sections summarize the analyses in those appendices.

5.2.1 Cost Methodology for Concrete and Other Building Material Removal and Disposal

Section 4 of Appendix C describes reference contamination levels on and within concrete and other building material surfaces for the reference facilities. Sources of information used to develop this information include previous reports on contamination levels in nuclear facilities and, where detailed information is not available, engineering judgment regarding the extent of this contamination.

Section 6.1 of Appendix C describes the concrete and other building material decontamination and removal techniques most likely to be used at the reference facilities, and the extent of contamination removal by these techniques. These techniques include surface cleaning by nondestructive means, as well as mechanical concrete removal methods such as chipping away surface layers. For these removal methods, costs are based upon the following:

1. The number of hours of direct staff labor necessary to remove contaminated concrete and, based on the unit cost of labor for concrete removal, the cost of direct staff labor;

2. Cost of overhead staff time during concrete removal;

3. Cost of materials used in the removal process;

4. Volumes of contaminated material requiring disposal because of removal of contaminated concrete and the resultant cost of transportation and disposal of the concrete and other waste materials generated during the removal process.

Based on these contamination levels and decontamination and removal techniques, tables of the labor hours, waste volumes, number of waste shipments, and total cost entailed in achieving the alternative residual dose criteria are presented in Section 7 of Appendix C.

5.2.2 Cost Methodology for Soil Removal and Disposal

Section 5 of Appendix C describes the reference facility soil contamination depth profiles. The GEIS has reviewed information regarding the level and location of contamination in on site soil

outside facility buildings and has developed reference contamination levels based on these data and on engineering judgment. These contamination levels may vary for specific sites. The information available is limited; therefore, three sets of reference soil contamination levels have been developed for each of the reference facilities. For analysis purposes, only the high contamination level is used because this is considered sufficiently representative.

Section 6.2 of Appendix C describes the soil decontamination and removal techniques that could be used to reduce radioactivity at the reference facilities and the extent of contamination removal by these techniques. This information is based on soil decontamination techniques effective in reducing contamination, namely soil excavation and disposal, and soil washing. For these soil contamination removal methods, the following information forms the cost basis:

1. The number of hours of direct staff labor necessary to remove contaminated soil and, based on the unit cost of labor for soil removal, the cost of direct staff labor;

2. Cost of overhead staff time during soil removal;

3. Cost of materials used in the removal process;

4. Volumes of contaminated soil requiring disposal and the resultant cost of transportation and disposal of the contaminated soil.

Based on these soil contamination depth profiles and the decontamination and removal techniques, Section 7 of Appendix C contains tables of the labor hours, waste volumes, number of waste shipments, and total cost needed to achieve the alternative residual dose criteria.

5.2.3 Survey Cost Methodology

Appendix D presents the cost of radiological surveys for alternative residual dose criteria for instruments and analytical methods routinely used in radiological surveys at nuclear facilities. Appendix D develops costs of radiological surveys for the reference facilities using the following information:

1. The survey methodology of NUREG/CR-1505, 1506, and 1507 (NRC 1995a-c), and of the draft MARSSIM (MARSSIM, 1996) report was followed; these are described in Appendix D. For each of the reference facilities, costs were determined for "affected" areas. Affected areas were larger than the areas actually decontaminated.

2. Instruments and analytical methods used in the performance of surveys are standard, commercially available equipment and techniques used in performing surveys.

3. Costs included labor to perform the survey, analytical costs, and overhead.

5.3 Results

Based on the discussion in Section 5.2 and Appendices C and D, estimates of costs are presented for illustration purposes for each reference facility in Tables 5-1 through 5-8 and parallel the cases presented in Section 4.2.3. The costs are provided for each of the residual dose criteria being considered. For each reference facility, the tables show the costs as follows:

Column 1 - Residual dose rate criteria.

Column 2 - Costs for labor (both direct and indirect) and equipment and supplies necessary to remove contaminated soil and for packaging, transportation, and disposal of the resulting waste materials at a licensed disposal facility. (soil contamination, Tables 5.1-5.4).

Column 2 - Costs for labor (both direct and indirect) and equipment and supplies necessary to remove contamination on the floors and walls of the facility and for packaging, transportation, and disposal of the resulting waste materials at a licensed disposal facility. (structure contamination, Tables 5.5-5.8).

Column 3 - Costs for labor (both direct and indirect) and equipment and supplies necessary to conduct the appropriate surveys in facility structures and on facility soils. As noted in Appendix D, this value includes the estimated cost of scoping, characterization, remediation, control, termination, and confirmation survey.

Column 4 - The total costs associated with decommissioning the facility to the specified residual dose criteria for different possible waste disposal costs.

As discussed in Chapter 3, other costs will be incurred as part of decommissioning, and many of them may be large, such as steam generator removal at a reactor. However, these costs are not included in the tables because they are not relevant to consideration of alternative dose criteria. These costs were discussed in NUREG-0586 (NRC, 1988).

Considerations of incremental cost along with an analysis of incremental impact reduction realized (i.e., risk averted) in reaching alternative dose criteria are combined to determine the costs involved in achieving incremental reductions in risk and are presented in Chapter 6. Results presented in Tables 5-1 through 5-8 are shown as calculated output and do not indicate precision to the number of significant figures shown. Values of "0" or "*" shown in the tables indicate no analysis was performed at that dose level, and information in the tables at those dose levels should be ignored.

5.4 Uncertainties in Assessing Generic Costs

There are several sources of uncertainty in evaluating the costs of alternative residual radioactivity criteria. Of particular concern are the difficulties in making a generic evaluation of reference contamination levels on and within concrete and other building material, including contamination levels in cracks in the concrete and contamination hot spots. Another uncertainty in this generic evaluation arises from assumptions about the areal extent and depth profile for soil contamination at reference facilities. In addition, there are issues involving the detection capability of radiological surveys at the lower residual dose criteria. These uncertainties are dealt with in the GEIS in the following manner:

1. Information about the level and location of contamination in concrete and other building material in nuclear facilities has been reviewed, and reference contamination levels are developed in the GEIS based on these data and on engineering judgment. These contamination levels may vary for specific sites. Reference contamination levels in concrete are based on an estimate of the range in which contamination is likely to occur in the buildings at the reference facilities. These levels are thought to provide a reasonable estimate of the likely range of impacts that may result from decontamination operations at such facilities.

2. Information on concrete and other building material decontamination methods (including high-pressure water jet) and removal processes (including scabbling) has been reviewed and that information has been used in the analysis of staff time necessary to remove contaminated concrete and soil removal.

3. Information about the level and location of contamination in soil in nuclear facilities has been reviewed, and reference contamination levels based on these data and on engineering judgment are developed in the GEIS. These contamination levels may vary for specific sites. The information available is limited; therefore, three sets of reference soil contamination levels have been developed for each of the reference facilities. The analysis evaluated these contamination levels, referred to as "high," "medium," and "low" soil contamination, to bound the problem and to provide an estimate of the range of costs that may result from differing soil contamination levels. The results presented in Section 5 are for the "high" soil contamination case where the results of Appendix C for the "high" soil contamination case are used, along with the survey cost results of Appendix D, to estimate total costs. For the "high" soil contamination case (see Appendix C), the results of the analysis indicate that some onsite soil must be removed to achieve all of the alternative residual radioactive dose levels being considered.

4. In determining the costs and practicality of termination surveys at the low levels of contamination contemplated in this rulemaking, the GEIS used the survey methodology described in Appendix D. This is considered a reasonable estimate of the range of costs for the surveys necessary to verify compliance with the residual dose criteria.

Based on the above, Tables 5-1 through 5-8 provide illustrations which parallel those presented in Chapter 4 (Tables 4-1 to 4-8) and present estimates of costs for the reference facilities that are analyzed separately for soil and structures.

6. Comparison of Impacts and Costs

This Chapter summarizes the impacts and costs associated with obtaining various dose levels for release considerations for the representative facilities considered. The impacts and costs presented here use the impacts and costs tables illustrated in Chapters 4 and 5 (and Appendix B and C). Appendix H discusses the resolution of comments on the Draft GEIS concerning the parameters modeled and any changes that have been made in the Draft GEIS considerations. The impacts and costs associated with achieving various dose levels have been treated separately for structures and soils. The Draft GEIS combined the analysis of structures and soils and was not sufficiently sensitive to the significant differences that can occur in cost-benefit considerations. Modeling considerations for structures has been left essentially unchanged from those considered in the Draft GEIS. However, modeling considerations for soil have been broadened to include those already considered in the Draft GEIS, which afford one measure of actual situations and more extreme (but possible) situations which represent more bounding forms of actual situations. For reference purposes, the modeling considerations for soil and structures presented in detail in the draft GEIS Appendix C is included in this GEIS as Attachment D to Appendix C. Appendix C, which calculates costs for removal of soil and structures, uses a broader range of contaminant scenarios than those presented in Appendix B. The cost-benefit analysis selected in Appendix B uses the high soil contamination case of Appendix C, a subset of those presented in Appendix C, and is considered to be sufficiently representative for performing a reasonably bounding analysis for generic cost-impact considerations.

Summaries of these cost-benefit results for the reference facility types considered are presented separately for soil and structures in Sections 6.2 and 6.3 for both unrestricted and restricted use situations for a variety of situations considered. The situations considered are described in Section 6.1 and presented in greater detail in Appendices B and C.

Section 6.4 is a summary of the impacts and costs associated with groundwater remediation on alternative criteria being considered. When NRC's proposed rule was issued, it included a requirement that, in addition to the all-pathways dose criterion, licensees also had to demonstrate that radioactivity levels in groundwater, that was a potential source of drinking water, did not exceed the limits of EPA's 40 CFR 141. This proposed requirement was added at the request of EPA and specific comments were requested as to its appropriateness; no specific analysis of the environmental impacts and cost-benefit of this requirement was done in the Draft GEIS (NUREG-1496). Section 6.4 of this Chapter provides a summary of an analysis of the impacts and costs associated with remediating groundwater doses below 25 mrem/y (see basis for use of 25 mrem/y as upper bound in Section 6.2) and includes cost-benefit consideration of impacts for the low dose levels associated with a separate groundwater standard such as 40 CFR 141. The analysis is presented in Appendix C.

6.1 Overall Cost-Benefit Analysis of Dose Criterion for Unrestricted Use

Tables 6.1 to 6.8 show the summarized results of the analyses of impacts and costs for soil and concrete removal. The results are indicated in terms of millions of dollars per estimated cancer mortality averted. In considering these results, the NRC uses the decisionmaking guidance of NUREG/BR-0058 and NUREG-1530. NUREG-1530 recommends that $2000 per person rem be the value used by NRC in making decisions between regulatory alternatives. The $2000 per person rem is derived from the studies reviewed by NUREG-1530 which arrive at $3 million per statistical life. The tables provide an indication of the range of results for different assumptions used in the analyses.

6.1.1 Summary of Assumption Used in the Analysis

1. Variation in contamination depth profiles This analysis was performed in response to public comments indicating that data and experience from additional actual facilities should be used in estimating the extent of contamination. Thus the soil contamination analysis contains both the profiles from the Draft GEIS, which are used to provide an indication of the results for fairly simple types of contamination, and also more complex and deeper profiles added as a result of review of data from actual decommissionings. The effect of this variation is to change the volumes of soil requiring remediation. These two profile types are generally indicated in the tables as "diffusion," and "mixing/landfill," or "real world" respectively.

2. Alternative unrestricted land uses Because a variety of possible land uses could occur after the facilities are released for unrestricted use, the tables show results for a set of alternative public uses of the site. The effect of this variation is the possible range of collective exposures which can occur and the resultant variation in net health impacts that can occur. The alternative unrestricted land uses included in the tables are residential farming, industrial use, and dense residential use. The alternative unrestricted building uses included in the tables are office use, denser occupancy (e.g., school use), and industrial use.

3. Burial charges A set of different burial charges for different possible situations and materials are included in the tables.

4. Remediation Methods Alternative soil remediation methods are indicated in the tables for either soil washing followed by transport or soil transport without washing. The impact of these differences is to change the volumes of soil requiring transport which changes both costs and the impacts associated with cleanup.

6.2 Results of Analysis for Unrestricted Use

The results of the analyses discussed above are presented in Tables 6.1 - 6.8 for the reference cases. These tables summarize the significant results presented in Attachment B of Appendix B. Results for unrestricted use of soil at the reference facilities are in Tables 6.1 - 6.4 and include analyses of several alternative cases, including type of soil profile, method of soil disposal, and type of post-license termination site use (e.g., resident farming, industrial use, high density dwelling use). Results for unrestricted use of structures at the reference facilities are in Tables 6.5 - 6.8 and include analyses of several alternative cases, including building location and type of post-license termination use (e.g., office use, residential use, industrial use).

The results presented in Tables 6.1 - 6.8 show a wide range of cost-benefit ratios among facility types as well as within facility type and are sensitive to the assumptions and parameters used in the analyses. Such results do not provide a quantitative basis for optimizing the selection of a cost-benefit ratio that can be implemented on a generic basis. Nevertheless, the following trends can be seen that provide guidance for overall cost-benefit considerations.

(a) For unrestricted use, based on consideration of a range of potential site-specific situations, modeling uncertainties, and a range of justifiable cost-benefit ratios, no definitive conclusion can be made on a generic basis which would distinguish between acceptable alternative residual radioactivity levels in the 15-25 mrem/y range.

(b) For soils, levels less than 25 mrem/y generally result in a cost-benefit ratio not considered reasonably justifiable under NRC's regulatory framework as described in NUREG/BR-0058.

(c) For structures, levels less than 25 mrem/y show more tendency to be reasonably justifiable under NRC's regulatory framework.

6.3 Results of Analysis for Restricted Use

Tables 6.1 - 6.8 indicate that incremental costs to achieve unrestricted use can be quite high. Appendices B and C indicate that by restricting site use (and therefore eliminating certain exposure pathways), the quantity of material which must be removed and disposed of can be reduced and therefore the costs can also be reduced.

