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Summary of Comments Received from Workshops on Radiological Criteria for Decommissioning

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ABSTRACT

The Nuclear Regulatory Commission (NRC) is conducting an enhanced participatory rulemaking to establish radiological criteria for site cleanup and decommissioning of NRC-licensed facilities. Open public meetings were held during 1993 in Chicago, IL, San Francisco, CA, Boston, MA, Dallas, TX, Philadelphia, PA, Atlanta, GA, and Washington, D.C. Interested parties were invited to provide input on the rulemaking issues before the NRC staff develops a draft proposed rule. This report summarizes 3,635 comments categorized from transcripts of the seven workshops and 1,677 comments from 100 NRC docketed letters from individuals and organizations. No analysis or response to the comments is included. The comments reflect a broad spectrum of viewpoints on the issues related to radiological criteria for site cleanup and decommissioning. The NRC also held public meetings on the scope of the Generic Environmental Impact Statement (GEIS) during July 1993. The GEIS meetings were held in Washington, D.C., San Francisco, CA, Oklahoma City, OK, and Cleveland, OH. Related comments from these meetings were reviewed and comments which differed substantially from those from the workshops are also summarized in the body of the report. A summary of the comments from the GEIS scoping meetings is included as an Appendix.

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FOREWORD

The Nuclear Regulatory Commission (NRC) is conducting an enhanced participatory rulemaking to establish radiological criteria for site cleanup and decommissioning of NRC-licensed facilities. As part of this rulemaking, workshops were held as open public meetings during 1993 in Chicago, IL; San Francisco, CA; Boston, MA; Dallas, TX; Philadelphia, PA; Atlanta, GA; and Washington, D.C. The purpose of the workshops was to solicit commentary on the fundamental approaches and issues that must be addressed in establishing radiological criteria for decommissioning. Written comments on approaches and issues also were solicited. Interested parties were invited to provide early and comprehensive input on the rulemaking issues before the NRC staff develops a draft proposed rule.

The purpose of this report is to summarize comments categorized from transcripts of the seven workshops and from NRC docketed letters from individuals and organizations. This report also includes a review of comments received regarding radiological criteria for site cleanup and decommissioning as a result of the public meetings held on the scope of the Generic Environmental Impact Statement (GEIS) during July 1993. These meetings were held in Washington, D.C., San Francisco, CA, Oklahoma City, OK, and Cleveland, OH.

This report contains information that is being considered by the NRC in developing the radiological criteria. 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.

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1 INTRODUCTION

1.1 Background

On June 27, 1988, the Commission published in the Federal Register (53 FR 24018) a final rule on general requirements for decommissioning nuclear facilities. The amended regulations addressed decommissioning planning needs, timing, assurance of the availability of funds for decommissioning, and environmental review requirements. That rule did not cover acceptable levels of residual radioactivity for decommissioned facilities. The rule indicated that specific requirements on how clean a nuclear facility must be to qualify for decommissioning would be dealt with later in a separate action.

On December 11, 1992, the Commission published in the Federal Register (57 FR 58727) a notice that it was preparing to initiate rulemaking on establishing radiological criteria for the decommissioning of NRC-licensed facilities. The notice listed a schedule for seven workshops throughout the United States beginning in January 1993, in Chicago, San Francisco, Boston, Dallas, Philadelphia, Atlanta, and Washington, D.C.¹

The purpose of the workshops was to solicit commentary from affected interests on the fundamental approaches and issues that must be addressed in establishing radiological criteria for decommissioning. Written comments on approaches and issues also were solicited. Material presented and used for discussion at the workshops included "Issues for Discussion at Workshops", undated, and "Decommissioning Case Studies" dated January 1993, and are found as Appendix A and B. Transcripts of the Workshops and copies of related letters are available for inspection or copying for a fee in the NRC Public Document Room, 2120 L Street, NW, (Lower Level), Washington, DC.

As part of the effort to codify radiological criteria for decommissioning to determine the extent to which radioactive contamination must be removed or reduced in lands and structures before a nuclear facility can be released and its license terminated, the NRC held public meetings on the scope of the GEIS during July 1993 in Washington, D.C., San Francisco, CA, Oklahoma City, OK, and Cleveland, OH. Interested parties were invited to provide early and comprehensive input before the NRC staff develops the GEIS. A notice in the Federal Register, June 18, 1993, also invited comments.

1.2 Overview of Comments

This report summarizes those comments made during the proceedings and comments received by letter. There were 3,635 comments categorized from records of the seven workshops and an additional 1,677 comments from 100 NRC docketed letters from individuals and organizations. A listing of commenters is found in Appendix C.

The comments were organized to the issues and sub-issues identified in Section 2. The summaries are found in Section 2 with a unique comment number, listed in parenthesis, assigned to each comment within an issue, and therefore the source of each comment can be identified as to origin, commenter, beginning page number, and beginning paragraph or line number. This information is found in Appendix D. Comments received during the workshops are numbered under 7,000 while docketed letter comments are numbered greater than 7,000.

The authors reviewed 1,596 comments related to radiological criteria for site cleanup and decommissioning which

¹ The workshops were held as follows: Jan. 27&28-Chicago, IL; Feb. 23&24-San Francisco, CA; Mar. 12-Boston, MA; Mar. 23&24-Dallas, TX; Apr. 13&14-Philadelphia, PA; Apr. 29&30-Atlanta, GA; May 6&7-Washington, D.C.

were received as a result of the GEIS scoping meetings held during July 1993. Comments that were different from those received as a result of the workshops were summarized in the body of the report. These comments were designated with a G prefix. Information concerning the origin of these comments can be found in Appendix E. Appendix E also contains a complete summary of the comments from the GEIS scoping meetings.

The comments reflect a broad spectrum of viewpoints on many of the issues related to radiological criteria for site cleanup and decommissioning.

2 SUMMARIES OF COMMENTS PER ISSUE

2.1 Need for and General Content of Rulemaking

2.1.1 Need and Scope

Almost all commenters supported the NRC's plans to develop radiological decommissioning standards and recommended that the rulemaking proceeding go forward expeditiously (1, 2, 3, 4, 38, 351, 412, 528, 561, 644, 672, 732, 736, 887, 893, 980, 1416, 1748, 2077, 2086, 2371, 2376, 2506, 2531, 2892, 3357, 3662, 3664, 3848, 4443, 4521, 4529, 4537, 7119, 7358, 7365, 7486, 7765, 7933, 8122, 8269, 8454, 8493, 8525, 8629, 8785, 8832, 8833). Other commenters stated that the rulemaking should not be hurried (1299, 2451, 4148, 4180, 4517, 4533), and one opposed the rulemaking (8834). Reasons given for supporting the rulemaking included:

Responsibility and accountability will be defined (980); criteria must be practical (1377).

A case-by-case approach is inconsistent, inefficient and impractical (1, 2, 561, 7358, 7486, 7765, 8525, 8785).

A single national standard helps to avoid interstate commerce complications entailed in having a number of different standards (4278).

This will give us the ability to get on with decommissioning (38, 2077, 7358, 7765, 8785).

Licensees are concerned that decommissioning requirements individually negotiated with the NRC might be changed (8629).

Both the operators and the public will know what is expected at the onset of licensing (1994, 3662, 3702, 7119, 7358, 7486).

Costs of decommissioning can be better estimated, planned for, and reduced (732, 893, 1748, 1994, 2077, 4443, 7765, 8833). Also, funds available for decommissioning can be applied to actual cleanup instead of for preparation of descriptive reports (7119).

Three commenters requested that the NRC make the standards as simple as possible and give reasoning for what is proposed (1753, 2457, 7870). If something is believed not to be dangerous, the NRC should convince us of this (1753). Another commenter stated that radiological risks should be put in perspective with other risks the public faces (3664).

Some commenters recommended that the NRC should consider and possibly establish both radiological and chemical decommissioning standards (759, 771, 7764, 8835). Other commenters recommended that the NRC should not regulate non-radiological risks that are regulated by other agencies (766, 1159, 7470, 7517). Three commenters recommended that NRC sites undergoing decommissioning should be cleaned up for non-radiological contaminants simultaneously under other applicable agencies' regulations (1159, 1708, 7470).