6.3.1 Cost Estimating Bases For Access Restrictions

Licensees may choose to remediate a contaminated site sufficiently to allow restricted release of the site. Examples include situations where further remediation is determined to be not cost effective for the benefit received and/or further remediation is determined to cause net public or environmental or harm to be unfeasible with existing technology. However, aside from deed restrictions, in order to show that such a site has been remediated to levels that are ALARA, a licensee should further consider reducing dose to individuals on the site by installing inexpensive but effective technologies to prevent inadvertent access to the contaminated soil areas on the site. This section provides cost estimates for representative low-cost technologies that may

accomplish this. The technologies evaluated in the section include installing a perimeter fence around the contaminated area, paving the contaminated area, and landscaping the area in a way to discourage access.

6.3.1.1 Perimeter Fence

One low cost but effective technology for restricting access to a contaminated site area is a perimeter fence. For the purposes of this analysis, a cost estimate is developed for both a residential and a low-security industrial fence that are intended to only prevent unintentional access to the area. The residential chain link fence is six feet high, is made of 11-gauge wire and galvanized steel, and has 1-5/8" line posts every 10 feet, 2" corner posts, and a 1-3/8" top rail. It is also assumed to have a six foot high, four foot wide gate every 1000 feet and to have a warning sign posted every 50 feet. The cost for installation of this fence is about $12.20 per linear foot, or $40.00 per linear meter (Means, 1996).

The industrial chain link fence is six feet high, is made of 6-gauge wire and galvanized steel, and has two-inch line posts every ten feet and a 1-5/8" top rail. It is also assumed that a set of double swing gates are in the fence every 1000 feet and that a warning sign is posted every 50 feet. The cost for installation of this fence is about $19.80 per linear foot, or $64.90 per linear meter (Means, 1996).

6.3.1.2 Paving and Surfacing

Another technology that can be used to minimize exposure of individuals to contaminated soil is to cover the contaminated land surface area with a material such as asphalt. This allows the possibility of reusing the site, such as for a parking area for vehicles. Cost estimates for installation of this technology range from about $\$11.9/m^2$ for a residential driveway-grade paved surface to $\$19.7/m^2$ for a highway-grade asphaltic concrete pavement (Means, 1996). The cost estimate for the driveway-grade paved surface includes estimates for grading the surface in preparation for paving, the lay-down of a stabilization (polypropylene) fabric, and the lay-down of a 2½-inch thick asphaltic concrete pavement. The cost estimate for the highway-grade paved surface includes for grading the surface in preparation for paving, installation of a 4-inch thick granular (1½-inch diameter stones) base course, lay-down of a 3-inch thick asphaltic concrete binder course, lay-down of a stabilization (polypropylene) fabric, and the lay-down of a 1½-inch thick asphaltic concrete wearing course.

6.3.1.3 Landscaping

A final low cost technology for preventing unintentional access to a site area is to landscape the area with plants that discourage access. For this analysis, it is assumed that a barberry shrub is planted around the perimeter of the area. The barberry shrub is a prickly shrub with sour green or red berries and yellow flowers and is often used for hedges. It grows to a height of four to five feet and a width of about four feet. The cost of landscaping with the barberry shrub is estimated to be $3.90/ft, or $12.90/m, and includes purchase and planting of the shrub and preparation of the bedding area with peat moss.

6.3.2 Access Restriction Costs for Reference Facilities

Table 6.9 provides estimates for the costs to implement contaminated site area access restrictions for each of the reference facilities described in Chapter 3. The capital costs are estimated using the unit costs discussed above. The average annual cost of maintenance was derived from the assumptions that the capital investment in the access restrictions depreciated by 5% each year, that the maintenance cost for the first year is 1% of the capital investment cost, and that maintenance costs increase by 10% each year thereafter. It is assumed that essentially the only wear and tear on the access restrictions are from natural environmental conditions. The assumed values for these parameters are, therefore, low relative to what they would be for actual operating equipment. Based on these assumptions, the lifetime of the access restrictions is about 30 years and the annual maintenance cost reported in Table 6.9 is the average annual maintenance cost over the 30-year period. If the paved surface were used as a parking lot, then annual maintenance costs would be expected to be significantly higher than shown in Table 6.9, and the lifetime of the surface would be expected to be considerably less than 30 years. Using one of these low cost technologies may further reduce the restricted site dose from soil from 25 mrem/y to essentially zero and illustrates that such ALARA considerations should be included as part of site specific overall ALARA considerations.

Overall, based on the discussion in Section 6.3.1, on costs of soil removal in Appendix C, and on the impacts presented in Appendix B, the incremental cost-benefit ratio associated with reducing doses to less than 25 mrem/y by restricting site use is estimated to have a wide range depending on the site specific approach to restricted use, but can range from values less than $3 million per estimated mortality averted to values in excess of $50 million per estimated mortality averted for the reference facilities studied. The larger values would generally occur if it were necessary to remove, transport, and dispose of soil to reach lower dose levels while smaller values would result if measures such as those described above and deed restrictions were used. The wide range illustrates the need for site specific ALARA analyses for sites considering restricted use.

6.4 Analysis of Groundwater Remediation

In Sections 6.2 and 6.3 it was concluded that for unrestricted use the cost-benefit ratio corresponding to that from soil removal which would result in a dose of 25 mrem/y or less is generally unreasonably high when compared to the range that is considered reasonable for decisionmaking purposes (see Section 6.1). It was also concluded that site-specific situations can be a factor that permits doses to be reduced below 25 mrem/y using ALARA considerations. Such site-specific considerations are especially necessary when dealing with groundwater contamination. This section considers groundwater contamination possibilities for all NRC licensees (i.e., unlikely, possible, and, likely (see Attachment E to Appendix C for a list of groundwater contamination indicators)) and corresponding reference cases 1, 2, and 3 are developed specifically for these potential groundwater contamination scenarios. For each of the reference cases, examples of site specific situations are considered and analysis performed to estimate cost-benefit ratio increments in going from 25 mrem/y to background. The results of the analysis presented below indicates that licensees whose sites have possible or likely groundwater contamination and a large number of people (25 or more) drinking from this source should consider site-specific remediation as part of the ALARA process.

6.4.1. Groundwater Remediation Reference Cases

NRC facilities have been divided into the following possible reference cases based on their likelihood for significant soil/groundwater contamination:

1. Licensees with little contamination and therefore very low potential for soil/groundwater contamination - certain sealed source manufacturers, short-lived radionuclide users, and other small licensees with little contamination (e.g., AGN research reactors)

2. Licensees with low to medium indicators for soil/groundwater contamination - research reactors, certain sealed source manufacturers and broad R&D facilities, some power reactors, etc. (based on "List of Indicators for Potential Subsurface Soil or Groundwater Contamination").

3. Licensees with medium to high indicators for soil/groundwater contamination - SDMP sites, large uranium/thorium facilities, some power reactors (based on the list of indicators noted above).

Based on a broad review of licensees, there are about 6000 NRC licensees in Reference Case 1 and about 500-700 NRC licensees in Reference Cases 2 and 3.

The following is an analysis of Reference Cases 1 - 3.

6.4.1.1 Reference Case 1

Because it is unlikely that these facilities will have any soil contamination or groundwater contamination, a screening analysis is likely to be sufficient to demonstrate that these facilities meet a 25 mrem/y all-pathways TEDE standard and do not have a significant dose contribution from the drinking water pathway.

Therefore, implementation of ALARA levels below the dose standards is likely to involve minimal effort.

6.4.1.2 Reference Case 2

Because there is generally some soil contamination at these sites, but not anticipated current groundwater contamination, specific efforts at characterization of groundwater are not done routinely as part of normal operations or decommissioning.

A screening analysis to demonstrate compliance with the all-pathways TEDE dose would be done. In the absence of any evidence of existing groundwater contamination (see Attachment E to Appendix C), this would be an analysis of prospective future contamination. Based on this, one of the following may occur:

1) Scenario 1: Screening shows the site meets the 25 mrem/y all-pathways TEDE and doses are low or nonexistent from the drinking water pathway based on groundwater sources. Under Scenario 1, there would likely be no ALARA requirement for additional remediation to reduce doses from the drinking water pathway;

2) Scenario 2: Screening shows the site meets the all-pathways TEDE but not low doses from the drinking water pathway based on groundwater sources; if this occurs, the following might take place based on ALARA considerations:

   a) More detailed site-specific evaluation - cost $50K - $150K, or

   b) Additional site characterization - cost $800K

   (Most sites would be expected to have costs in the $50K - $150K range; a few (<10) could be higher).

   If additional analyses show the site actually meets ALARA requirements, no remediation (either soil removal or restrictions on use) would be needed. There would also be additional costs for surveys to lower soil concentration levels to demonstrate that a lower groundwater concentration had been met. These costs are taken from Appendix D of the Final GEIS.

   The cost/benefit and ALARA analysis for Scenario 2 would be highly dependent on site specific physical factors, including whether or not the groundwater was used for drinking water and what size population was being served.

6.4.1.3 Reference Case 3

These sites have medium/high indicators for subsurface soil and groundwater contamination, and therefore would generally have to do groundwater characterization, either as part of their operations or as part of a decommissioning effort. This cost is estimated to be approximately $800K and would be common to both a 25 mrem/y all-pathways TEDE standard and an ALARA analysis to evaluate the need for additional groundwater remediation.

Based on the groundwater characterization, the following could occur:

1) Reference Case 3A - Existing groundwater contamination = 0

   For these cases, licensees would still have do prospective modeling of groundwater contamination based on the soil contamination present at their site. If this more detailed site-specific evaluation shows that the site meets the 25 mrem/y all-pathways TEDE but not the ALARA requirement, the licensee would have to perform remediation of the site. Possible remediations include soil removal, restricting water use while supplying replacement water, or source stabilization.

This evaluation of prospective contamination would consider radionuclides in the soil such as Co-60, Cs-137, Sr-90, H-3, thorium, and uranium. Because uranium is the most likely radionuclide to move through soil to groundwater at a fast enough pace or have a long enough half-life to cause significant groundwater contamination, the scenario described below considers uranium contamination (see Appendix C). Similar analyses could be considered for Co-60, Cs-137, Sr-90, H-3, or thorium.

The following analysis is done for Reference Case 3A:

a. Uranium contamination in soil moves such that groundwater contamination will occur over time and the resulting drinking water dose is 50% of the TEDE; it is conservatively assumed for a site-specific analysis that this dose occurs both onsite and offsite (see Appendix C);

b. An ALARA analysis will be highly dependent on site specific factors that affect both the transport of contaminants to the aquifer and the available remediation options. Based on that site specific analysis, the following situations might occur:

    1) Soil could be removed from onsite to prevent further migration of uranium to groundwater resulting in costs of soil removal. The cost benefit analysis for soil removal could be approximated by that in Table 6.10 and would likely not be cost effective unless the population served by the groundwater resource was large enough;

    2) To meet the ALARA requirements, there could be restrictions placed onsite and/or offsite (see discussion in Reference Case 3B);

    3) To meet the ALARA requirements, there may not be a need to either move soil or place restrictions on site use because the site, when analyzed with a more detailed site-specific analysis, meets the requirements without remediation (see for example, Tables 4.5.3 and 4.5.4 of the "Draft EIS Decommissioning of the Shieldalloy Metalogical Corporation Cambridge, Ohio, Facility," NUREG-1543, July 1996). Costs involved in this case would be that to perform detailed groundwater analyses and to demonstrate that separate ALARA requirements for groundwater have been met.

2) Reference Case 3B - Existing groundwater contamination is less than 25 mrem/y but may not meet ALARA requirements for the groundwater pathway.

For these cases, licensees might need to remediate their site. Possible remediations include pump and treat or restricting water use while providing replacement water.

For these sites, a review of current licensees in Appendix C ("Groundwater Contamination Detected at NRC Licensed Facilities") indicates that some sites have existing groundwater contaminated with Sr-90, H-3, Tc-99, alpha emitting nuclides, or uranium. The scenarios below are based on a review of the licensees in Appendix C and consist of certain materials facilities (Sr-90, Tc-99, alpha emitting nuclides), reactors (H-3), and uranium facilities. Such contamination generally takes

place because of a specific release event rather than a slow release from contaminated soil.

Three scenarios are considered under Reference Case 3B:

A. Scenario 1 - Reference (composite) case of a materials facility with Sr-90 groundwater contamination such that the dose through the drinking water pathway is 20 mrem/y.

The following analysis is done for Scenario 1 of Reference Case 3B:

a. The drinking water dose from groundwater is assumed conservatively to occur both onsite and offsite (see Appendix C).

b. In general, to remediate a site to meet ALARA requirements, a licensee could do one of the following:

1) The groundwater below the site could be remediated by pump and treat operations to reduce Sr-90 concentration levels. The incremental costs for pump and treat are in Column 3 of Table 6.11. The benefits of reduced exposure to the contaminated plume are estimated based on assuming 25 persons would take their drinking water from the contaminated plume. The cost-benefit analysis of such a situation is shown in Column 4 of Table 6.11, and would not be cost-effective. This analysis is illustrative and demonstrates that for site-specific situations where larger populations may exist, a cost-benefit analysis should be done to indicate whether remediation is cost-effective.

2) To meet the ALARA requirements, there could be restrictions placed on the onsite and/or offsite use of the water.

a) For onsite restrictions, it is assumed there would be no costs for replacement water because the site could be zoned for industrial use (see 2b below)

b) For offsite restrictions, it is assumed that replacement water supplies would have to be provided; the cost benefit analysis for replacement water assumes that 25 persons would take their drinking water from the contaminated plume. It is not assumed that the land would be purchased as the costs of this are too indeterminate and uncertain for a generic analysis. The costs of replacement water for 25 persons are shown in Table 6.13, Column 3, and the cost benefit analysis is shown in Column 4.

3) To meet ALARA requirements, there may not be a need to either pump and treat or place restrictions on water use because the site, when analyzed with a more detailed site-specific analysis, meets the requirements without remediation. Costs involved in this case would be that to perform detailed groundwater analyses and to demonstrate that the ALARA requirements for groundwater have been met.

B. Scenario 2 - Scenario 2 is for a reference (composite) case of a reactor with H-3 groundwater contamination at or slightly in excess of 20,000 pCi/L.

The following analysis is done for Scenario 2 of Reference Case 3B:

a. The groundwater drinking water dose is assumed conservatively to occur both onsite and offsite (see Appendix C).

b. In general the following situations could occur to meet ALARA groundwater requirements:

1) The groundwater below the site cannot be treated by pump and treat operations to remove H-3. Hence this is not further analyzed.

2) There could be restrictions placed on both onsite and/or offsite water use. This analyses could be approximated by Table 6.13.

3) There may not be a need to either pump and treat or place restrictions on water use because the site, when analyzed with a more site-specific, detailed analysis, meets the groundwater ALARA requirements without remediation.

C. Scenario 3 - Scenario 3 is for a reference (composite) case of a uranium facility with uranium groundwater contamination. An ALARA analysis will be highly dependent on site specific factors that affect both the transport of contaminants to the aquifer and the available remediation options. Based on a site specific analysis, a variety of outcomes is possible.

The following analysis is done for Scenario 3 of Reference Case 3B:

a. The drinking water dose from groundwater is assumed conservatively to occur both onsite and offsite (see Appendix C).

b. In general, to remediate a site to meet ALARA requirements, a licensee could do one of the following:

1) The groundwater below the site could be remediated by pump and treat operations to reduce uranium concentration levels. The incremental costs for pump and treat are in Column 3 of Table 6.12. The benefits of reduced exposure to the contaminated plume are estimated based on assuming 25 persons would take their drinking water from the contaminated plume. The cost-benefit analysis of such a situation is shown in Column 4 of Table 6.12, and would not be cost-effective. This analysis is illustrative and demonstrates that, for site specific situations where a large population may exist, a cost-benefit analysis should be done to indicate whether remediation is cost-effective.

2) To meet the ALARA requirements, there could be restrictions placed on the onsite and/or offsite use of the water.

a) For onsite restrictions, it is assumed there would be no costs for replacement water because the site could be zoned for industrial use (see 2b below)

b) For offsite restrictions, it is assumed that replacement water supplies would have to be provided; the cost benefit analysis for replacement water assumes that 25 persons would take their drinking water from the contaminated plume. It is not assumed that the land would be purchased as the costs of this are too indeterminate and uncertain for a generic analysis. The costs of replacement water for 25 persons are shown in Table 6.13, Column 3, and the cost benefit analysis is shown in Column 4.

3) To meet ALARA requirements, there may <u>not</u> be a need to either pump and treat or place restrictions on water use because the site, when analyzed with a more detailed site-specific analysis, meets the requirements without remediation, because the more detailed analyses show the actual contamination to meet the more restrictive requirements. Costs involved in this case would be that to perform detailed groundwater analyses and to demonstrate that the ALARA requirements for groundwater have been met.

Table 6.1
Cost-Benefit for Soil Cleanup at Reference Power Reactor
(in incremental $M/fatality averted)

Unrestricted Use

Case 1 - Diffusion into the soil; $50/ft3 burial cost for soil; soil removal after soil washing; unrestricted use with resident farmer use of the site
Case 1A - Same as Case 1, but with industrial use of the site
Case 1B - Same as Case 1, but with residential high density dwelling use

Case 2 - Diffusion, $50/ft3 burial cost for soil; no soil washing; unrestricted use with resident farmer use of the site
Case 2A - Same as Case 2, but with industrial use
Case 2B - Same as Case 2, but with residential high density dwelling

Case 3 - Real world soil profile data; $50/ft3 burial cost; soil removal after soil washing; unrestricted use with resident farmer use of the site
Case 3A - Same as Case 3, but with industrial use
Case 3B - Same as Case 3, but with residential high density dwelling

Case 4 - Real world soil profile data; $50/ft3 burial cost for soil; no soil washing; unrestricted use with resident farmer use of the site
Case 4A - Same as Case 4, but with industrial use
Case 4B - Same as Case 4, but with residential high density dwelling

Dose Reduction (mrem/y)	Cases 1, 2, 3, 4	Cases 1A, 2A, 3A, 4A	Cases 1B, 2B, 3B, 4B
100-60	800 - neg	210 - neg	42 - 170
60 -25	800 - neg	220 - neg	43 - 2000
25 - 15	10000 - neg	2600 - neg	510 - neg
15 - 3	neg	neg	4000 - neg

Notes:

1) neg = there is a net negative health effect

Table 6.2
Cost-Benefit for Soil Cleanup at Reference Uranium Fuel Fabrication Facility
(in incremental $M/fatality averted)

Unrestricted Use

Case 1 - Diffusion into the soil; $50/ft3 burial cost for soil; soil removal after soil washing; unrestricted use with resident farmer use or industrial use of the site

Case 2 - Diffusion; $50/ft3 burial cost for soil; no soil washing; unrestricted use with resident farmer or industrial use of the site
Case 2A - Same as Case 2, but with $10/ft3 burial costs for soil;
Case 2B - Same as Case 2, but with residential high density dwelling

Case 5 - Real world soil profile data; $50/ft3 burial cost for soil; soil removal after soil washing; unrestricted use with resident farmer or industrial use of the site

Case 6 - Real world soil profile data; $50/ft3 burial cost; no soil washing; resident farmer or industrial use
Case 6A - Same as Case 6, but with $10/ft3 burial cost for soil
Case 6B - Same as Case 6, but with residential high density dwelling

Dose Reduction (mrem/y)	Case 6[1]	Cases 6A, 5, 6B[1]	Case 2[1]	Cases 1, 2A, 2B[1]
100-60	34	7-20	5	1-3
60-25	246	36-94	7	2-4
25-15	670	64-210	24	5-18
15-3	neg	280-neg	87	17-71

Notes:

1) neg = there is a net negative health effect

Table 6.3
Cost-Benefit for Soil Cleanup at Referenced Sealed Source
Manufacturer/Broad R&D Facility
(in incremental $M/fatality averted)

Unrestricted Use

Case 1 - Diffusion into the soil; $50/ft3 burial cost for soil; soil removal after soil washing; unrestricted use with resident farmer use of the site
Case 1A - Same as Case 1, but with industrial use of the site
Case 1B - Same as Case 1, but with residential high density dwelling use

Case 2 - Diffusion; $50/ft3 burial cost; no soil washing; unrestricted use with resident farmer use of the site
Case 2A - Same as Case 1, but with industrial use
Case 2B - Same as Case 1, but with residential high density dwelling use

Case 3 - Real world soil profile data; $50/ft3 burial cost; soil removal after soil washing; unrestricted use with resident farmer use of the site
Case 3A - Same as Case 3, but with industrial use
Case 3B - Same as Case 3, but with residential high density dwelling use

Case 4 - Real world soil profile data; $50/ft3 burial cost; no soil washing; unrestricted use with resident farmer use of the site
Case 4A - Same as Case 4, but with industrial use
Case 4B - Same as Case 4, but with residential high density dwelling use

Dose Reduction (mrem/y)	Cases 1, 2, 3, 4	Cases 1A, 2A, 3A, 4A	Cases 1B, 2B, 3B, 4B
100 - 60	380 - neg	100 - neg	21 - 63
60 - 25	500 - neg	140 - neg	23 - 1900
25 - 15	940 - neg	250 - neg	50 - neg
15 - 3	neg	neg	440 - neg

Notes:

1) neg = there is a net negative health effect

Table 6.4
Cost-Benefit for Soil Cleanup at Reference Rare Metal Extraction Facility
(in incremental $M/fatality averted)

Unrestricted Use

Case 1 - Diffusion into the soil; $50/ft3 burial cost; no soil washing; unrestricted use with resident farmer use of the site
Case 1A - Same as Case 1, but with $10/ft3 burial cost
Case 1B1 - Same as Case 1, but with industrial use
Case 1B2 - Same as Case 1, but with high density dwelling use
Case 1C - Same as Case 1, but with use of in-situ surveys

Case 2 - Real world profile data; $50/ft3 burial cost; no soil washing; resident farmer use of the site
Case 2A - Same as Case 2, but with $10/ft3 burial cost
Case 2B1 - Same as Case 2, but with industrial use
Case 2B2 - Same as Case 2, but with high density dwelling use
Case 2C - Same as Case 2, but with use of in-situ surveys

Dose Reduction (mrem/y)	Case 2	Cases 2A, 2B1, 2C	Cases 1, 1A, 1B1	Cases 1B2, 1C, 2B2
100-60	13	4-13	1	1-2
60-25	30	11-27	3-4	1-3
25-15	110	58-69	29-48	1-11
15-3	580	210-440	160-270	16-49

Table 6.5
Cost-Benefit for Structures Cleanup at Reference Power Reactor
(in incremental $M/fatality averted)

Unrestricted Use

Case 1 - Bioshield contamination; $350/ft3 burial cost for concrete; 50 persons working in bioshield area

Case 1A - Same as Case 1, but with 20 persons working in bioshield area

Case 2 - Floor and wall contamination; $350/ft3 burial cost for concrete; office use of the facility (210 persons using contaminated area of facility - 25000 ft2/120 ft2/person)

Case 3 - Floor and wall contamination; $350/ft3 burial cost for concrete; industrial use of facility (25 persons using contaminated areas of facility)

Case 4 - Floor and wall contamination; $350/ft3 burial cost of concrete; residential use of the facility (25 persons using contaminated areas of facility)[(2)]

Dose Reduction (mrem/y)	Cases 1,1A	Case 2	Cases 3,4
100-60	8 - 16	<2	<12
60-25	12 - 24	2	12
25-15	14 - 28	5	29
15-3	74 - 160	9	51

Table 6.6

Cost-Benefit for Structures Cleanup at Reference Uranium Fuel Fabrication Facility
(in incremental $M/fatality averted)

Unrestricted Use

Case 1 - Floor and wall contamination; $350/ft3 burial cost for concrete, office use of the facility (1000 persons using contaminated area of facility - 120,000 ft/120 ft2/person)

Case 2 - Floor and wall contamination; $350/ft3 burial cost for concrete; industrial use of facility (80 persons using contaminated areas of facility)

Case 3 - Floor and wall contamination; $350/ft3 burial cost for concrete; residential use of facility (120 persons using contaminated area of facility)[2]

Dose Reduction (mrem/y)	Case 1	Cases 2,3
100-60	<1	<8
60-25	1	8
25-15	2	19
15-3	3	33

Table 6.7

Cost-Benefit for Structures Cleanup at Reference Sealed Source Manufacture/Broad R&D Facility
(in incremental $M/fatality averted)

Unrestricted Use

Case 1 - Floor and wall contamination; $350/ft3 burial cost for concrete; office use of the facility (5 persons using contaminated area of facility - 600 ft/120 ft2/person)

Case 2 - Floor and wall contamination; $350/ft3 burial cost for concrete; industrial use of facility (1 person using contaminated areas of facility)

Case 3 - Floor and wall contamination; $350/ft3 burial cost for concrete; residential use of the facility (1 person using contaminated areas of facility)[2]

Dose Reduction (mrem/y)	Case 1	Cases 2,3
100-60	<2	<5
60-25	2	5
25-15	5	12
15-3	9	20

Table 6.8

Cost-Benefit for Structures Cleanup at Reference Rare Metal Extraction Facility
(in incremental $M/fatality averted)

Unrestricted Use

Case 1 - Floor and wall contamination; $350/ft3 burial cost for concrete; office use of the facility (500 persons using contaminated area of facility - 60,000 ft/120 ft2/person)

Case 2 - Floor and wall contamination; $350/ft3 burial cost for concrete; industrial use of facility (40 persons using contaminated areas of facility)

Case 3 - Floor and wall contamination; $350/ft3 burial cost for concrete; residential use of facility (60 persons using contaminated areas of facility)[2]

Dose Reduction (mrem/y)	Case 1	Cases 2,3
100-60	<1	<13
60-25	1	13
25-15	3	33
15-3	5	60

Table 6.9

Calculated Costs for Site Access Restrictions

Reference Facility	Perimeter Fence ($000)		Paved Surface ($000)		Landscaping ($000)	
	Capital	Annual Maintenance	Capital	Annual Maintenance	Capital	Annual Maintenance
Nuclear Power Plant	2.7 - 4.3	0.15 - 0.24	3.3 - 5.5	0.18 - 0.30	0.90	0.05
Uranium Fuel Fabrication Plant	15.4 - 25.1	0.84 - 1.38	110 - 180	6.0 - 9.9	5.0	0.27
Sealed Source Manufacturer	3.4 - 5.6	0.19 - 0.31	5.5 - 9.2	0.30 - 0.50	1.1	0.06
Rare Metals Extraction Plant	15.4 - 25.1	0.84 - 1.4	110 - 180	6.0 - 9.9	5.0	0.27

Table 6.10

Soil Removal to Control Prospective U Contamination
Incremental Costs & Impacts, from 25 mrem/y
Based on Usage by 25 Persons

Dose Reduction (mrem/y)	(1) soil removal cost at $10/ft^3 ($M)	(2) soil removal cost at $50/ft^3 ($M)	(3) Incremental Mortality	(4) cost /benefit for $10/ft^3 ($M/DA)	(4) cost /benefit for $50/ft^3 ($M/DA)
25-15	7.8	27	0.12	12	38
15-3	13.4	44	0.15	45	130
3-background	19	66	0.15	112	440

Table 6.11

Sr-90 Remediation by Pump and Treat
Incremental Costs from 25 mrem/y for 25 Persons
Based on Usage by 25 Persons

Dose Reduction (mrem/y)	Incremental Mortality	Incremental cost ($M)	Incremental cost /benefit ($M/DA)
25-15	0.0055	1.7	309
15-3	0.0116	5.4	466
3-backgroud	0.0139	32	23000

Table 6.12

U Remediation by Pump and Treat
Incremental Costs from 25 mrem/y for 25 Persons
Based on Usage by 25 Persons

Dose Reduction (mrem/y)	Incremental Mortality	Incremental cost ($M)	Incremental cost /benefit ($M/DA)
25-15	0.13	17	131
15-3	0.26	124	477
3-background	0.31	306	987

Table 6.13

Remediation by Restricting Use & Providing Replacement
Water for a Sr-90 and U Site
Incremental Costs from 25 mrem/y Based on Usage by 25 Persons

Dose Reduction (mrem/y)	Incremental Mortality	Incremental cost ($M)	Incremental cost /benefit ($M/DA)
25 Sr-90 -background	0.0139	3.3	250
25 U -background	0.31	11	36

7. Conclusions

7.1 Introduction

As discussed in Section 1.4, this GEIS is being prepared to fulfill NRC's responsibilities under NEPA, and the draft and final GEIS have been developed in accordance with 10 CFR 51 which contains NRC's regulations implementing NEPA.