Two commenters recommended that the NRC consider in the rule-making all pertinent issues raised in the uranium mill tailings regulations (6, 1730). Another commenter requested that the rulemaking clarify the extent to which the new radiological criteria apply to uranium mill tailings sites (8463).

One commenter while favoring the NRC's efforts to develop decommissioning standards cautioned that this will be an effective undertaking only if the EPA concurrence is obtained (8454).

One commenter advised that the procedural requirements and basic structure of the standard be codified. This includes the process for determination of ALARA and how to address sites that may not meet a risk limit (8895).

One commenter stated the risk goal concept should be part of the regulation. How to comply with the regulations should be given in regulatory guides and be subject to peer and public review (8899).

One commenter proposed that the criteria address the need for complete emergency response to potential incidents and the necessary training of medical and emergency response personnel (G825).

2.1.2 Responsibilities and Requested Community Involvement

Several commenters recommended that the rulemaking should clearly specify that licensees are responsible for taking remedial actions to clean up the sites which they contaminate (1678, 1717, 2564, 2997, 3635, 3903, 3936, 4266, 7519, 7587, 7655). One commenter stated that if the NRC imposes lingering liabilities for firms this could be an incentive for them to go out of business (4218). Two commenters recommended that the rulemaking should specifically address who is responsible for cleaning up a site if a licensee ceases to exist (1717, 2972). Two commenters suggested that perhaps the law should be changed to have the Department of Energy take title to a site and the NRC license the site in perpetuity (1606, 1610).

Several commenters questioned whether the NRC could be trusted to oversee decommissioning and some recommended the establishment of an independent agency to do this (1276, 1770, 1792, 1793, 4040, 7596, 7607, 7756, 7761, 8218). Other commenters questioned the legitimacy of the NRC (1180, 2976).

Many commenters recommended that the rulemaking should provide for and ensure local citizen group participation in overseeing the decommissioning of contaminated sites and the enforcement of requirements (247, 569, 571, 905, 1259, 1262, 1297, 1363, 1438, 1449, 1562, 1643, 1696, 1713, 1736, 1782, 1785, 1800, 2045, 2055, 2485, 2638, 2727, 2732, 2742, 2825, 2871, 3316, 3321, 3324, 3327, 3415, 3551, 3584, 3668, 3725, 3900, 4042, 4043, 4045, 4113, 4159, 4183, 4185, 4199, 4215, 4220, 4234, 4245, 4264, 4401, 4411, 4415, 4420, 4429, 4430, 4435, 4436, 4437, 4449, 4652, 4655, 7081, 7327, 7334, 7348, 7460, 7472, 7532, 7556, 7594, 7673, 7905, 7960, 7972, 7977, 8153, 8182, 8200, 8283, 8288, 8509, 8518, 8704, 8806, 8807, 8808, 8810, 8836). One commenter wanted all intervenors to prove that they are directly impacted by the decommissioning and formed from the physical area of the affected communities (G911). One commenter noted that citizen group participation is not needed for all licensed operations (2560). Several recommended that funding should be provided for this purpose by the organizations which are responsible for site cleanup or by the federal government (569, 571, 1438, 1562, 1696, 1713, 2558, 2727, 2742, 3551, 3795, 3900, 4042, 4045, 4303, 4323, 4395, 4401, 4428, 4434, 4460, 7327, 7334, 7556, 7972, 7983, 8509). One commenter requested that the decommissioning process allow for full public hearings to receive appropriate citizen input at each site (7960). Another commenter cautioned that a tremendous burden would be placed on licensees, regulators, and the public if every site had to go through a decommissioning hearing process (2916). Another commenter stated that there should not be a long drawn out decommissioning process with hearing after hearing (3321). One commenter cautioned that special interests groups could prevent cleanup (8786). Other commenters suggested that the citizen participation should be modeled similar to the Federal Clean Up Boards and be provided with technical assistance grants (1782, 3300, 3525, 4655).

One commenter recommended that the role of tribal authorities should be addressed in the rulemaking (1722).

2.1.3 Other Considerations

Many comments were offered concerning possible provisions that might be placed in the decommissioning rulemaking. These included:

The rules should be written to assure implementation of enforceable standards without loopholes (1702, 2847, 7007, 7635, 7637, 7639, 7784, 8252, 8769, 8837), and should not be interpretable in a way other than originally intended (1622, 3435, 4009, 7784).

The starting point for setting decommissioning standards is to specify acceptable dose levels (8467). Limits must be related to total effective dose equivalent (8195).

The standards for workers and the public should not be different (834) .

The standards should be consistent with past NRC cleanup criteria (8, 443, 446) and include quantitative limits for loose and fixed contamination, activation products, and concentrations of radioactivity in soil, ground water, and surface water (942, 965, 1353, 2755, 7159, 7621, 7885, 7990, 8104, 8385, 8429, 8435, 8572, 8778, 8838).

Various options should be considered along with their costs before deciding on the requirements of the imposed rule (1205, 2753, 2755, 7560, 4842).

Hopes that the rules will require thorough cleanup to unrestricted use even if it takes a long time before the license can be terminated (4284).

Cost should not be a limiting factor in deciding what standards should be applied (7672, 7820, 8242, 8793).

Reconsider changing the definition of decommissioning to permit restricted use of sites (1682, 2335, 2703, 3186, 3266, 3299, 3309, 3513, 3563, 3568, 4651, 7412, 7416, 7797, 7827, 7864, 7926, 7928, 8046, 8460, 8602, 8839), entombment (2335, 2786, 7416, 7827), and delayed decommissioning (640, 7412, 7827, 7880). Also, assure that the definition is not biased towards the concerns of industry (8766).

Distinguish between types of facilities and establish different requirements for these; also consider short-lived radioisotopes differently from long-lived ones (101, 445, 888, 972, 1054, 1706, 1762, 2034, 2069, 2370, 2403, 2523, 2779, 3186, 3266, 3504, 3645, 4001, 4293, 4654, 4829, 7572, 7921, 8019, 8255, 8444, 8543, 8777, 8840, 8841).

Radon requires special consideration because of its high natural background (8899).

Define "return-to-background" in terms of radionuclides that were not present prior to the operation of the facility (7806).

Place a 50-year limit on moth-balling reactors (8771).

Require an Environmental Impact Statement for decommissioning each reactor (7593, 8771, 8842).

Avoid the unnecessary generation of radioactive wastes and assure that sufficient funds are set aside for their control and disposal (2490, 3442, 3563, 7607, 7868, 8843).

There may be a legal constraint on the degree to which the NRC may consider costs to licensees in setting standards, except to the extent that the NRC is going beyond adequate protection (73).

Licensees should submit a decommissioning plan for review and approval (973, 2504, 2637, 4785, 7432, 7593, 7930, 7969, 8005, 8587).

Licensees should reassess and the NRC should review whether enough money has been or is being set aside for decommissioning to meet the new radiological cleanup standards (175, 2929, 7078, 7612, 7727, 7868, 8776, 8765) and in the event a plant might close prematurely (319, 903, 7727).

The rules should include a requirement for certification of compliance with applicable limits (1929, 4485, 7635).

The NRC should permit the approval of exceptions or exemptions to the standards where the cost of cleanup is disproportionately high for the achieved reduction of risk (969, 7864, 7925).

The NRC should not allow broad exceptions or exemptions and incomplete cleanup of sites (7007, 7587).

Care should be taken not to prescribe technology requirements too specifically for this could hinder development of better technologies (1761, 3248).

Provide a well-defined way of knowing when the decommissioning objective has been reached (2551, 2603, 2622, 4294, 4404, 7885); avoid requirements that are extremely difficult or impossible to enforce (7635, 7637, 7990, 8429).

The ALARA principle should be defined and applied in the decommissioning rule, and a level should be specified below which further site cleanup is not required (1958, 2071, 2497, 2652, 4409, 4650, 7432, 8087). Also, the rulemaking should require the submission of a decontamination and decommissioning ALARA plan (8587).

All information pertaining to decommissioning should be open to disclosure and made available to the public (3684, 3719, 3720, 3748, 3758, 3771, 3832, 4651, 7336, 8764).

Require licensees to pay into a fund for distribution to people who are subjected to risks from contaminated sites (3906).

Being clear at the front-end about decommissioning expectations is important to getting things properly done (2756, 2931) and decommissioning proposals should be submitted at the design stage (3403, 3909).