In accordance with 10 CFR Part 51, the NRC prepared and issued NUREG-1496, Volumes 1 and 2, "Draft Generic Environmental Impact Statement in Support of Rulemaking on Radiological Criteria for Decommissioning of NRC-Licensed Nuclear Facilities" (draft GEIS) which contained analyses and presented conclusions and the preliminary recommendation regarding regulatory alternatives and the establishment of radiological criteria for decommissioning. The Draft GEIS provided a basis for rulemaking in 10 CFR Part 20 of the NRC's regulations to provide specific radiological criteria for the decommissioning of soils and structures at sites under its jurisdiction.

The Draft GEIS was issued with the NRC's proposed rulemaking on radiological criteria for decommissioning and comments were requested on both the proposed rule and on NUREG-1496 in the Federal Register notice issuing that rule (59 FR 43200, August 22, 1994). The public comment closed on January 22, 1995. Public comments received on the Draft GEIS are summarized in NUREG/CR-5383

In accordance with 10 CFR 51.90 and 10 CFR 51.91, this Final GEIS includes the comments received on the Draft GEIS and responses to those comments (see Appendix H), reconsiders the regulatory alternatives presented in the Draft GEIS (Chapter 2), and includes a supplement to the analyses of the Draft GEIS (Chapters 3 - 6, and Appendices B - G). The results of those activities are included in Chapters 1 - 6 and are summarized in Section 7.2 below. Based on the analyses in this Final GEIS, appropriate regulatory alternatives have been analyzed in detail to the extent feasible in a generic analysis, and rulemaking decisions regarding the overall approach for licensing termination (see Section 7.2 below) have been made which will achieve the requirements of sections 101 and 102(1) of NEPA.

7.2 Conclusions

7.2.1 Discussion

Chapters 1 - 6 describe the supplementation and modification of the analyses of the draft GEIS based on the public comments received. As is discussed in those chapters, given the range of possible parameters, scenarios, and site specific situations, both the Draft GEIS and the Final GEIS find that there is a wide range of cost-benefit results among the different facilities and within facility types and that there is no unique algorithm which decisively is the most beneficial

result for all facilities. Nevertheless, the following section summarizes the results of this Final GEIS.

7.2.2 Summary of Results

Despite the difficulties noted in Section 7.2.1, the following summarizes Chapters 1 - 6 and how their results can be helpful for insight in making decisions regarding health impacts, associated costs, objectives of decommissioning, restricted use, and decisions on potential exemptions:

1) Achieving, as an objective of decommissioning ALARA, Reduction to Pre-Existing Background). The objective of returning a site to pre-existing background conditions is consistent with the concept of returning a site to the radiological condition that existed before its use. However, the question of whether this objective as a goal of decommissioning, ALARA should be codified by rule depends on a variety of factors, including cost, practicality (e.g., measurability) of achieving the objective, and the type of facility involved.

As noted in Section 7.3.1, decommissioning is expected to be relatively easy for a certain class of nonfuel-cycle nuclear facilities (i.e., those that use either sealed radioactive sources or small amounts of short-lived nuclides), because there is usually no residual radioactive contamination to be cleaned up and disposed of, or if there is any, it should be localized or it can be quickly reduced to low levels by radioactive decay. Decommissioning operations will generally consist of disposing of a sealed source or allowing licensed short-lived nuclides to decay in storage, submitting form NRC-314, and demonstrating (either through radiation survey or other means such as calculation of reduction of the contamination level by radioactive decay) compliance with the requirements for license termination. Because contamination at these facilities is expected to be negligible or to decay to negligible levels in a short time, achieving an objective of returning these facilities to background would not appear to be an unreasonable objective of ALARA.

However, in general, for those nuclear facilities where contamination exists in soils and/or structures, the analyses in Chapters 1 - 6 of this Final GEIS shows, in a manner similar to the Draft GEIS, that achieving an ALARA decommissioning objective of "return to a pre-existing background" is not reasonable as it may result in net detriment or because cost cannot be justified because detriments and costs associated with remediation and surveys tend to increase significantly at low levels, while risk reduction from radiation exposure from criteria near background is marginal.

2) Establishment of Dose Criterion. As noted in Section 7.2.1, given the range of possible parameters, scenarios, and site specific situations, both the Draft GEIS and the Final GEIS find that there is a wide range of cost-benefit results among the different facilities and within facility types and that there is no unique algorithm which decisively is the most beneficial result for all facilities which could be set as a residual dose criterion.

In consideration of such a constraint, national and international radiation standards setting bodies, including ICRP and NCRP note in their most recent documents (ICRP 60 and NCRP No. 116) that, although the limit for the public dose should be 100 mrem/y from all man-made sources combined, it would seem appropriate that the amount that a person would receive from a single source, should be further reduced to be a fraction of the limit to account for the potential that an individual may be exposed to more than one source of man-made radioactivity, thus limiting the potential that an individual would receive a dose at the public dose limit. NCRP No. 116, Chapter 15, notes that no single source or set of sources under one's control should result in an individual being exposed to more than 25 mrem/y. This fraction was presented as a simple alternative to having a site operator (where a site could expose individuals to levels greater than 25 mrem/y) investigate all man-made exposures that an individual at the site would be exposed to so as to demonstrate that the total dose does not exceed 100 mrem/y. The clear implication in this simple alternative is that if individual sources are constrained to 25 mrem/y that NCRP believes it likely, given the potential for multiple exposures, that the public dose limits will be met. Further reductions considering ALARA would be still be considered by NCRP No. 116.

ICRP 60, Section 5.5.1, in discussing the principles of constraints and limits, notes that it is appropriate to select dose constraints applied to each source to allow for contributions from other sources so as maintain doses below the 100 mrem/y limit. ICRP 60 does not contain numerical guidance on dose constraints for particular practices, but notes that cumulative exposures to individuals from existing sources near 100 mrem/y are rarely a problem primarily because of the widespread use of source-related dose constraints. Further explanation of the fundamental concepts of ICRP 60 are contained in the paper "The ICRP Principles of Radiological Protection and Their Application to Setting Limits and Constraints for the Public from Radiation Sources," by Professor Roger Clarke, Chairman of the ICRP. The paper notes that the constraint approach derives from the optimization principle of radiation protection in which, for any source, individual doses should be ALARA and also be constrained by restrictions on doses to individuals (i.e., dose constraints). The paper further notes that a constraint is an individual related criterion applied to a single source in order to ensure that the overall dose limits are not exceeded, and that a dose constraint would therefore be set at a fraction of the dose limit as a boundary on the optimization of that source. Based on the principles presented in the paper, the constraint recommended in the paper for a decommissioned site is 30 mrem/y and that further optimization through the ALARA principle is appropriate. As is the case for NCRP No. 116, the implication of the paper and ICRP 60 is that the constraint level is a boundary on the dose from this source and is sufficient to assure that members of the public are not exposed to levels in excess of the public dose limit. The rationale for this is expressed in Section 5.5.1 of ICRP 60 where it is noted that the critical exposed group is not normally exposed to the constraint level from more than one source although they may be exposed to some dose level less than the constraint level from more than one source.

In its review of how the principles and recommendations of the ICRP, NCRP, and Federal Radiation Protection Guidance (FRG) are relevant to the proposed NRC rule, NRC's Advisory Committee on Nuclear Waste noted that 15 mrem/y represented an unnecessarily conservative fraction of the 100 mrem/y annual limit. Although it agreed that the need to partition the annual recommended dose limit among several sources from which a person is likely to be exposed appears justifiable, and noted that no explicit guidance from the various national and international bodies on this subject exists, ACNW stated that a value of 25 percent or 30 percent of the 100 mrem/y limit appears more justified and appropriate based on the likelihood that no more than 3 or 4 separate regulated sources will affect the critical group at any instance. ACNW further noted that the selection of 15 mrem/y that represents about 1/7 of the annual limit assumes that a person will encounter a simultaneous dose from seven different regulated sources and that this appears to be unjustified, particularly because the ALARA principle accompanies all such NRC regulatory actions.

The recommendations of the above organizations can be summarized as suggesting that a constraint value be set as part of the process of optimizing the dose from a particular source and that this constraint value should be set as a boundary value below which further optimization or ALARA principles should be employed. The recommendations also appear to suggest that setting a source constraint of 25 - 33 percent of the annual dose limit of 100 mrem/y is appropriate and adequate to ensure that the dose limit is met, and do not tend to lend support to 15 mrem/y as a means of expressing the appropriate fraction to constrain the dose from an individual source because it is not likely that a critical group will be exposed to as many as seven sources. Consequently, the constraint value should be set using a more reasonable approach.

NUREG/CR-5512 provides an analysis of exposure pathways for critical groups at decommissioned facilities. The principle limiting scenarios include: (a) full time residence and farming at a decommissioned site, (b) exposure while working in a decommissioned building, and (c) renovation of a newly decommissioned building. These principle limiting exposure scenarios tend to be conservative in their estimate of doses and also tend to be somewhat mutually exclusive; i.e., a person living near a decommissioned nuclear facility would only receive a dose near the constraint level if living patterns assumed full-time residency and farming at the site. These living patterns would make it difficult for the member of this critical group to also be a member of the critical group from other licensed or decommissioned sources. Conversely, a person having less residency than a full time farmer (e.g., apartment dweller, homeowner who works away from the site) might receive doses from other sources but would receive less than the constraint value from the decommissioned site because the exposure time and the number of pathways would be reduced. Thus, given the assumptions regarding living patterns made in evaluating compliance with the constraint level, it is difficult to envision an individual receiving levels approaching constraint levels for more than one licensed or decommissioned source. It is also likely that individuals at a decommissioned site will actually be exposed to doses substantially below the constraint level because cleanup is a coarse removal process. For example, the Appendix C indicates that, for the reference cases analyzed, removal

of a layer of concrete by scabbling will result in doses at levels from 2 to more than 10 times lower than a constraint value. In addition to consideration of decommissioned sources, it is also difficult to envision that an individual would come in contact with more than a relatively minimal number of other sources as part of normal living patterns. For example, the NCRP in NCRP No. 93, "Ionizing Radiation Exposure of the Population of the United States," September 1987, reviewed likely radiation exposures to the public from consumer products, air emissions, and fuel cycle facilities (including nuclear power plants) and found that, in general, exposure to the public is in the few mrem/y range. Recent experience on nuclear power plant emissions and dose commitments (NUREG/CR-2850) tends to support the conclusions of NCRP No. 93 on power plant exposures.

This generic evaluation of various sources, including decommissioned sources, supplemented by the recommendations of the standards setting bodies and advisory committee noted above, suggests that the 15 mrem/y value may be too restrictive for its intended purpose of constraining doses from this category of sources in establishing an appropriate boundary constraint, and rather leads to a conclusion that 25 percent of the public dose limit is a sufficient and ample fraction to use as a limitation or constraint for decommissioned sources in that it provides a sufficient and ample margin of safety for protection of public health and safety. It is recognized that this conclusion reflects a judgement regarding the likelihood of individuals being exposed to multiple sources with cumulative doses approaching 100 mrem/y rather than an analysis based on probability distributions for such exposures. Thus, a dose criterion of 25 mrem/y, distinguishable from background, should be established.

Wide variation in local concentrations of naturally occurring radon have been observed in all regions of the United States, including in soils and buildings. These variations make it very difficult to distinguish between naturally occurring radon and radon resulting from licensed material. Because of these variations and the limitation of measurement techniques, it is not practical to distinguish between naturally occurring radon and elevated radon concentrations from licensed activities at levels which would result in doses comparable to a 25 mrem/y dose criterion. Consequently, implementation of such a criterion should not be expected to demonstrate that radon from licensed activities is indistinguishable from background on a site-specific basis. This will be the case when radium, the principal precursor to radon, is indistinguishable from background or reduced to levels which meet the 25 mrem/y criterion for unrestricted release. In some instances it may not be reasonable to achieve levels of residual concentrations of radon precursors within the limit for unrestricted use. Restrictions (see Item #5 below) could be applied to limit the effects of precursors but doses would also be reduced based on ALARA principles. In developing guidance on the application of ALARA in such cases, the practicality of employing radon mitigation techniques in existing or future structures should be considered.

3) Decommissioning ALARA analysis for soil contamination. Soil contamination can exist onsite at nuclear facilities because of a variety of reasons including small spills or leaks,

deposition from airborne effluents, burial or placement in the ground onsite of system byproducts or other waste materials, or large leaks. The level of soil contamination for the large majority of NRC-licensed facilities (>6000) is either zero or is minimal. Certain facilities (e.g., power reactors, fuel facilities, industrial facilities) may have greater soil contamination, and certain of these facilities have been identified as having extensive soil contamination (albeit generally at relatively low levels) and have been placed in the Site

Decommissioning Management Plan (SDMP) (see NUREG-1444). These sites warrant specific NRC attention regarding their decommissioning.

As indicated above, for the generic scenarios considered, the results of Chapters 1 - 6 in this Final GEIS evaluation indicate that there is a wide range of possible cost-benefit ratios. Nevertheless, there appears to be a strong indication that removing and transporting soil to waste burial facilities to achieve exposure levels at the site at or below a 25 mrem/y unrestricted use dose criterion is generally not cost-effective when evaluated against the range normally considered justifiable under NRC's regulatory framework presented in NUREG/ BR-0058 and NUREG-1530 (see Section 6.1). Further, even for a range of cleanup levels at or above a 25 mrem/y criterion there can also be cases where costs are unreasonable in comparison to benefits realized;

4) Decommissioning ALARA analysis for structures containing contamination. Contamination of building floors and walls can exist at nuclear facilities for a variety of reasons including system leaks, spills, tracking, and activation. The large majority of NRC licensed facilities (>6000) have zero or limited building contamination. Contamination in general does not penetrate the surface of concrete and can be readily removed by water jets or concrete scabbling. If the building is reused for some new industrial, office, or other use after license termination, persons can be in fairly direct contact with the decommissioned floors and walls.

As indicated above, for the range of generic situations considered, the results of Chapters 1 - 6 of this Final GEIS evaluation indicate that there is a wide range of possible cost-benefit ratios. Nevertheless, there appears to be more of a tendency than for soil that cleanup of concrete to levels at or below 25 mrem/yr can be cost effective in certain cases when compared against the regulatory alternatives decision-making guidelines of NUREG/CR-0058 and NUREG-1530.

In actual situations, it is likely that even if no specific analysis of ALARA were required for soil and concrete removal that the actual dose will be reduced to below 25 mrem/y because of the nature of the removal process. For example, the process of scabbling of concrete removes a layer of concrete which likely contains a large fraction of the remaining radioactivity, and the process of soil excavation is a gross removal process that also is likely to remove large fractions of the radioactivity.

To reflect the analyses of Chapters 1 - 6, in any ALARA analysis conducted to support decisions about a site specific cleanup, all detriments potentially resulting from the cleanup activities should be taken into consideration in balancing costs and benefits, e.g., traffic mortalities which might occur as contaminated waste is transported away from the site (e.g., see Appendix B).

5) Restricted use and Exemptions from Rule Criteria. As illustrated in Chapters 1 - 6, there can be situations where restricting site use to achieve a TEDE of 25 mrem/y is a more reasonable and cost-effective option than unrestricted use. In this manner, restrictions can provide

protection of public health and safety at reasonable cost by limiting the time period that an individual spends onsite or restricting agricultural or drinking water use. For many facilities, the time period needed for restrictions can be fairly short, i.e. long enough to allow radioactive decay to reduce radioactivity to levels which permit release for unrestricted use. For example, at reactors, manufacturing facilities, or broad scope licensees where the principal contaminants can have half-lives of 5 - 30 years (Co-60, Cs-137) restricting site use for about 10 - 60 years can result in achieving unrestricted use levels. Thus restricted use, accompanied by provisions which assure the restrictions remain in place, can have a part in a license termination approach. Considerations for assuring that restrictions remain in place were discussed in the Draft GEIS and included provisions for legally enforceable institutional controls, financial assurance to provide that the controls remain in place, and a "cap" on the level of radioactivity allowable in the unlikely event that controls should fail.

For restricted use, Chapter 6 suggests that while removal of soil to levels below 25 mrem/y may not be cost-effective, other simple and less costly measures, such as fencing or landscaping may be cost-effective and should be considered as part of the ALARA process.

The Draft GEIS and Chapters 1 - 6 analyze impacts and costs associated with alternative regulatory actions for nuclear facilities licensed by the NRC. The preamble to the proposed rule (59 FR 43200) discussed the fact that there may be several existing licensed sites where the health and the environment may best be protected by means other than the decommissioning activities analyzed in Chapters 1 - 6, and that these facilities might seek exemptions (under §20.2301) from the criteria of the rule. Based on the analysis of Chapters 1 - 6 of this Final GEIS, for the very large majority of NRC licensed sites (>6000), it continues to be reasonable to envision that the unrestricted and/or restricted use regulatory alternatives analyzed here will provide appropriate and achievable criteria for decommissioning. Nevertheless, it is also reasonable to continue to anticipate that there may be site specific special circumstances, not analyzed in this Final GEIS because of their specific situation, which need particular analysis.

6) Groundwater Cleanup. The NRC proposed rule included separate requirements for groundwater protection, but there was not detailed separate analysis of groundwater cleanup in the Draft GEIS. Public comments on the proposed rule, including EPA comments supporting the separate requirement, were received on the impacts and costs associated with groundwater cleanup. Chapter 6, and Appendix C, contain further technical analyses of costs and impacts associated with groundwater remediation.

The analyses of the Draft GEIS and of Chapters 1 - 6 of this Final GEIS in support of the proposed rule analyzed impacts and costs of regulatory alternatives which would contain criteria (an individual dose criterion for unrestricted use, ALARA, and restricted use) to protect the public from radiation from all of the pathways that they could be exposed to from a decommissioned facility (e.g., direct exposure to radiation from material on the soil surface, ingestion of food grown in the soil and from fishing, inhalation of dust from soil surfaces, and

drinking water obtained from surface waters and from groundwater). Such criteria would thus limit the amount of radiation that a person could potentially receive from all possible sources at a decommissioned facility, i.e., it is an "all-pathways" standard.

Because equivalent doses received through any pathways of exposure would involve equivalent risks to the person exposed, it would appear that, with regard to the need to set a separate standard for groundwater, there is no reason from the standpoint of protection of public health and safety to have a separate, lower, criterion for one of the pathways (e.g., drinking water) as long as, when combined, they don't exceed the total dose standard established in the rule. A standard imposed on a single pathway, such as drinking water, may have been appropriate in the past for site cleanups when a dose-based standard for decommissioning did not exist. It may also be appropriate for chemical contamination when no total limit on exposure exists. But the presence of an overall TEDE criterion for all radionuclides combined and on all pathways of exposure combined, including drinking water, would remove the need for such a single-pathway standard. This is a better and more uniform method for protecting public health and safety than, as was contained in NRC's proposed rule, setting separate requirements using the MCLs contained in 40 CFR 141. This is because the MCL requirements do not cover all radionuclides, and do not provide a consistent risk standard for different radionuclides. Therefore, it would appear that an overall single TEDE criterion should be adopted in the final rule.

Thus, while it is evident that exposures from drinking contaminated groundwater need to be controlled, and that the environmental integrity of the nation's groundwater resources needs to be protected, it is also evident that protection of public health and safety is fully afforded by limiting exposure to persons from all potential sources of radioactive material (TEDE) at a decommissioned facility. There is, therefore, no compelling reason to impose a separate limit on dose from the drinking water pathway and separate groundwater requirements need not be set in NRC's rulemaking. Nevertheless it should be made clear that, because of the importance of protecting this resource as a source of potential public exposure, the groundwater pathway is clearly included as part of the all-pathways unrestricted use dose criterion. Further separate protection of the resource, per se, cannot be effected unilaterally as part of this Final GEIS but might be the subject of some future EPA action.

In actual situations, based on typical operational practices of most nuclear facilities and based on the behavior of radionuclides in the environment, for the very large majority of sites, concentrations of radionuclides in the groundwater will be well below the dose criterion of this final rule and in fact would be either below or only marginally above the MCLs codified in 40 CFR 141 as referenced in the proposed NRC rule. For example, the large majority of NRC licensees either use sealed sources or have very short-lived radionuclides; the potential for contamination from these facilities reaching groundwater is highly unlikely. Even for facilities like reactors or certain industrial facilities, whose major contaminants are relatively short-lived nuclides like Co-60 or Cs-137, the migration of these nuclides through soil is so slow as to preclude groundwater contamination of any significance. In addition, it is not anticipated that

there would be decommissioned nuclear facilities located near enough to public water treatment facilities such that treatment facilities would be affected by the potential groundwater contamination from decommissioned facilities

As further analyzed in Chapter 6 and Appendix C, cost and practicality is reviewed in this Final GEIS to determine whether such analyses can provide additional information regarding decisions on issues such as ALARA levels, including how, and to what level, ALARA efforts should be made in groundwater cleanup, and if, and in what manner, restrictions on use should be considered. Analysis of impacts to populations, and the cost of remediating those impacts, is particularly important for groundwater because this resource can be used for public uses away from the site being decommissioned. The analysis in Appendix C draws from NRC's experience and the public comments regarding contaminated sites. In particular with regard to groundwater remediation, potential methods considered include removal of soil to preclude prospective contamination, pump and treat process for the cleanup of existing groundwater contamination, and the supply of alternate sources of drinking water, as well as administrative costs of predicting and measuring levels in the plume of contaminated groundwater.

Given the range of possible parameters, scenarios, and site specific situations, Section 7.2.1 notes that there is a wide range of cost-benefit results and there is no unique algorithm which decisively is an ALARA result for all facilities. This finding is especially true for groundwater contamination where the behavior of radionuclides in soil and in the aquifer is highly site specific, and much more so than, for example, behavior in concrete. The results of the overall considerations of Section 6.4 of Chapter 6 for all pathways are thus applicable to the groundwater component, with certain specific findings for the groundwater component; e.g., removing soil to doses less than the dose criterion of 25 mrem/y is not generally likely to be cost effective when evaluated against the range normally considered justifiable under the regulatory framework described in NUREG/BR-0058 and NUREG-1530 (see Section 6.1). However, there was more of a tendency that sites where there can be both groundwater contamination and a relatively large population obtaining all their drinking water from the site plume would be potentially cost-effective to treat. Thus, licensees should consider their site specific conditions under which an ALARA analysis could identify the need to consider reducing the dose below the unrestricted use dose criterion.

(7) Citizen Participation

The public should not only be fully informed of the decommissioning actions at a particular site but also be able to effectively participate in site decommissioning decisions. In particular, for decommissioning where the licensee does not propose to meet the conditions for unrestricted use, licensees should seek community involvement and advice through a variety of methods regarding the proposed decommissioning.

It is recognized that special environmental or cultural issues may be associated with a particular decommissioning action which would require more stringent implementation of the requirements. Sites on or contiguous to historical sites or Native American lands that contain religious or sacred areas are examples of such special issues. These issues can best be handled on a site-by-site basis as part of the decommissioning plan review process, and as part of the NRC's environmental review under NEPA. Where necessary, the provisions for public comment and for seeking community involvement and advice would provide a mechanism for addressing these issues.

(8) Minimization of Contamination

There should be specific attention given to design features and procedures that facilitate decommissioning the site, reduce the amount of radioactive waste, and minimize the overall public risk associated with decommissioning.

(9) Relationship between the Generic Environmental Impact Statement and Site-Specific Decommissioning Actions

This GEIS evaluates the environmental impacts associated with the remediation of several types of NRC-licensed facilities to a range of alternative residual radioactivity levels. The generic analysis will likely encompass the impacts that will occur in most Commission decisions to decommission an individual site where the licensee proposes to release the site for unrestricted use. Therefore, the GEIS can be useful in satisfying the NRC's obligations under the National Environmental Policy Act in regard to individual decommissioning decisions that meet the 25 mrem/y criterion for unrestricted use. However, it is reasonable to still initiate an environmental assessment in regard to any particular site, for which a categorical exclusion is not applicable, to determine if the generic analysis encompasses the range of environmental impacts at that particular site.

In cases where a license is terminated and the site is released under restricted use conditions, licensees would demonstrate that land use restrictions or other types of institutional controls will provide reasonable assurance that the 25 mrem/y limit can be met. The types of controls and their contribution to providing reasonable assurance that 25 mrem/y can be met for a particular site will differ for each site in this category. Similarly, Item #5 above notes there may be other site specific special circumstances, not analyzed in this Final GEIS because of their specific situation, which need particular analysis. Therefore, the environmental impacts for these cases cannot be analyzed on a generic basis and the a independent environmental review should be conducted for each site-specific decommissioning decision where land use restrictions or institutional controls are relied on by the licensee or where other alternate analysis is necessary.

The GEIS indicates that the decommissioning for certain classes of licensees (e.g., licensees using only sealed sources) will not individually or cumulatively have a significant effect on the

human environment. Therefore, for these categories of licensees, the decommissioning of these types of licenses should be actions eligible for categorical exclusion from the Commission's environmental review process.

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ENCLOSURE 6

Final Regulatory Analysis

Amendments to 10 CFR Parts 20, 30, 40, 50, 51, 70, and 72

Radiological Criteria for License Termination

1. Statement of Problem

Amendment of the Nuclear Regulatory Commission's regulations regarding decommissioning of licensed facilities to provide specific radiological criteria for the decommissioning of lands and structures is necessary to ensure that decommissioning will be carried out without undue impact on public and occupational health and safety and the environment. The intent of this rulemaking is to provide a clear and consistent regulatory basis for determining the extent to which lands and structures must be remediated before decommissioning of a site can be considered complete and the license terminated. The Commission believes that inclusion of criteria in the regulations will result in more efficient and consistent licensing actions related to the numerous and frequently complex site remediation activities anticipated in the future.

The NRC has previously applied site release criteria for decommissioning on a site-specific basis using existing guidance. Although, as noted in the discussion which follows, site-specific situations will still occur, the Commission believes that codifying radiological criteria for decommissioning in the regulations will allow the NRC to more effectively carry out its function of protecting public health and the environment at decommissioned

sites by providing for more efficient use of NRC and licensee resources,

consistent application across all types of licenses, and a predictable basis for decommissioning planning.