Use conventional units for radiological criteria (such as rem, roentgen, and curie) followed by International Systems of Units in parenthesis (7639), define all units used, and explain all acronyms (7867, 7954). Two commenters recommended that dose limits should be expressed in both rad and rem units (7114, 7954).

Specify in the rulemaking that licensees who decommission the operations under an NRC-approved

decommissioning plan will not be subject to future standards unless these address a significant threat to the public health and safety (4162, 7115, 7925, 7928, 8111, 8145).

Provide 18 to 24 months after publication of the rulemaking before it becomes effective (7930).

Specify the use of no particular model in assessing whether the prescribed decommissioning limits have been met; perhaps require that the model must be validated and verified (1353, 4376, 8106, 8572, 7990, 8087, 8763).

Consider including in the cleanup criteria the presumption that any health effects that could have been attributable to radiological effects came from the site unless proved otherwise (4438, 7801).

Clarify the relation of NRC decommissioning requirements to the EPA's Superfund program (8844).

Assure NRC's decommissioning requirements are not compromised by free trade agreements such as a North American Free Trade Agreement (7739).

The NRC should specify performance requirements rather than prescriptive requirements (7835, 7864, 8106, 8133, 8230, 8572, 8659, 8845).

The NRC should specify both performance and prescriptive requirements (8484).

Consider exposure of people off-site as well as onsite (7839, 7890).

The NRC should specify a range of degrees in prescriptive requirements rather than performance requirements (8252, 8483, 8746); specify concentration and activity levels limits rather than risk limits or goals (4843).

Address the cleanup of sites with special significance to groups, including homelands and historical sites (7314).

Some commenters requested that the NRC provide specific guidance on the decommissioning standards so that licensees and the public will know what applies and what contamination levels must be met; details should be placed in Regulatory Guides (1690, 1702, 2652, 2779, 2811, 3235, 3519, 7423, 7426, 7827, 7885, 8104, 8106, 8133, 8385, 8429, 8484, 8572, 8659, 8845) including reference to acceptable standards prepared by standards writing organizations (7423, 7426).

2.2 Compatibility

2.2.1 NRC/EPA Criteria

Some commenters recommended that NRC and EPA radiological decommissioning standards should be identical (232, 245, 912, 2105, 2858, 3224, 3234, 3244, 3245, 3497, 7284, 7633, 8783). In particular, it was recommended that the NRC's standards conform to the EPA's RCRA and Superfund drinking-water standard (2678, 8517, 8723). Three commenters recommended that drinking water standards should remain under EPA's authority (234, 235, 4461). Many commenters recommended that NRC and EPA standards should be at least compatible (231, 239, 338, 427, 527, 744, 1328, 1364, 1374, 1930, 1948, 2277, 2882, 3234, 3241, 3247, 3252, 3254, 3325, 3518, 3526, 3898, 4186, 4647, 4828, 7152, 8015, 8093, 8114, 8116, 8168, 8205, 8455, 8517, 8528,

8601, 8653, 8702, 8740, 8784, 8846, 8847, 8893). Not only should the standards be consistent, but also the methods of pathway analyses should be consistent (4510, 8330) and guidance should be extended to the regional levels (7264). If requirements are not compatible, there is the possibility that a site decommissioned under NRC standards might later require additional cleanup under EPA's Superfund standards (231, 1340, 4168, 8205). Some commenters cautioned against the NRC's patterning its standards after the EPA's Superfund regulations (244, 1744, 3277, 3295, 3303, 4270, 7255, 8239). Others stated that Superfund has some good provisions and needs to be made to work (2458, 3306, 4845). Two commenters stated that the NRC's rulemaking should include Superfund-like provisions for interim cleanup actions (4297, 8306). Some commenters suggested that it might not be in the public interest for the NRC and the EPA to harmonize risk goals unless the most stringent standards are adopted (1012, 1712). One commenter stated that nuclear regulation laws should be revised in light of concepts that have come out of environmental laws over the past ten to twenty years (3821). Another commenter stated that NRC's compatibility policy should be delineated in the rulemaking (7016).

Several commenters stated that it is important that whatever standards the NRC adopts should not have to be improved upon by other federal agencies or by state or local governments (242, 3241, 3245, 3325). One commenter encouraged the EPA to develop separate standards from the NRC (8114, 8322, 8455, 8779). Another commenter suggested that EPA use ICRP methods to compute dose to risk factors (8788). Even when a state takes the same standard and puts it in a different form, the change could have a significant impact on those subject to the standard (3325). NRC standards should be specific with respect to what kinds of concentrations result in what level of risk (2373) and should be verifiable and measurable (4830, 8848). Some commenters stated that decommissioning standards need to be considered not only for radioactive materials under the NRC's jurisdiction, but also for other sources of radiation (241, 940, 2665, 2667, 2670, 2698, 2852, 2858, 3036, 3044, 3063, 3224, 3553, 4290, 4828, 4830, 7488, 7867).

Other commenters stated that there is a need for consistency in the regulation of radioactive materials and hazardous chemicals (744, 951, 1269, 2422, 3227, 3252, 3835, 7488, 8432, 8723). Still other commenters questioned whether radioactive materials and hazardous chemicals are comparable and whether that adoption of a single standard for these materials is appropriate (2572, 3845, 3861, 3868, 3947, 7255, 8742). One commenter stated that it is not possible to comply with existing waste disposal standards when mixed radioactive and chemical wastes are involved (3966). Other commenters stated that if the NRC and the EPA use different approaches for regulating risk, they will not have comparable regulations that are practical to apply (3237, 3252, 8114). Still other commenters objected to dual regulation by the NRC and the EPA (7846, 8015, 8653).

Differences in the radiological standards being presently applied by the NRC (in accordance with recommendations of national and international standards groups) site-by-site and those applied by the EPA under the Clean Air Act and Superfund were discussed. The EPA uses a risk goal of ten to the minus four to ten to the minus six (240, 1458, 1646, 2127, 3621, 3768, 3823, 3913). A risk of ten to the minus four corresponds to a dose of three millirems per year (238, 239, 240). One commenter states that a dose constraint of 30 mrem/year is consistent with ten to the minus four lifetime risk if conservative but realistic assumptions are used (8881). The NRC has been using a dose limit of 100 millirems per year (238, 239, 240, 3621, 3768). Two commenters stated that EPA risk numbers should provide the underpinning of NRC decommissioning standards (7030, 7456).

Some commenters stated that the different risk (dose) levels of the two agencies should be resolved (239, 1025, 7284, 8653). Others argued that the difference between the two levels is relatively small (238, 8325, 8559, 8569, 8653) because the EPA applies its three millirems restriction as a risk goal and permits higher levels (exemptions) whereas the NRC applies its 100 millirems restriction as a risk limit and then requires further reduction under the ALARA (as low as reasonably achievable) principle (238). The EPA is not always achieving the three millirems risk goal (240, 8325), but the NRC is always meeting the 100 millirems risk limit. Accordingly, one commenter

stated that the two risk levels as used by the NRC and the EPA are consistent (8054, 8569). One commenter cautioned that NRC should not apply its decommissioning standards more restrictively than the EPA (8325, 8330).

One commenter observed that under the NRC's present dose limit of 100 millirems an individual's cancer risk is increased from 20 percent to 20.3 percent and under the EPA's risk goal of three millirems is increased from 20 percent to 20.03; and such differences are not observable (237).

2.2.2 Roles of Federal Agencies and State, Local, and Tribal Governments

Several commenters recommended that there should be closer coordination among the various federal, state, and local government agencies in the development of standards (249, 722, 790, 925, 1373, 1650, 1709, 1952, 1955, 2470, 2571, 2861, 3228, 3256, 3259, 3689, 4055, 4182, 4189, 4197, 4214, 4219, 4225, 4288, 4681, 7075, 7421, 7473, 7595, 7750, 7759, 7762, 7798, 8113, 8439, 8682, 8703, 8780, 8803, 8804). One commenter stated that duplication of effort is frustrating to the public, expensive, and of dubious value (7595). Another commenter stated that without agreement and approval by all jurisdictions, those regulated are stymied (8113). Still another commenter stated that because of world-wide United States responsibilities the NRC and the EPA should assure that federal and state regulations are not in serious conflict with recommendations of international organizations (3256). Other commenters stated that the EPA and the NRC should develop decommissioning standards together (2383, 7759, 8459, 8682, 8703, 8780, 8781, 8782, 8803, 8804).

One commenter stated that there are some really diverse standards and criteria out there and these add to confusion of the public (374). Another commenter recommended that licensees should be regulated by a single regulatory authority instead of being subject to multiple regulatory jurisdiction, e.g., by the NRC, the EPA, and the states (3557).

One commenter stated that the EPA needs to conduct some type of annual audit of the NRC to see if it is carrying out its responsibilities properly (1650). Other commenters stated that the EPA and the NRC should maintain their independence because this helps to preserve the public health and welfare (3222, 7356, 7939, 8239). Still another stated that the EPA does not need to regulate NRC-licensed facilities when it determines that the NRC's program provides an ample margin of safety (1663).

Some commenters recommended that Agreement States should be equal partners with federal agencies (939, 1879, 3228). In particular, the NRC should involve Agreement States at the front end of rulemaking (3228, 4055, 7625, 7629, 8280). Several commenters stated that it must be decided whether Agreement States must adopt all of the federal standards verbatim or whether they might adopt more stringent standards (2009, 3278, 3628, 4165, 4841, 7477). Some commenters stated that Agreement States should conform to NRC standards (7582, 8280). Others stated that Agreement States should have flexibility in implementing the standard (3499, 4846), but one commenter indicated that states already have flexibility to adopt standards either more stringent or more lax than those of the NRC (4177).

One commenter stated that the whole scheme of interlocking regulatory procedures could stand to be looked at as a whole and possibly very seriously revised to make more common sense (778). Another commenter stated that the NRC and the EPA should assure that final actions are taken with respect to site cleanup so that state and local governments do not have to deal with it further (331, 1446). Still another commenter indicated that states should have complete say over questions of finality or continued imposition of standards (2484).

Many commenters requested that the roles of all federal, state, tribal, and local governments should be addressed (246, 706, 907, 1178, 1335, 1378, 1973, 1984, 1986, 1988, 1997, 2004, 2010, 2016, 2042, 2046, 2048, 2056, 2152, 2333, 2476, 2479, 2486, 2509, 2515, 2517, 2673, 2896, 2933, 3546, 3661, 3689, 4163, 4197, 4219, 4223,

4250, 4262, 4272, 7759, 8203, 8287, 8511). Some commenters stated that special attention should be given to state, tribal and local government concerns (117, 137, 531, 706, 1973, 1984, 1986, 1988, 2004, 2010, 2016, 2046, 2048, 2056, 2333, 2484, 2486, 2509, 2515, 2517, 3546, 3789, 3873, 3882, 3956, 4163, 4197, 4210, 4225, 4250, 4262, 4272, 4300, 7458, 7468, 7473, 7475, 7762, 8184, 8199, 8203, 8511, 8744, 8748, 8751, 8754). One commenter stated that state and local governments should be able to enforce NRC standards when the NRC fails to do so (3579, 7337). Some commenters stated that tribes should be treated the same as states (907, 1650, 1651).

Other commenters recommended that states, tribes and local governments should be allowed to impose more stringent cleanup criteria than those specified in federal rules (312, 581, 1969, 3267, 4230, 7337, 7922, 7959, 8229, 8511, 8849), because they have concurrent, continuing, and overlapping responsibilities with the NRC (1045). In particular, states should have some latitude to develop different standards owing to different situations in different states (1878). Other commenters stated that state and local governments should not be able to set more stringent standards (7883, 8148, 8158). Some commenters recommended that the NRC should not preempt state regulation of sites after these are released by the NRC and are no longer subject to NRC regulation (3607, 4173, 4304, 7463). Also, NRC should not preempt State determinations for regulating solid waste which contains radioactive materials (7716, 7458, 7461, 7468, 7475, 8173, 8177, 8184, 8229). Some commenters stated that generic criteria should be developed sufficiently stringent so that state and local governments will not need to impose more stringent criteria (347, 2048, 4172). Other commenters stated that there must be compatibility between federal agencies' and states' standards to assure against inconsistency between states in interstate transactions (3259, 4246, 4269, 4487). Another commenter stated that if states and localities want to impose more stringent standards, they should pay their share of the costs for meeting the additional requirements (4478).

Three commenters expressed concern about the roles of the EPA and the DOE in decommissioning (2854, 2905, 8787). One commenter stated that the DOE should be regulated by a federal agency (3416). Others requested that the impact of NRC decommissioning standards on the DOE be considered (2933, 2934, 8803). One commenter noted that DOE uses a dose constraint of 30 mrem/year (8879). Still another requested that the NRC rulemaking not cause confusion with the DOE's West Valley Demonstration Project (2582).

One commenter raised questions about the respective roles of federal and state agencies in light of the State Compact Agreements expressed concern about the costs to the states to ensure protection of the public (7076).

2.3 Process to Be Used in Developing Rule

2.3.1 Importance of Public Participation

Several commenters noted that interactive public participation is important to the process of NRC rulemaking (303, 307, 311, 346, 552, 627, 674, 761, 762, 901, 1219, 1244, 1368, 1383, 1389, 1437, 1737, 1904, 2374, 2898, 3081, 3087, 3524, 3570, 3588, 4075, 4847, 7003, 7476, 7741, 7790, 7793, 7893, 7895, 8181, 8202, 8422), and that this would be facilitated through better education of the public (5, 7, 343, 674, 693, 712, 713, 715, 762, 822, 837, 847, 849, 886, 1247, 1249, 1323, 1579, 1769, 1873, 1882, 1887, 1891, 1907, 3570, 3612, 4075, 4831, 7087, 7091, 7095, 7744, 8545, 8548). Participation in rulemaking should include knowledgeable public health officials, physicians, and health scientists (4287, 4848). One commenter recommended the formation of citizen groups paralleling those of the EPA in the Federal Restoration Program (G270). Some commenters recommended that the public comment period for the notice of enhanced rulemaking be extended (4451, 4849). Some commenters requested that the NRC hold an additional public meeting around the country after the decommissioning rules are published for public comment (711, 7893). One commenter believed that no citizen group has been omitted (664).

2.3.2 Feedback on Workshops

Most commenters expressing views on this subject approved of the NRC holding the workshop meetings to receive advice and recommendation on site cleanup issues (653, 695, 705, 710, 798, 800, 801, 803, 809, 1042, 1254, 1255, 1313, 1820, 1885, 2759, 2762, 2763, 3438, 3439, 3441, 3443, 3445, 3467, 3471, 3479, 3480, 4074, 4452, 4453, 4455, 4458, 4459, 4462, 4463, 4464, 4465, 4466, 4467, 4832, 4850, 7093, 7161, 7330, 7559, 7729, 7730, 7790, 7892, 7894, 7975, 8186, 8261, 8423, 8523, 8524, 8628, 8789, 8856). Some recommended that more meetings of this type should be held on a regular basis (568, 695, 801, 809, 1042, 1749, 1820, 1885, 4457, 4461, 4466) and recommended that the NRC should provide financial assistance to support such public participation (695, 1876, 4073, 7748, 7794). Some commenters voiced skepticism that public participation of this kind would make a difference in what the NRC decides to do (567, 636, 647, 665, 666, 667, 710, 741, 800, 1011, 1282, 1385, 3102, 4072, 4076, 7109, 7330, 7794, 7973, 8794). Some stated that holding and attending the meetings was not money well spent (7363, 7375).

Several commenters stated that a better representation of citizen and public interest groups at the workshops was needed (313, 660, 665, 676, 677, 861, 962, 1274, 1282, 1315, 1863, 1864, 1865, 1867, 2195, 2413, 4773, 4803, 7745, 8523). One commenter openly disagreed (636).

Other commenters stated that the U.S. Geological Survey and professional ecologists should have been invited (1507, 1529). Some other commenters stated that the NRC did not give adequate notice on the workshops (607, 647, 653, 660, 665, 676, 710, 717, 1866, 1867, 1869, 1870, 1905, 1911, 4815, 7976). Other commenters stated that participants in the workshops should have been given opportunity to recommend agenda items (1251, 1546, 1551, 1553, 1917, 1918, 1920, 1921, 2764, 2765). Additional comments on the workshops and possible future meetings included:

Future announcements of meetings should be sent to people who have attended previous meetings rather than rely on Federal Register notices (297, 714, 7794); send out press releases announcing future meetings (7976).