The Commission has reassessed residual contamination levels contained in existing guidance based on changes in basic radiation protection standards, improvements in remediation and radiation detection technologies, decommissioning experience, public comments received on the proposed rule, and public comments received on rule drafts and presented at workshops held as part of the rulemaking effort.

These criteria apply to the decommissioning of most licensed facilities and facilities subject to the Commission's jurisdiction. The Commission will apply these criteria in determining the adequacy of remediation of residual radioactivity resulting from the possession or use of source, byproduct, and special nuclear material. The criteria apply to decommissioning of nuclear facilities that operate through their normal lifetime as well as to those that may be shut down prematurely.

2. Objectives

Based on two broad considerations of the decisionmaking rationale; i.e., health and safety aspects and cost and practicality, the overall license termination approach that the Commission has chosen includes: (1) an unrestricted use dose criterion of 25 mrem/y applicable on a generic basis without site-specific analysis, (2) provisions for ALARA, (3) permitting restricted use if

certain provisions are met, and (4) codifying alternate site-specific criteria in the rule to alleviate the need for exemptions in

special circumstances. The implementation aspects of this approach comprise the following objectives (the requirements of which are mainly in §§ 20.1401 through 20.1406):

1. The criteria would apply to the decommissioning of facilities licensed under Parts 30, 40, 50, 60, 61, 70, and 72 of this chapter as well as other facilities subject to the Commission's jurisdiction under the Atomic Energy Act of 1954, as amended, and the Energy Reorganization Act of 1974, as amended. For high-level and low-level waste disposal facilities (10 CFR Parts 60 and 61), the criteria would apply only to ancillary surface facilities that support radioactive waste disposal activities. For uranium and thorium facilities already subject to Appendix A of 10 CFR Part 40 and uranium solution extraction facilities, cleanup of radionuclides, other than radium from buildings and soils, is to result in a dose no greater than the dose resulting from cleanup of radium contaminated soil to the standard specified in Criterion 6(6), Appendix A, of 10 CFR Part 40. Groundwater protection and decontamination at uranium and thorium recovery facilities subject to Appendix A of 10 CFR Part 40, and uranium solution extraction facilities, are to be governed solely by the applicable requirements of Appendix A.

2. The criteria would not apply to sites which have (a) been decommissioned prior to the effective date of the rule in accordance with criteria identified in the Site Decommissioning Management Plan (SDMP) Action Plan of April 16, 1992 (57 FR 13389), or (b) previously submitted and received Commission approval on a license termination plan (LTP) or decommissioning plan that is compatible with SDMP Action Plan criteria, or (c) submitted a sufficient LTP or decommissioning plan within [insert a date 6 months after effective date of the

rule] and such LTP or decommissioning plan is approved by the Commission before [insert date 18 months after effective date of rule] and in accordance with the criteria identified in the SDMP Action Plan except that if an EIS is required in the submittal, there will be a provision for day-for-day extension.

3. After a site has been decommissioned and the license terminated in accordance with the criteria in this subpart, additional cleanup would be required by the Commission only if based on new information it determines that residual radioactivity remaining at the site could result in significant threat to public health and safety.

4. When calculating total effective dose equivalent (TEDE), the licensee should base estimates on the greatest annual TEDE dose expected within the first 1000 years after decommissioning.

5. A site would be considered acceptable for unrestricted use if the residual radioactivity that is distinguishable from background radiation results in a TEDE to an average member of the critical group that does not exceed 25 mrem/y, including that from groundwater sources of drinking water, and the residual radioactivity has been reduced to levels that are as low as is reasonably achievable (ALARA). Determination of the levels which are ALARA is to take into account consideration of any detriments, such as traffic accidents, expected to potentially result from decontamination and waste disposal.

6. A site would be considered acceptable for license termination under restricted conditions if:

(a) The licensee can demonstrate that further reductions in residual radioactivity necessary to comply with the provisions of § 20.1402 would result in net public or environmental

harm or were not being made because the residual levels associated with restricted conditions are as low as is reasonably achievable;

(b) The licensee has made provisions for legally enforceable institutional controls that provide reasonable assurance that the TEDE from residual radioactivity distinguishable from background to the average member of the critical group will not exceed 25 mrem/y;

(c) The licensee has provided sufficient financial assurance to enable an independent third party, including a governmental custodian of a site, to assume and carry out responsibilities for any necessary control and maintenance of the site;

(d) The licensee has submitted a decommissioning plan or LTP to the Commission indicating the licensee's intent to decommission in accordance with 10 CFR 30.36(d), 40.42(d), 50.82(a) and (b), 70.38(d), or 72.54 and specifying that the licensee intends to decommission by restricting use of the site. In addition, the licensee has documented in the LTP or decommissioning plan how the advice of individuals and institutions in the community, who may be affected by the decommissioning, has been sought and incorporated, as appropriate, following analysis and disposition of that advice. The advice sought would include input on the implementability of the institutional controls and the financial assurance chosen;

(e) Residual radioactivity at the site has been reduced so that if the institutional controls were no longer in effect, there is reasonable assurance that the TEDE from residual radioactivity distinguishable from background to the average member of the critical group would be as low as is reasonably achievable and would not exceed either: (1) 100 mrem/y or (2) 500 mrem/y. A licensee may propose to use the 500 mrem/y value if and

only if the licensee: (a) Demonstrates that further reductions in residual radioactivity necessary to comply with the 100 mrem/y value of (e)(1) are not technically achievable, would be prohibitively expensive, or would result in net public or environmental harm; (b) Makes provisions for durable institutional controls; and (c) Provides sufficient financial assurance to enable a responsible government entity or independent third party to both carry out periodic rechecks of the site no less frequently than every 5 years to assure that the institutional controls remain in place as necessary and to assume and carry out responsibilities for any necessary control and maintenance of those controls.

7. A site would be considered acceptable for license termination using alternate criteria greater than the dose criterion of No. 5, above, if the licensee: (1) provides assurance that public health would continue to be protected and that an individual member of the public would be unlikely to receive a total dose from all sources of more than the 100 mrem/y limit of Subpart D of 10 CFR Part 20 by submitting an analysis of possible sources of exposure, (2) has employed to the extent practical restrictions on site use according to the provisions of No. 6, above, in minimizing exposures at the site, and (3) reduced doses to ALARA levels.

8. Upon the receipt of an LTP or decommissioning plan from the licensee or a proposal by the licensee for release of a site under restricted conditions or alternate criteria or whenever the Commission deems such notice to be in the public interest, the Commission would (1) notify and solicit comments from local and State governments in the vicinity of the site and any Indian Nation or other indigenous people that have treaty or statutory rights that could be affected by the decommissioning; (2) publish a notice in the Federal Register and in a forum such as local

newspapers, letters to State or local organizations, or other appropriate forum which is readily accessible to individuals in the vicinity of the site; and (3) solicit comments from affected parties.

9. Applicants for licenses, other than renewals, would describe in the application how facility design and procedures for operation will minimize, to the extent practicable, contamination of the facility and the environment, facilitate eventual decommissioning, and minimize, to the extent practicable, the generation of radioactive waste.

3. Alternatives

The license termination approach and its implementation presented in the objectives requires that all the elements be retained for cohesiveness. Therefore, the following alternatives considered in this regulatory analysis are for all of the objectives described above.

3.1 Alternative - Take No Action

This alternative was rejected because it would not clarify the license termination process for NRC licensed facilities. This alternative would not be responsive to addressing the current resource burden for the Commission and its licensees.

3.2 Alternative - Regulatory Guidance

This alternative was rejected because it would not provide the necessary regulatory basis to mandate particular licensee actions. In order to maintain regulatory flexibility consistent with current regulatory needs, changes to the way in which license termination activities are defined and permitted to be performed in the regulations are necessary.

3.3 Alternative - Rulemaking

This alternative was selected because it would codify procedures and definitions for license termination activities that have been dealt with on a case specific basis and provides a firm regulatory basis for their generic implementation.

4. Regulatory Impact - Costs and Benefits

The detailed analysis of the costs and benefits associated with choosing various alternative criteria for license termination were discussed in the draft GEIS and regulatory analysis accompanying the proposed rule. Based on comments on these documents, a final GEIS was developed which broadened the range of case specific considerations for more extreme soil contamination remediation situations that might be required. Moreover, the draft GEIS combined the analysis of structures and soils and was not sufficiently sensitive to significant differences that can occur in cost benefit considerations. In the final GEIS analysis, modeling considerations for structures have been left essentially unchanged from those considered in the draft GEIS, and the conclusions of the draft regulatory analysis regarding structures remain valid. However, modeling considerations for soil have been broadened to include those already

considered in the Draft GEIS, which afford one measure of actual situations and more extreme (but possible) situations which represent more bounding forms of actual situations. Summaries of these cost-benefit results for the facility types considered are presented separately for soil and structures in Sections 4.2 and 4.3 for both unrestricted and restricted use situations for a variety of situations. The situations considered are described in Section 4.1.

Section 4.4 is a summary of the impacts of a range of alternative criteria for groundwater. When NRC's proposed rule was issued, it included a requirement that, in addition to the all-pathways dose criterion, licensees also had to demonstrate that radioactivity levels in groundwater that was a potential source of drinking water did not exceed the limits of EPA's 40 CFR 141. This proposed requirement was added at the request of EPA, and specific comments were requested as to its appropriateness; no specific analysis of the environmental impacts and cost-benefit of this requirement was done in the Draft GEIS. Section 4.4 provides a summary of an analysis of the impacts and costs associated with remediating groundwater doses below 25 mrem/y (see basis for use of 25 mrem/y as upper bound in Section 4.2) and includes consideration of impacts for the low dose levels that a separate groundwater standard would result in (i.e., 40 CFR 141).

4.1. Overall Cost-Benefit Analysis of Dose Criterion for Unrestricted Use

Tables 4.1 to 4.8 show the summarized results of the analyses of impacts and costs for soil and concrete removal. The results are indicated in terms of millions of dollars per estimated cancer fatality averted. In considering these results, the NRC uses the decisionmaking guidance of NUREG/BR-0058 and NUREG-1530. NUREG-1530 recommends that $2000 per person rem

be the value used by NRC in making decisions between regulatory alternatives. The $2000 per person rem is derived from the studies reviewed by NUREG-1530 which arrive at $3 million per statistical life. The tables provide an indication of the range of results for different assumptions used in the analyses.

4.1.1. Summary of Assumption Used in the Analysis

1. Variation in contamination depth profiles. This analysis was performed in response to public comments indicating that a broader range of actual data should be used in estimating the extent of contamination. Thus, the soil contamination analysis contains both the profiles from the Draft GEIS, which are used to provide an indication of the results for fairly simple types of contamination, and also more complex, deeper, and extreme (but possible) profiles added as a result of review of existing data and which represent more bounding forms of actual situations (denoted as "real world"). The effect of this variation is to change the volumes of soil requiring remediation. These two profile types are generally indicated in the tables as "diffusion" and "mixing/landfill" or "real world," respectively.

2. Alternative unrestricted land uses. Because a variety of possible land uses could occur after the facilities are released for unrestricted use, the tables show results for a set of alternative public uses of the site. The effect of this variation is the possible range of collective exposures which can occur and the resultant variation in net health impacts that will occur. The alternative unrestricted land uses included in the tables

are residential farming, industrial use, and residential use. The alternative unrestricted building uses included in the tables are office use, residential use and industrial use. Restricted use of sites is also considered in the analysis.

3. Burial charges. A set of different burial charges for different possible situations and materials is included in the tables.

4. Remediation Methods. Alternate soil remediation methods are indicated in the tables for either soil washing followed by transport or soil transport without washing. The impact of these differences is to change the volumes of soil requiring transport which changes both costs and the impacts associated with cleanup.

4.2. Results of Analysis for Unrestricted Use

The results of the analyses discussed above are presented in Tables 4.1 - 4.8 for the reference cases. Results for unrestricted use of soil at the reference facilities are in Tables 4.1 - 4.4 and include analyses of several alternate cases, including type of soil profile, method of soil disposal, and type of post-license termination site use (e.g., resident farming, industrial use, high density dwelling use). Results for unrestricted use of structures at the reference facilities are in Tables 4.5 - 4.8 and include analyses of several alternate cases, including building location and type of post-license termination use (e.g., office use of the facility, residential use, industrial use).

The results presented show a wide range of cost-benefit ratio variation among facility types as well as within facility type and are sensitive to the assumptions and parameters used in the analyses. Such results do not provide a quantitative basis for optimizing the selection of a cost-benefit ratio that can be implemented on a generic basis. Nevertheless, certain trends can be found that provide guidance for overall cost-benefit considerations.

(a) For unrestricted use, based on consideration of a range of potential site-specific situations, modeling uncertainties, and a range of justifiable cost-benefit ratios, no definitive conclusion can be inferred that enables one to distinguish between acceptable generic residual radioactivity levels in the 15-25 mrem/y range.

(b) For soils, residual radioactivity levels resulting in a dose of less than 25 mrem/y generally result in a cost-benefit ratio not considered reasonably justifiable under NRC's regulatory framework (see Section 4.1).

(c) For structures, levels less than 25 mrem/y show more tendency to be reasonably justifiable under NRC's regulatory framework.

(d) Restricted use considerations can greatly reduce costs for achieving similar or lower doses than for unrestricted use.

4.3. Results of Analysis for Restricted Use

4.3.1 Cost Estimating Bases For Access Restrictions

Licensees may choose to only remediate a contaminated site sufficiently to allow restricted use of the site. Examples include situations where further remediation is determined to be cost prohibitive for the benefit received and/or further remediation is determined to be unfeasible with existing technology. However, aside from deed restrictions, in order to show that such a site has been remediated to ALARA, a licensee should further consider reducing dose to individuals on the site by installing inexpensive but effective technologies to prevent inadvertent access to the contaminated soil areas on the site. The intent of this section is to provide cost estimates for representative low cost technologies that may accomplish this. The technologies evaluated in the section include installing a perimeter fence around the contaminated area, paving the contaminated area, and landscaping the area in a way to discourage access. Table 4.9 summarizes the costs for the low cost restrictions considered for the reference facilities.