Fortunately, this was not billed as a consensus conference, because it is unlikely any of us would leave with a consensus (439). One commenter wanted to develop consensus (1472).

Consider holding a public forum the evening before or after the workshops (716).

GEIS scoping meetings should be held in the same areas as the workshops and additional sites should be considered (708, 717, 718).

After the NRC develops the decommissioning standards, hearings should be held at these same locations (711).

The NRC should give greater weight to comments by citizen representatives than to industry comments (7974).

It is important to pick good meeting locations (881).

There was not enough media coverage of the workshops (1311, 1817, 1819).

Informal discussions outside the formal workshop sessions were very beneficial (1872).

You will not get the right people to attend meetings unless you specifically invite them (1875).

Allow additional time for the meetings (7748).

Evening and weekend meetings should be considered (1877).

Smaller group meetings within the workshop would have been better (1918, 2761).

Provision of more technical information to participants would have been helpful (1253, 1254, 1341, 1919, 4815, 7679, 8790, 8792).

Breaking the workshop into small groups is not a good idea (1922, 2762).

At least one afternoon should be reserved for discussion of agenda items identified by participants (1920, 1921).

The facilitators should make people stick to the subject of decommissioning at the workshops and to specified topics (3476, 7271, 7363). One commenter desired direct repartee (2766).

Audience participation would be more effective if comments were not excessively delayed (7106).

No individual or element should be allowed to dominate discussions (7106).

2.3.3 Guidance on Standards Development

Several commenters recommended that NRC decommissioning standards should be based on and be consistent with the scientific information and advice of such organizations as the National Council on Radiation Protection and the International Commission on Radiological Protection (444, 650, 934, 971). See discussion also under Section 2.5.1 of this document. The standards should be driven by the need to protect people and not by such things as aesthetics, land use, and environmental protection (8425). Other commenters recommended that consideration should be given to suppressed scientific information (302, 367, 422, 538, 1087, 1324, 1916, 4851). See discussion also under Section 2.4.4 of this document. One commenter noted that the debate on health effects, called for by workshop participants, is already being waged in the peer-review scientific arena and recommended that the health-risk debate be based on the best available knowledge (1102). Other commenters stated that the NRC's decommissioning standard should be based on what we want for the future and not be based on past problems (2629, 2855). One commenter stated that utilities have a conflict of interest in the rulemaking proceedings so their comments should be limited to what is technically feasible (7728).

One commenter stated that the question of what risk level is acceptable is not really that much of a scientific decision; rather it is a question of what the public finds acceptable (10). One commenter was frightened by the way government panders radical environmental organizations (G297). Another commenter suggested that the NRC should determine whether standards are to be technologically-based or politically-based; if the latter don't waste time on technological input (328). Still another stated that the definition of "political" could apply to interests of the general public or to interests of industry (2936). Several commenters stated that the standards have to be based on technology and not on politics (376, 646, 4282, 7823, 8775, 8850). Some commenters stated that standards should be developed taking political realities into account (1375, 3398, 3580, 3940). Another commenter stated that the NRC's decommissioning standard should not be influenced by difficulties of measurement or costs of implementation (2563).

One commenter stated that the NRC's backfit rule in 10 CFR 50.109 would be a good model for establishing when to apply decommissioning standards, including a test of whether a new requirement results in a substantial increase in overall public health and safety and whether its benefits outweigh its costs (8598). Another commenter recommended that the Generic Environmental Impact Statement should offer detailed descriptions of what the NRC believes would be the consequences of various alternatives as well as information on how the NRC's estimates were developed (7354). Still another commenter stated that the NRC should reconsider whether SDMP sites should be required to comply with the new decommissioning standards (7923). One commenter recommended selecting a few sites of varying contamination to apply the GEIS through decommissioning prior to final adoption of standards for everyone (G190).

Several commenters stated that the NRC must build trust before some members of the public will be willing to accept standards proposed by the NRC (1462, 1935, 2444, 2733, 2740, 2749, 2751, 2767, 3189, 3218, 8851). Presently these people do not trust anything to do with nuclear energy (1339, 1462, 1484, 1933, 2444).

One commenter stated that a national debate should be held, or a commission should be appointed, to identify the public risks that exist throughout society and to recommend how to spend limited resources in dealing with them (2329). Another commenter suggested that a participatory process take place to discuss the differences in background (2253).

One commenter stated that while radiation protection standard may relate to risk, it is too fundamental a quantity to state in the decommissioning standards. They should be stated in terms of radiation exposure, radiation dose or radioactivity concentration. Either lifetime dose is the most appropriate radiological criterion for decommissioning, or estimation and expression in average annual effective dose to members of the critical group would be practical (8067).

One commenter suggested that the regulations not be overly prescriptive and that guidance for achieving compliance be included in regulatory guides which consider public comment (8900).

The issue of expanding the definition of "decommissioning" to cover more than license termination and unrestricted use raises questions about waste policy and future liability (7332, 7927, 8006).

2.4 Approaches for Establishing Radiological Criteria for Decommissioning

2.4.1 Risks Limits and Risks Goals

Most commenters from state governments, the nuclear utilities, the fuel cycle industry, the medical community and non-fuel cycle industry, cleanup contractors, and professional society/standard-setting organizations favored a risk-based or dose-based standard over a standard based on best available technology or return to background (12, 17, 18, 24, 26, 27, 28, 29, 30, 31, 32, 35, 37, 41, 42, 45, 364, 392, 411, 487, 502, 520, 751, 981, 989, 1063, 1090, 1100, 1146, 1179, 1304, 1355, 1404, 1536, 1671, 1677, 1681, 1705, 1724, 1775, 1928, 1954, 1959, 1964, 2025, 2063, 2110, 2157, 2175, 2292, 2344, 2395, 2407, 2412, 2437, 2455, 2462, 2496, 2502, 2538, 2541, 2569, 2608, 2636, 2710, 2777, 2783, 2851, 2999, 3023, 3023, 3028, 3033, 3085, 3261, 3358, 3374, 3387, 3478, 3527, 3532, 3541, 3560, 3575, 3592, 3599, 3615, 3636, 3657, 3680, 3738, 3743, 3751, 3755, 3766, 3769, 3773, 3778, 3805, 3826, 3871, 3877, 3899, 3911, 3953, 3972, 4102, 4106, 4157, 4198, 4206, 4488, 4852, 7000, 7020, 7027, 7031, 7131, 7283, 7285, 7296, 7428, 7489, 7497, 7523, 7566, 7574, 7623, 7628, 7642, 7690, 7770, 7825, 7848, 8117, 8339, 8349, 8352, 8359, 8433, 8531, 8537, 8607, 8618, 8676, 8801, 8802, 8814, 8815, 8821, 8852).

Several commenters opposed using a risk-based standard (22, 418, 946, 987, 1000, 1113, 1655, 1990, 2179, 2184, 2185, 2418, 2546, 2979, 3484, 3733, 3760, 4112, 4193, 4398, 4419, 4472, 7101, 7126, 7155, 7341, 7381, 7399,

7645, 7803, 7898, 7986, 7987, 8711). Some commenters cautioned that risk goals and limits should be used with care (7275, 7302, 7752, 8027, 8051, 8082, 8560, 8611, 8638, 8663, 8869). Another commenter rejected dose-based standards for several stated reasons (7986). One commenter suggested that the decommissioning standard include concentration and activity level limits derived from risk goal and risk limits rather than specifying a risk goal or risk limit by itself (7001). Another commenter suggested the use of concentration screening levels based on small doses to avoid costly evaluations (8886).

Reasons given for supporting and opposing a risk-based standard included the following:

In support:

Historically NRC regulations have been risk-based and these have provided a very good safety record (29, 3592, 7848, 8531, 8636, 8823).

A risk-based standard provides site-to-site flexibility and assures that longer-lived and toxic radionuclides are cleaned up more restrictively than other less hazardous radionuclides and that specified risk/dose levels are not likely exceeded (27, 30, 31, 32, 2496, 3012, 3261, 8302, 8494).

A risk-based standard will assure uniform treatment of different hazards (1954, 2395, 3527, 3575, 3766, 8339, 8494, 8618, 8823).

EPA cleanup standards in the Clean Air Act and Superfund are risk-based (520, 3085, 3911, 7031, 7848, 8557).

Risk-based limits will assure protection of the public (28, 8302, 8676).

There must be some notion of acceptable risk whether we like it or not (487, 1775).

This will achieve consistency with the levels of health protection recommended by the international scientific community (8823).

There is a higher level of stability associated with setting a risk level than in using a background standard (2538, 3028, 8631).

A risk-based approach provides a means to get on with decommissioning more quickly (364, 1589, 8349).

A risk-based standard would minimize decommissioning costs and afford a better allocation of finite resources (1681, 1964, 2407, 2462, 2608, 2641, 2710, 7285, 7848, 8117, 8823).

In opposition:

There is no safe level of radiation risk exposure (1113, 1990, 1995, 2596, 2979, 3484, 4112, 4472, 7126, 7381, 7399, 7645, 8208, 8711).

Setting acceptable risk levels is like playing God (7341, 7987).

The only acceptable goal is probably background (2035, 2060, 2546, 2617, 2625, 4193, 4398, 4419, 7090, 7381).

A risk-based standard mimics the Below Regulatory Concern (BRC) concept which the NRC rejected (22, 946, 2179, 2198, 8711).

A risk-based standard could be unstable, because the public's perception of acceptable risk might change (418, 1655).

Use of a risk based standard would not allow a balancing of societal benefits and societal costs (7645).

Verification of risk-based standards is theoretical. Modeling depends on the good faith of licensees and places the burden on intervenors or the NRC (987).

Biological effects of radiation are not predictable (1000) and risk data are not sufficiently reliable (1000, 2184, 2979, 3094, 3733).

Standards based on acceptable risk could lead to litigation (2185).

A limit may be used to justify not cleaning up further (3392).

Most commenters who supported risk-based or dose-based standards favored limits over goals (24, 27, 28, 35, 41, 42, 45, 364, 411, 413, 502, 981, 989, 1063, 1100, 1146, 1179, 1304, 1320, 1536, 1589, 1671, 1705, 1724, 1928, 1959, 2025, 2063, 2157, 2175, 2462, 2502, 2524, 2538, 2569, 2608, 2650, 3028, 3085, 3261, 3358, 3541, 3636, 3751, 3755, 3805, 3871, 3911, 3972, 4102, 4106, 4852, 7020, 7027, 7131, 7296, 7428, 7489, 7497, 7523, 7533, 7566, 7623, 7628, 7770, 7825, 7848, 7854, 7874, 8117, 8124, 8154, 8191, 8257, 8302, 8326, 8349, 8352, 8406, 8636, 8660, 8663, 8666, 8801, 8802, 8813, 8814, 8815, 8852). A risk limit is the highest risk believed acceptable and efforts are made to get below this level as much as reasonably achievable. A risk goal is a level that is desirable to achieve, but exceptions are allowed when this level cannot be met. A risk limit is enforced; a risk goal is not (20). Some commenters suggested that perhaps both a risk goal and a risk limit should be specified (26, 392, 1775, 3023, 7000, 7302, 7359, 8064).

Most of the commenters who supported a risk limit recommended that it be coupled with an ALARA (as low as reasonably achievable) requirement (14, 27, 37, 109, 392, 487, 502, 981, 1063, 1090, 1100, 1320, 1928, 1959, 2157, 2289, 2431, 2441, 2442, 2455, 2502, 2524, 2538, 2591, 2593, 2600, 2608, 2650, 2777, 3023, 3028, 3033, 3358, 3387, 3478, 3592, 3599, 3751, 3805, 3877, 3972, 4102, 4106, 4206, 4488, 7428, 7523, 7566, 7628, 7770, 7775, 7848, 7851, 7854, 7874, 8124, 8154, 8191, 8257, 8302, 8326, 8406, 8443, 8468, 8471, 8478, 8494, 8531, 8549, 8607, 8631, 8660, 8720, 8801, 8813, 8821, 8822, 8863). Two commenters recommended that ALARA efforts to reduce dose not be applied below a screening level of a few millirems per year (7775, 8443). Another commenter suggested that most licensees could be accommodated by establishing very low radioactivity levels which if met would not require an ALARA analysis (8051). Several commenters opposed ALARA on the grounds that it gives licensees more flexibility than is desirable (2305, 2435, 2459, 2546, 2625, 3871, 4419, 4853). Other commenters opposed ALARA on the grounds that cleanup should not be required below the specified risk limit (14, 37) and that ALARA is not enforceable (2439, 2645, 2653). Two commenters stated that if the ALARA principle is used it must be defined and set out as a requirement (2602, 8896). Two commenters questioned the quantification of ALARA (7117, 7131, 7302).

One commenter noted that once the risk limit is achieved, the multi-attribute analysis (e.g., ALARA) allows consideration of practicality; however, if risk goals are applied, the multi-attribute analysis is not necessary (8902, 8908).

Another commenter stated that the EPA and the FDA have established arbitrary minimal risk goals as regulatory

standards; most other agencies take risk/benefit into consideration and this is recommended (3812). One commenter stated the EPA's selection of values for radionuclides in water could be construed as subjective (8722).

Some commenters distinguished between establishing a risk limit and adoption of a dose limit (18, 37, 487, 1404, 2197, 2777, 3387, 3592, 3599, 3615, 3680, 7489, 7533, 7566, 7574, 7698, 7825, 7874, 8066, 8319, 8474, 8607, 8815). One commenter stated that the health physics profession has recognized for over 40 years that people cannot agree on the risk concept (3599). However, another commenter believes a risk level can be accepted by the public (889).

Two commenters noted that constraints may be needed to assure exposure limits are met in the event more than one site might contribute personal exposure (8100, 8799). One commenter suggested a limit of 100 mrem/year and a dose constraint of 30 mrem/year (8875). Aside from multi-unit nuclear power stations, licensed sites tend to be separated enough in distance that a potentially exposed group is unlikely to be exposed to radioactive material from more than one site (8100).

Another commenter recommended that the NRC use 10,000 person-rem as the threshold below which, for low doses and low dose rates, there is no cancer risk and that ALARA should be applied at a value of not more than \$10,000 per person-rem for collective doses above 10,000 person rem. An alternative recommendation was that if a 100-year /risk model would not predict one cancer fatality, no further decontamination was required. The ALARA principle should be used in cases where the 100-year dose is greater than that which will result in one cancer fatality (G791).

2.4.2 Best Available Technology

Almost all commenters on this option voiced objections to a possible best effort/best available technology standard (47, 49, 52, 53, 54, 55, 316, 393, 496, 819, 825, 1085, 1183, 1194, 1200, 1347, 1812, 1818, 2029, 2061, 2074, 2136, 2145, 2170, 2177, 2180, 2183, 2258, 2346, 2592, 3031, 3032, 3310, 3384, 3974, 4207, 4854, 7025, 7335, 7401, 7491, 7576, 7691, 7811, 7856, 8056, 8356, 8448, 8613, 8644, 8713, 8725).

Reasons given included:

Such a standard would be extremely subjective (819, 2029, 2177, 2258, 7491, 7691, 8356); it would mean different things to individuals (53, 2346, 7856, 8448, 8565, 8644); and its connotation is to do what is practical, not what is needed (49, 1085).

Best effort would be a subsidy to the nuclear industry (316).

Best effort is a cop out (1818).

Costs should not outweigh health and environmental costs (433, 2029).

A best technology standard is similar to the rejected below regulatory concern (BRC) notion (2180).

There would be no end point to decommissioning costs (54, 393, 2136, 3384, 4207, 8056, 8356, 8357, 8448, 8565, 8613, 8874).

Costs could be more significant than the risk approach (3310, 3974); such a standard would be unstable (2145, 2183).

Lax standards could be set on the basis of today's inadequate technology (496, 7335).

Such a standard could thwart innovative technology developments (1812, 7401).

For most reasonable risk-limit standards, there is not much limitation on technology (2170, 8356).

Best effort is inconsistent with recommendations of the ICRP and NCRP (7576).