Overall, based on the above discussion and on costs of soil removal estimated in the final GEIS, the cost-benefit ratio of incremental impacts and costs associated with restricted use in reducing doses to less than 25 mrem/y is estimated to have a wide range depending on the site-specific approach to restricted use but can range from values less than $3 million per estimated mortality averted to values in excess of $50 million per estimated mortality averted for the reference facilities studied. The larger values would generally occur if it were necessary to remove, transport, and dispose of soil to reach lower dose levels while smaller values would

result if measures such as those described above and deed restrictions were used. The wide range illustrates the need for site-specific ALARA analyses for sites considering restricted use.

4.4 Analysis of Groundwater Remediation

In Sections 4.2 and 4.3, it was concluded that the cost-benefit ratio corresponding to that from soil removal which would result in a dose of 25 mrem/y is generally unreasonably high when compared to a range that is considered reasonable for decisionmaking purposes (see Section 4.1). It was also concluded that site-specific situations can be a factor that permits doses to be reduced below 25 mrem/y using ALARA considerations. Such site-specific considerations are especially necessary when dealing with groundwater contamination. This section considers groundwater contamination possibilities for all NRC licensees (i.e., groundwater contamination is unlikely, possible, and likely). Based on a broad review of licensees, there are about 6000 NRC licensees that are in the unlikely category and about 500 NRC licensees in the possible and likely categories. For the latter two categories, examples of site-specific situations are considered and analysis performed to estimate cost-benefit ratio increments in going from 25 mrem/y to background. The results of the analysis presented in Tables 4.10 to 4.14 indicate that licensees whose sites have possible or likely groundwater contamination and a large number of people (25 or more) drinking from this source should consider site-specific remediation as part of the ALARA process.

4.5 Additional Considerations

4.5.1 Constraint on Dose Criterion

As noted in Section 4.2, given the range of possible parameters, scenarios, and site-specific situations, both the Draft GEIS and the Final GEIS found that there is a wide range of cost-benefit results among the different facilities and within facility types and that there is no unique algorithm which decisively is the most beneficial result for all facilities which could be set as a constraint. Based on considerations delineated in the final GEIS and Statement of Considerations in the final rule, the Commission has reconsidered the dose constraint of 15 mrem/y contained in the proposed rule and, based on its judgement, considering sources of exposure, potential risk, consistency with other standards, etc., decided that a dose constraint of 25 mrem/y should be a sufficient requirement. However, as already noted, 25 mrem/y is not necessarily an ALARA result, even for soil remediation, and therefore site-specific situations must be considered.

Also, as noted in the final GEIS and Statement of Consideration in the final rule, it is not practical to distinguish between naturally occurring radon and elevated radon concentrations from licensed activities at levels which would result in doses comparable to a 25 mrem/y dose criterion. Consequently, implementation of such a criterion should not be expected to demonstrate that radon from licensed activities is indistinguishable from background on a site-specific basis. This will be the case when radium, the principal precursor to radon, is indistinguishable from background or reduced to levels which meet the 25 mrem/y criterion for unrestricted release. In some instances it may not be reasonable to achieve levels of residual concentrations of radon precursors within the limit for unrestricted use. Restrictions (as

discussed below) could be applied to limit the effects of precursors but doses would also be reduced based on ALARA principles. In developing guidance on the application of ALARA in such cases, the practicality of employing radon mitigation techniques in existing or future structures would be considered.

4.5.2 Restricted Use

Requirements for restricted use were presented in the proposed rule and impacts analyzed in the draft regulatory analysis. In the proposed rule, licensees planning to select restricted use were required to show that, aside from net negative impacts on the public or the environment, termination of the license for unrestricted use would be prohibitively expensive. The Statement of Considerations accompanying the proposed rule was mute on what would be considered prohibitively expensive. Based on the cost-benefit analysis presented in the final GEIS and consideration of a range of costs that the NRC would consider reasonably justifiable (see Section 4.1), the requirement of prohibitively expensive has been removed from the final rule and replaced with a requirement based on NRC's decisionmaking framework for deciding between regulatory alternatives. That is, the licensee must first consider an unrestricted use license termination at or below 25 mrem/y using ALARA. Only after the licensee has demonstrated that 25 mrem/y cannot be met for unrestricted use would the licensee be permitted to consider restricted use license termination. Of course, as in the proposed rule but made explicit in the final rule, even under restricted use, the licensee would still need to consider ALARA.

Another requirement in the proposed rule is that for restricted use license termination, the licensee must seek advice from affected members of the public through a Site Specific Advisory

Board (SSAB) whose structure and method of interaction are explicitly prescribed in the rule. In the final rule, the SSAB requirement has been eliminated and replaced by performance requirements regarding the licensee's public interaction, which could include the licensee's use of an SSAB. This affords the licensee greater flexibility in seeking advice from affected members of the public but does not relieve the licensee of the responsibility for seeking and resolving the appropriate public input required in the rule which remains same as in the proposed rule. The documentation on how the advice from affected parties has been sought and incorporated, as appropriate, is required as an element of the license termination or decommissioning plan. Thus, the requirements of the proposed and final rule regarding the aspect of public input are essentially the same but permit the licensee greater flexibility in the final rule.

4.5.3. Elimination of Case Specific Licensing

In the Statement of Considerations for the proposed rule, the Commission recognized that there may be some licensees who are unable to terminate their license within the confines of the proposed rule and that site-specific determinations using criteria outside the scope of the proposed rulemaking may be necessary. However, the Commission noted that if, in the future, general criteria can be developed, the Commission will consider additional rulemaking to establish the criteria for general rulemaking. Because general rulemaking requirements provide better guidance than case specific determinations in terms of uniformity, implementability, and efficiency, the Commission has codified provisions for these facilities under the aegis of the rule rather than have licensees seek an exemption process. It is expected that codifying provisions for these facilities will affect few licensees (a few tens) and that the possibility of licensees being

unable to terminate their license under the final rule requirements will be very remote. The Commission has used a tiered approach in terms of difficulty of requirements to ensure that only those licensees having the more difficult cases of license termination consideration not covered in the proposed rule will attempt to use the provisions codified in the final rule. There are two areas of consideration that have been codified in the final rule:

1. Permitting a Larger Cap for Restricted Use. Although 10 CFR Part 20 restricts doses to members of the public to 100 mrem/y, it permits higher doses on a temporary basis as long as the doses don't exceed 500 mrem. The final rule requirements, in permitting a cap as high as 500 mrem/y, require that durable institutional control provisions are made and that sufficient financial assurance is provided to enable a responsible third party, such as a governmental custodian of the site, to carry out periodic recheck of the site at least every 5 years and ensure that the necessary controls are in place and maintained when necessary. Consistent with a tiered approach, the licensee, in being permitted to use a cap above 100 mrem/y, must demonstrate that compliance with the 100 mrem/y cap is not technically achievable, would be prohibitively expensive, or would result in net public or environmental harm. The use of prohibitively expensive goes beyond the cost-benefit considerations of justifiably reasonable (see Section 4.1). For the prohibitively expensive considerations, costs in the range of an order of magnitude greater than that contained as part of the decisionmaking guidelines in NUREG/BR-0058 are of the type that would be considered appropriate by the NRC. A licensee who was qualified to use

the higher cap would still need to consider ALARA to reduce the cap as much below 500 mrem/y as reasonably justifiable.

2. Alternate Criteria. Because the Commission desires the final rule requirements to be as inclusive as possible for NRC licensees desiring to terminate their license, it is anticipated that there may be a few instances where the 25 mrem/y license termination criteria to members of the public, even under restricted use conditions, would not be practical. In such circumstances, the Commission may consider a site acceptable using alternate criteria that exceed 25 mrem/y. As noted in the final GEIS and final rule Statement of Considerations, the Commission's judgement of the 25 mrem/y license termination dose as being sufficient is based on considerations of exposure from multiple sources such that the total dose to members of the public does not exceed 100 mrem/y. Therefore, if the licensee can provide assurance that public health would continue to be protected by submitting an analysis of possible sources of exposure involved and that an individual member of the public would be unlikely to receive a total dose from all sources of more than 100 mrem/y, then a dose limit greater than 25 mrem/y may be acceptable to the Commission. Before consideration of alternate criteria proposed by the licensee will be considered, the licensee must also employ to the extent practical restrictions on site use, as considered for restricted use, in minimizing exposure at the site. In addition, if an alternate criterion is approved by the Commission, the licensee must still consider ALARA in reducing doses further.

5. Decision Rationale

The assessment of costs and benefits discussed above, quantitatively when possible and qualitatively otherwise, leads the Commission to the conclusion that the overall impacts of the rulemaking will be a reduction in licensee costs primarily due to the efficiency, uniformity, and flexibility of the license termination process. Although there are apparent costs associated with several of the amendments, the Commission believes that these costs are the same or less than the ones that would have been incurred by licensees under the current rules and case specific exemptions to their license and that the benefits associated with the entire set of regulatory amendments outweighs the costs.

6. Implementation

Regulatory guidance is being developed for implementation of the rule in areas of dose modeling for converting dose criteria to measurement concentrations, performing license termination surveys and selection of appropriate measurement equipment, and methodology for performing ALARA calculations. In addition, an information base is being developed for decisions for case-specific situations regarding the potential that multiple sources will result in a total dose of 100 mrem\y from all sources to an individual member of the public.

6.1 Schedule

It is expected that completion of regulatory guidance will take about a year. Although the rule can be effective 30 days after it is noticed in the Federal Register, rule implementation should be required a year after it is noticed.

Table 4.1

Cost-Benefit for Soil Cleanup at Reference Power Reactor
(in incremental $M/fatality averted)

Unrestricted Use

Case 1 - Diffusion into the soil, $50/ft3 burial cost, soil removal after soil washing; resident farmer use of the site
- Case 1A - industrial use of the site
- Case 1B - residential, high density dwelling use

Case 2 - Diffusion, $50/ft3, no soil washing; resident farmer use of the site
- Case 2A - industrial use
- Case 2B - residential, high density dwelling

Case 3 - Real world soil profile data, $50/ft3 burial cost, soil removal after soil washing; resident farmer use of the site
- Case 3A - industrial use
- Case 3B - residential, high density dwelling

Case 4 - Real world soil profile data, $50/ft3, no soil washing; resident farmer use of the site
- Case 4A - industrial use
- Case 4B - residential, high density dwelling

Dose Reduction (mrem/y)	Cases 1, 2, 3, 4	Cases 1A, 2A, 3A, 4A	Cases 1B, 2B, 3B, 4B
100-60	800 - neg	210 - neg	42 - 170
60 -25	800 - neg	220 - neg	43 - 2000
25 - 15	10000 - neg	2600 - neg	510 - neg
15 - 3	neg	neg	4000 - neg

Notes:
1) neg = there is a net negative health effect

Table 4.2

Cost-Benefit for Soil Cleanup at Reference Sealed Source
Manufacturer/Broad facility
(in incremental $M/fatality averted)

Unrestricted Use

Case 1 - Diffusion into the soil, $50/ft3 burial cost, soil removal after soil washing; resident farmer use of the site
Case 1A - industrial use of the site
Case 1B - residential, high density dwelling use

Case 2 - Diffusion, $50/ft3, no soil washing; resident farmer use of the site
Case 2A - industrial use
Case 2B - residential, high density dwelling

Case 3 - Real world soil profile data, $50/ft3 burial cost, soil removal after washing; resident farmer use of the site
Case 3A - industrial use
Case 3B - residential, high density dwelling

Case 4 - Real world soil profile data, $50/ft3, no soil washing; resident farmer use of the site
Case 4A - industrial use
Case 4B - residential, high density dwelling

Dose Reduction (mrem/y)	Case 6[1]	Cases 6A, 5, 6B[1]	Case 2[1]	Cases 1, 2A, 2B[1]
100-60	34	7-20	5	1-3
60-25	246	36-94	7	2-4
25-15	670	64-210	24	5-18
15-3	neg	280-neg	87	17-71

Notes:
1) neg = there is a net negative health effect

Table 4.3

Cost-Benefit for Soil Cleanup at Reference Uranium Fuel Fabrication Facility
(in incremental $M/fatality averted)

Unrestricted Use

Case 1 - Diffusion into the soil, $50/ft3 burial cost, soil removal after soil washing; resident farmer use or industrial use of the site

Case 2 - Diffusion, $50/ft3, no soil washing; resident farmer or industrial use of the site

- Case 2A - $10/ft3 burial costs for soil; resident farmer or industrial use of the site
- Case 2B - $50/ft3, resident, high density dwelling

Case 5 - Real world soil profile data, $50/ft3 burial cost, soil removal after soil washing; resident farmer or industrial use of the site

Case 6 - Real world soil profile data, $50/ft3, no soil washing; resident farmer or industrial use

- Case 6A - $10/ft3, resident farmer or industrial use
- Case 6B - $50/ft3, residential, high density dwelling

Dose Reduction (mrem/y)	Cases 1, 2, 3, 4	Cases 1A, 2A, 3A, 4A	Cases 1B, 2B, 3B, 4B
100 - 60	380 - neg	100 - neg	21 - 63
60 - 25	500 - neg	140 - neg	23 - 1900
25 - 15	940 - neg	250 - neg	50 - neg
15 - 3	neg	neg	440 - neg

Notes:

1) neg = there is a net negative health effect

Table 4.4

Cost-Benefit for Soil Cleanup at Reference Rare Metal Extraction Facility
(in incremental $M/fatality averted)