Some commenters stated that best-effort could be an appropriate adjunctive approach (2039, 7277, 7382, 7647, 7899, 7902, 7993, 8480). Other commenters said best available technology should perhaps be applied in conjunction with a risk-based standard (3029, 7127).

One commenter stated that there might be some financial incentive used by the NRC to induce industry to use the best available technology for achieving the lowest levels of cleanup (4855). Other commenters said compliance with NRC decommissioning standards should be demonstrated by the best available technology (899, 7297). Still other commenters stated that the NRC should explore the use of the best available technology world-wide (587, 7320, 8732). Two commenters suggested that best effort determinations must consider both available technology and associated costs (51, 1332).

One commenter suggested that if a best available technology standard is adopted, the NRC should provide flexibility to permit the use of new technologies without having to wait for a regulation change (1812). Another commenter suggested that if the NRC takes the best available technology approach, it should place details in guides and not in NRC regulations (48).

2.4.3 Return-to-Background

Most commenters from Citizen/Environmental Organizations and some from other organizations favored a return-to-background standard (62, 63, 65, 70, 71, 350, 386, 398, 399, 410, 421, 424, 448, 458, 474, 476, 556, 783, 810, 874, 929, 1021, 1023, 1028, 1037, 1086, 1319, 1330, 1423, 1469, 1471, 1475, 1482, 1486, 1569, 1658, 1668, 1674, 1741, 1751, 1786, 1908, 1916, 1989, 2018, 2022, 2038, 2047, 2057, 2072, 2079, 2083, 2092, 2113, 2168, 2237, 2307, 2309, 2323, 2377, 2492, 2510, 2519, 2555, 2567, 2771, 2846, 2877, 2930, 3003, 3016, 3042, 3074, 3105, 3282, 3381, 3549, 3587, 3593, 3602, 3666, 3709, 3714, 3734, 3824, 3828, 4192, 4209, 4310, 4399, 4418, 4423, 4426, 4475, 7006, 7008, 7009, 7013, 7065, 7092, 7102, 7103, 7146, 7164, 7171, 7324, 7328, 7338, 7343, 7352, 7383, 7392, 7554, 7557, 7601, 7611, 7669, 7742, 7782, 7805, 7813, 7900, 7963, 7967, 7979, 7981, 8212, 8219, 8223, 8231, 8234, 8245, 8259, 8514, 8695, 8696, 8699, 8707, 8714, 8718, 8727, 8729, 8737, 8745).

Reasons given for supporting and opposing a return-to-background standard included the following:

In support:

This standard would provide more stability in the long-term (71, 448, 1658, 7979, 8234) even if it presents difficulty in definition and demonstration of compliance (350, 424, 458, 1023, 2113, 7408).

Any lesser standard would be a subsidy to industry (783, 810, 8245).

Growing studies show that low-levels of radiation increase health risks (1471, 1668, 1739, 2113, 2771, 7092, 7102, 7328, 7383). The NRC has no moral right to permit a risk higher than that from background (1668, 1989).

This is the only standard without a notion of below regulatory concern (BRC) (421, 2567, 3587).

Sites should be returned to the condition they were in before nuclear operations commenced (410, 1021, 1028, 1482, 1486, 1908, 1989, 2057, 3074, 3105, 3828, 4310, 7352, 7557, 7611, 7669, 7782, 7805, 7813, 7900, 7967, 8212).

All risk estimates must be suspected as erroneous; it is better to err on the side of safety and go towards zero (2377).

Finality in decommissioning is not politically realistic unless the end point is background (2361, 2519, 3824, 7102, 7979).

This is the only standard suitable for unrestricted site use (1078, 1916, 3549, 3593).

It is wise and prudent to decontaminate down to background (1569), and this will provide the needed level of surety (70).

This is most acceptable and possibly the only standard that the public is willing to accept (62, 63, 398, 1741, 2072, 3074, 3602, 7102, 7324, 7554).

If other than a return-to-background standard is adopted, industry will remain liable for contamination at a site (1660, 1751, 4209).

Standards based on acceptable risk will lead to a litigator (1674, 7963).

In opposition:

This option does not consider risk or cost (7577, 7649, 7692, 7853, 8059, 8360, 8364, 8451, 8566).

Cleanup to background is more than what is needed for safety (395, 408, 685, 1047, 1543, 1670, 2150, 2251, 2553, 2577, 2700, 2709, 2818, 7125, 7492, 7692, 7859, 8364, 8646, 8870) and is economically unfeasible (2355).

A return-to-background standard would be more costly than a risk standard (2031, 2223, 3368) and would result in a significant waste of limited resources (395, 442, 463, 490, 1768, 2577, 3721, 8566).

Such a standard would result in the accumulation of the most volume of low-level wastes (1636, 2295, 4104, 4235, 7404) and would result in ineffective use of low-level waste disposal space (68).

A risk-based standard is a more equitable approach than a return-to-background standard (3770, 3779, 3924).

A return-to-background standard would trigger alarms that are meaningless (66, 3721).

This standard may not be achievable (60, 1068, 1814, 2351, 2525, 2550, 2606, 2815, 3336, 3754, 7125, 7692, 8615) and could push technology beyond its present capability (64, 3312, 8370).

This option is incompatible with ICRP and NCRP recommendations (7404, 7577).

Determination of levels of radiation at or near background is elusive and multifaceted. Background varies

spatially, temporally, and seasonally with climate and over long time frames in ways that are not well understood (435, 457, 463, 484, 500, 534, 1068, 1186, 1190, 1192, 1198, 2090, 2100, 2364, 2433, 2525, 2540, 2543, 2545, 2550, 2570, 2574, 2585, 2706, 2770, 2981, 3026, 4349, 4445, 4856, 7125, 7150, 7273, 7308, 7367 7615, 7618, 7692, 7859, 8062, 8188, 8256, 8451, 8646).

It is technically impractical to set the limit at background or undetectable above background (1439, 1694, 2351, 7125, 7692, 8190, 8370). The standard would shift with improving measurement technology and would provide no point of finality to the cleanup process (69, 450, 1694, 2826, 8190, 8370).

The use of a return-to-background standard does not ensure regulatory stability (1188, 1195, 8256, 8566).

Such a standard could result in more money being spent for monitoring and proving you are at background than is spent on decontamination efforts (453).

A return-to-background standard could create greater health risks than those being remediated (482, 1272, 2031, 4104, 4235, 8059, 8870).

Movement of contaminated soil to reach background will bring about unnecessary exposure (68, 7404, 8059, 8360, 8646). Also, there is not much you can do about contaminated groundwater (589).

A return-to-background standard for unrestricted use could cause more harm through removal of top soil than if left in place (2274, 8360).

High technology measurements will not clarify what background is. They will just show that it fluctuates and is not a clear, achievable number (2243).

If a return-to-background standard is used, farmers would have to be told to clean up their fields, and people who buy Brazil nuts would have to ship the shells to a low-level radiation waste site (547).

Going to background is unacceptable and it will be litigated (533, 4388).

Opposed for other reasons or without stating a reason (1195, 1305, 1429, 1439, 1672, 1704, 2885, 3343, 7184, 7404, 8149, 8188).

Several comments were offered concerning how a return-to-background standard might be implemented by the NRC.

Some commenters stated that nuclear facilities should be designed to be returned to background (929, 7967). Another commenter stated that perhaps a return-to-background standard could be applied at some sites, but not broadly applied at all sites (588).

Another commenter stated that the attraction of a return-to-background standard, as opposed to a numerical limit, is that this standard empowers the community to reach consensus on how clean is clean. What is important is how the limit is determined and who determines it (1786).

Still another commenter indicated that if the NRC adopts a return-to-background standard, it must specify what kinds of measurements must be made, including sensitivity and reliability of instruments and how to demonstrate that the standard has been achieved (67). The variability of background and the difficulty of precise analytical measurements at low levels require a logical approach to defining background (7294). "Background " does not

mean zero, but rather a level of radioactivity based on an average of the test results of a number of samples taken in known noncontaminated areas adjacent to the site being decommissioned (7619).