Unrestricted Use

Case 1 - Diffusion into the soil, $50/ft3 burial cost, resident farmer use of the site
- Case 1A - $10/ft3; resident farmer use
- Case 1B1 - $50/ft3; industrial use
- Case 1B2 - $50/ft3; high density dwellings
- Case 2C - $50/ft3; resident farmer use, use of in-situ surveys

Case 2 - Real world profile data, $50/ft3 burial cost, resident farmer use of the site
- Case 2A - $10/ft3; resident farmer use
- Case 2B1 - $50/ft3; industrial use
- Case 2B2 - $50/ft3; high density dwellings
- Case 2C - $50/ft3; resident farmer use, use of in-situ surveys

Dose Reduction (mrem/y)	Case 2	Cases 2A, 2B1, 2C	Cases 1, 1A, 1B1	Cases 1B2, 1C, 2B2
100-60	13	4-13	1	1-2
60-25	30	11-27	3-4	1-3
25-15	110	58-69	29-48	1-11
15-3	580	210-440	160-270	16-49

Table 4.5

Cost-Benefit for Structures Cleanup at Reference Power Reactor
(in incremental $M/fatality averted)

Unrestricted Use

Case 1 - Floor and wall contamination, $350/ft3 burial cost, office use of the facility (210 persons using contaminated area of facility - 25000 ft2/120 ft2/person)

Case 2 - Floor and wall contamination, $350/ft3, denser (e.g., school) facility occupancy (500 persons using facility - 25000 ft2/50 ft2/person)

Case 3 - Floor and wall contamination, $350/ft3, industrial use of facility (25 persons using contaminated areas of facility)

Case 4 - Bioshield contamination, $350/ft3
Case 4A - 50 persons working in bioshield area
Case 4B - 20 persons working in bioshield area

Dose Reduction (mrem/y)	Cases 1,1A	Case 2	Cases 3,4
100-60	8 - 16	<2	<12
60-25	12 - 24	2	12
25-15	14 - 28	5	29
15-3	74 - 160	9	51

Table 4.6

Cost-Benefit for Manufacturer/Broad R&D Facility Sealed Source
(in incremental $M/fatality averted)

Unrestricted Use

Case 1 - Floor and wall contamination, $350/ft3 burial cost, office use of the facility (5 persons using contaminated area of facility - 600 ft/120 ft2/person)

Case 2 - Floor and wall contamination, $350/ft3, denser (e.g., school) facility occupancy (12 persons using facility - 600 ft2/50 ft2/person)

Case 3 - Floor and wall contamination, $350/ft3, industrial use of facility (1 person using contaminated areas of facility)

Dose Reduction (mrem/y)	Case 1	Cases 2,3
100-60	<1	<8
60-25	1	8
25-15	2	19
15-3	3	33

Table 4.7

Cost-Benefit for Structures Cleanup at Reference Uranium
Fuel Fabrication Facility
(in incremental $M/fatality averted)

Unrestricted Use

Case 1 - Floor and wall contamination, $350/ft3 burial cost, office use of the facility (1000 persons using contaminated area of facility - 120,000 ft/120 ft2/person)

Case 2 - Floor and wall contamination, $350/ft3, denser (e.g., school) facility occupancy (2400 persons using facility - 120000 ft2/50 ft2/person)

Case 3 - Floor and wall contamination, $350/ft3, industrial use of facility (80 persons using contaminated areas of facility)

Dose Reduction (mrem/y)	Case 1	Cases 2,3
100-60	<2	<5
60-25	2	5
25-15	5	12
15-3	9	20

Table 4.8

Cost-Benefit for Structures Cleanup at Reference Rare Metals Extraction Facility
(in incremental $M/fatality averted)

Unrestricted Use

Case 1 - Floor and wall contamination, $350/ft3 burial cost, office use of the facility (500 persons using contaminated area of facility - 60,000 ft/120 ft2/person)

Case 2 - Floor and wall contamination, $350/ft3, denser (e.g., school) facility occupancy (1200 persons using facility - 120000 ft2/50 ft2/person)

Case 3 - Floor and wall contamination, $350/ft3, industrial use of facility (40 persons using contaminated areas of facility)

Dose Reduction (mrem/y)	Case 1	Cases 2,3
100-60	<1	<13
60-25	1	13
25-15	3	33
15-3	5	60

Table 4.9

Calculated Costs for Site Access Restrictions

Reference Facility	Perimeter Fence ($000)		Paved Surface ($000)		Landscaping ($000)	
	Capital	Annual Maintenance	Capital	Annual Maintenance	Capital	Annual Maintenance
Nuclear Power Plant	2.7 - 4.3	0.15 - 0.24	3.3 - 5.5	0.18 - 0.30	0.90	0.05
Uranium Fuel Fabrication Plant	15.4 - 25.1	0.84 - 1.38	110 - 180	6.0 - 9.9	5.0	0.27
Sealed Source Manufacturer	3.4 - 5.6	0.19 - 0.31	5.5 - 9.2	0.30 - 0.50	1.1	0.06
Rare Metals Extraction Plant	15.4 - 25.1	0.84 - 1.4	110 - 180	6.0 - 9.9	5.0	0.27

Table 4.10

Soil Removal to Control Prospective U Contamination
Incremental Costs & Impacts, from 25 mrem/y
Based on usage by 25 persons

Dose Reductions (mrem/y)	(1) soil removal cost at $10/ft^3 ($M)	(2) soil removal cost at $50/ft^3 ($M)	(3) Incremental Mortality	(4) cost /benefit for $10/ft^3 ($M/DA)	(4) cost /benefit for $50/ft^3 ($M/DA)
25-15	7.8	27	0.12	12	38
15-3	13.4	44	0.15	45	130
3-background	19	66	0.15	112	440

Table 4.11

Sr-90 Remediation by Pump and Treat
Incremental Costs from 25 mrem/y
Based on usage by 25 persons

Dose Reduction (mrem/y)	Incremental Mortality	Incremental cost ($M)	Incremental cost /benefit ($M/DA)
25-15	0.0055	1.7	309
15-3	0.0116	5.4	466
3-background	0.0139	32	23000

Table 4.12

U Remediation by Pump and Treat
Incremental Costs from 25 mrem/y
Based on usage by 25 Persons

Dose Reduction (mrem/y)	Incremental Mortality	Incremental cost ($M)	Incremental cost /benefit ($M/DA)
25-15	0.13	17	131
15-3	0.26	124	477
3-background	0.31	306	987

Table 4.13

Remediation by Restricting Use & Providing Replacement Water for an Sr-90 Site
Incremental Costs from 25 mrem/y
Based on usage by 25 Persons

Dose Reduction (mrem/y)	Incremental Mortality	Incremental cost ($M)	Incremental cost /benefit ($M/DA)
25 -background	0.0139	3.3	250

Table 4.14

Remediation by Restricting Use & Providing Replacement Water for a U Site
Incremental Costs from 25 mrem/y
Based on usage by 25 persons

Dose Reduction (mrem/y)	Incremental Mortality	Incremental cost ($M)	Incremental cost /benefit ($M/DA)
25 mrem-background	0.31	11	36

ENCLOSURE 7

NRC ESTABLISHES MAXIMUM PERMISSIBLE RADIATION LEVELS

FOR LICENSE TERMINATION

The Nuclear Regulatory Commission is amending its regulations to establish maximum permissible radiation levels when a nuclear facility permanently shuts down and is released for other uses.

The new rules require licensees of permanently shutdown facilities to reduce radioactivity to low enough levels to permit the license to be terminated safely. Release of the property may be either:

- Unrestricted, in which case it could be used for any purpose, or
- Restricted, so that it could not be used for certain purposes, such as residential housing.

Previously the regulations permitted license termination only if radioactivity remaining on the site was low enough to permit unrestricted use of the property.

Unrestricted Release

Under the new regulations, a site may be released for unrestricted use if the radiation dose from contamination remaining on the property will be no more than 25 millirems per year. (This may be compared to a dose of about 5 millirems of background radiation from one round-trip cross-country airline flight, or about 10 millirems extra per year from living in a brick rather than a wood house.)

Restricted Release

The new regulations permit release of a site for restricted use if the radiation dose from contamination remaining on site will be no more than 25 millirems per year with legally enforceable institutional controls (such as deed restrictions). In addition, if a site is released for restricted use, the licensee must provide sufficient financial arrangements to allow an independent third party to assume and carry out responsibilities for any necessary control and maintenance of the site.

Further, a licensee that intends to decommission by restricting use of the site must seek advice, from individuals and institutions in the community who may be affected by the decommissioning, on whether the provisions for institutional controls proposed by the licensee (1) will provide reasonable assurance that the radiation dose from contamination remaining on site will not exceed 25 millirems per year, (2) will be enforceable, and (3) will not impose undue burdens on the local community or other affected parties.

There must be reasonable assurance that, even if the institutional controls were no longer in effect, the maximum yearly radiation dose from contamination remaining on site would not exceed either 100 or 500 millirems per year, and be as low as reasonably achievable.

Licensees who propose to use the 500-millirem criterion must (1) demonstrate that further reductions in remaining radioactivity are not technically achievable, would be prohibitively expensive, or would result in net public or environmental harm; (2) make provision for durable institutional controls, such as engineered barriers or government control or ownership; and (3) provide sufficient financial resources to enable an independent third party to carry out periodic rechecks of the site at least every 5 years to make sure that the institutional controls remain in

place, and to assume and carry out responsibilities for any necessary controls and maintenance of those controls.

Alternative Criteria for License Termination

The Commission expects the very large majority of licensees to reduce residual radioactivity to levels that meet the new criteria for unrestricted or restricted release. However, the Commission is concerned about the possible presence of sites that could present unique decommissioning problems.

Therefore, the rule contains provisions under which the Commission may terminate a license using alternate criteria, greater than 25 millirems per year, if the licensee provides assurance that public health and safety would continue to be protected, and that a total radiation dose from all sources of more than 100 millirems per year would be unlikely. The licensee must also place restrictions on site use to the extent practical and reduce the radiation dose to levels that are as low as reasonably achievable.

If the licensee cannot meet any of these criteria (unrestricted release, restricted release, or release with alternate criteria), it may be necessary to keep the site under license in order to ensure that exposures to the public are appropriately monitored.

Public Input

To provide opportunities for public comment, when the Commission receives a license termination or decommissioning plan from a licensee, or a proposal for restricted release of a site or release using alternate criteria, the agency will publish a notice in the Federal Register. In addition, it will provide local notification via a notice in local newspapers, letters to state or local

organizations, or other appropriate means. It will also notify appropriate local and state governments and Indian Nations and solicit their comments.

The new cleanup criteria for decommissioning will not apply to sites already covered by a license termination or decommissioning plan approved by the Commission before (_____ insert date 24 months after effective date of rule).

A proposed rule on this subject was published for public comment on August 22, 1994. Changes made as a result of the comments received and additional NRC analysis are described in a Federal Register notice published on _____.

#

ENCLOSURE 8

The Honorable James M. Inhofe, Chairman

Subcommittee on Clean Air, Wetlands, Private

Property and Nuclear Safety

Committee on Environment and Public Works

United States Senate

Washington, DC 20510

Dear Mr. Chairman:

The NRC has sent to the Office of the Federal Register for publication the enclosed revisions to the Commission's rules in 10 CFR Parts 20, 30, 40, 50, 51, 70, and 72 regarding decommissioning of licensed facilities to provide specific radiological criteria for the decommissioning of lands and structures. The final rule is intended to enhance the efficiency and consistency of license termination decisions for the numerous and varied types of NRC licenses.

Sincerely,

Dennis K. Rathbun, Director
Office of Congressional Affairs

Enclosures:
1. Public Announcement
2. Federal Register Notice

cc: Senator Bob Graham

The Honorable James M. Inhofe, Chairman
Subcommittee on Clean Air, Wetlands, Private
Property and Nuclear Safety
Committee on Environment and Public Works
United States Senate
Washington, DC 20510

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Office of Congressional Affairs

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The Honorable Dan Schaefer, Chairman
Subcommittee on Energy and Power
Committee on Commerce
United States House of Representatives
Washington, DC 20515

Dear Mr. Chairman:

The NRC has sent to the Office of the Federal Register for publication the enclosed revisions to the Commission's rules in 10 CFR Parts 20, 30, 40, 50, 51, 70, and 72 regarding decommissioning of licensed facilities to provide specific radiological criteria for the decommissioning of lands and structures. The final rule is intended to enhance the efficiency and consistency of license termination decisions for the numerous and varied types of NRC licenses.

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Dennis K. Rathbun, Director
Office of Congressional Affairs

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cc: Representative Ralph Hall

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ENCLOSURE 9

Mr. Robert P. Murphy
General Counsel
General Accounting Office
Room 7175
441 G. St., NW
Washington, DC 20548

Dear Mr. Murphy:

Pursuant to Subtitle E of the Small Business Regulatory Enforcement Fairness Act of 1996, 5 U.S.C. 801, the Nuclear Regulatory Commission (NRC) is submitting a final rule regarding decommissioning of licensed facilities to provide specific radiological criteria for the decommissioning of lands and structures. The final rule is intended to enhance the efficiency and consistency of license termination decisions for the numerous and varied types of NRC licenses.

We have determined that this rule is not a "major rule" as defined in 5 U.S.C. 804(2). We have confirmed this determination with the Office of Management and Budget.

Enclosed is a copy of the final rule that is being transmitted to the Office of the Federal Register for publication. The Regulatory Flexibility Certification and Regulatory Analysis are included in the final rule. This final rule is scheduled to become effective 30 days after publication in the Federal Register.

Sincerely,

Dennis K. Rathbun, Director
Office of Congressional Affairs

Enclosure: Final Rule

Mr. Robert P. Murphy
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General Accounting Office
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The Honorable Al Gore
President of the United
States Senate
Washington, DC 20510

Dear Mr. President:

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The Honorable Newt Gingrich
Speaker of the United States
House of Representatives
Washington, DC 20515

Dear Mr. Speaker:

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