2.4.4 Other Approaches for Establishing Criteria

Some commenters stated there is a large body of scientific literature not embraced by the NCRP and ICRP that indicates there is no safe level of radiation exposure (326, 372, 623, 1019, 1049, 1914, 2111, 2181, 3731, 4857, 7384, 7723, 7788), or radiation is more harmful than recognized by them (1213, 4758, 2385, 2717, 3160, 3283, 7012, 7664, 7732, 8217, 8253). Several references were mentioned in this connection (1228, 1583, 2111, 3006, 3135, 3150, 3283, 3302, 3611, 3731, 3793, 3951, 4857, 7664, 7689, 7723, 7788, 8217, 8253, 8375). Some commenters suggested that national and international scientific advisory bodies might not be totally objective (1292, 3402, 7788). Other commenters stated that the public will never trust health effect studies unless conducted by independent individuals or organizations (372, 2227, 2917, 2938, 4175). One commenter questioned the value of having the public rather than scientists evaluate technical data (1240).

Two commenters stated that the Department of Energy, the nuclear industry, and the NRC have covered up the true health effects of radiation that bear on the issue (1789, 2447). Other commenters said that the government generally covers up knowledge of health effects from nuclear facilities because it doesn't want to know about them (692, 1248, 2230). Still other commenters stated that more study is needed before the NRC decides on decommissioning standards (1019, 1169, 1403, 2267, 3093, 3125, 3177, 3741, 3775, 4056, 4058, 4374, 7107, 7118, 7483, 7654, 7689, 7732, 7763, 8519, 8708). One commenter recommended that the NRC invite those people who are outside the "internal scientific" community for an open discussion of what levels they believe should be set (1222, 2181). Another commenter stated that the debate on health effects called for by some workshop participants is already being waged in the peer-review scientific arena (1103). Studies not deemed acceptable by peer review should be given special scrutiny before their recommendations become the basis for regulatory policy (7287). Other commenters stated that the health-risk debate should not be conducted based upon information from isolated incidents, but should be based upon the best available knowledge (324, 1103). Others stated that consensus can be reached without one hundred percent agreement and in fact international consensus on reasonable levels of risk have been established by national and international scientific groups (1545, 4858).

One commenter suggested that the EPA should be requested to explain or justify its claim that its risk limits for toxic chemicals can be used for the control of radioactive material contamination (7256). Other commenters stated that the EPA's chemical risk standards may not be directly applicable to radiological protection risks (7838, 7940, 8240, 8318). Additionally, it was suggested that the NRC consider requiring cleanup of man-made residual contamination only to a level below that of the preexisting background radiation levels; if naturally occurring background radiation exposures are reduced, require less cleanup of the man-made radioactive materials (7265, 7380).

Some commenters stated that the National Cancer Institute (NCI) had studied the radiation dose versus cancer incidence rates around nuclear power plants and had concluded that there are no significant health effects at those sites (1080, 1742, 1821). Other commenters stated that the NCI study was poorly designed and purely a political cover (1225, 1248).

One commenter suggested that perhaps a national debate should be held or some sort of study commission should be established to determine what real risks exist in society and how the limited resources available to deal with them should be spent (2334). One commenter indicated that all four approaches be incorporated into the criteria (7272).

Two commenters referred to studies which indicate that low doses of radiation may be beneficial (3269, 7287).

One commenter urged NRC to regard "hormesis" with great skepticism (7947).

One commenter believes that the final decisions are political (2306).

2.5 Establishing a Basis for Risk Goals or Limits

2.5.1 National and International Consensus

Many commenters suggested that a proper basis for establishing risk goals or risk limits would be the recommendations of the U.S. National Council on Radiation Protection and Measurements (NCRP) and the International Commission on Radiological Protection (ICRP) (112, 309, 650, 958, 985, 1208, 1218, 1314, 1363, 1522, 1537, 1584, 1962, 1977, 2013, 2028, 2121, 2158, 2193, 2200, 2204, 2248, 2290, 2586, 2683, 2867, 2873, 3257, 3263, 3270, 3347, 3360, 3389, 3514, 3555, 3561, 3595, 3600, 3616, 3736, 3744, 3781, 3878, 3935, 3946, 4188, 4194, 4252, 4808, 7032, 7269, 7288, 7388, 7405, 7418, 7429, 7487, 7490, 7494, 7522, 7534, 7545, 7562, 7568, 7578, 7634, 7643, 7695, 7769, 7824, 7872, 7878, 8011, 8022, 8030, 8043, 8049, 8070, 8094, 8125, 8169, 8279, 8289, 8301, 8307, 8320, 8324, 8335, 8340, 8371, 8411, 8415, 8434, 8456, 8485, 8496, 8500, 8538, 8608, 8655, 8853, 8911). Some commenters noted that national and international consensus standards take into consideration the effects of low-level radiation (1050, 1568, 3171) and are based on the assumption that low-levels of radiation cause health effects (89, 92, 1572, 3163, 3171, 4149, 4155, 7104, 7157, 8520). Some questioned that assumption and believed that health risks are not substantially increased by exposure to low-levels of radiation (87, 88, 90, 401, 1051, 1266, 1574, 1598, 1941, 2193, 3839, 4152, 4385, 4483, 7128).

One commenter stated that a combination of risk limits and risk goals or "screening levels" is used by NRC and DOE, by the international community, and in some cases by EPA. DOE is considering use of a site specific dose constraint of 30 mrem/year to ensure individuals do not exceed 100 mrem/year from all sources (8878).

One commenter stated that where possible the NRC rule should be consistent with the guidance and standards of other radiation protection guidance and regulatory groups. The rule must be consistent with EPA's "generally applicable " radiation standards for decommissioning and should be consistent with other related initiatives (8894).

Some commenters stated that establishment of decommissioning standards based on current recommendations of the NCRP and the ICRP would be like building on shifting sands because present understanding of the health effects of low-level radiation is not very good, and applicable standards are going lower and lower as we get additional information (74, 75, 76, 81, 84, 519, 1000, 1035, 1212, 1233, 1436, 1524, 1540, 1568, 2415, 3400). Others stated that there is no safe level of radiation risk exposure (1114, 1710, 2138, 2210, 4479). Still others stated that ICRP standards need to be revised to account for recent studies which show low-levels of radiation are more harmful than previously thought (3010, 3284). See discussion also in Section 2.4.4. Other commenters disagreed that radiation standards are decreasing over time (85, 680) and stated that some radiation standards have in fact been liberalized over time (86).

Those favoring acceptance of NCRP and ICRP recommendations stated:

More is known about radiation hazards than about those of any other toxic substance (82, 2013).

The ICRP and the NCRP recommend that protective actions should be both justified and optimized (8022) and do more good than harm (8029). In the case of individual sources, there should be dose constraints set below the dose limit (1314).

Enough is known about the health effects of radiation to establish a reasonable estimate of risk from a particular radiation dose (391, 415, 2849).

There has not been any great new knowledge about the effects of radiation at low doses for a long time (77, 78, 79).

You should be cautious about information that has not been through a scientific peer review (2290).

Those opposed stated that any radiation exposure above background poses an unacceptable risk (91, 397, 404, 438, 634, 638, 1143, 1540, 1669, 1710, 1766, 1739) and they distrust the body of expert consensus reported to be out there (1582, 1740, 1940, 2415, 3103, 3833).

The IAEA recommended limits for decommissioning are greater than the IAEA limit of 1 millirem/year for recycling to uncontrolled use (3337).

Standards by professional organizations such as the American Nuclear Society and the American Society for Testing and Materials will help the industry and the public know what and how decommissioning will be done (4260).

One commenter suggested that DOE requirements for radon are similar to 40 CFR 192 and allow for no action if the concentrations are predominately from background (8934). Also, NCRP Report No. 116 and international and Canadian recommendations of 20 pCi/l for radon were noted (8942).

2.5.2 Risk/Dose Relationship

Several commenters recommended that the NRC consider adopting a risk limit standard equating to a radiation dose of 25 to 100 millirems per year (113, 525, 526, 1155, 1208, 1523, 1532, 1533, 1536, 1570, 1572, 1647, 1688, 1703, 1773, 1930, 2129, 2217, 2277, 2554, 4809, 4859, 7112, 7321, 7394, 7493, 7501, 7533, 7536, 7569, 7642, 7696, 7842, 7899, 8012, 8024, 8026, 8032, 8036, 8044, 8290, 8339, 8342, 8388, 8416, 8479, 8549, 8553, 8575, 8649, 8657, 8690, 8811, 8816, 8817, 8818, 8819). According to two commenters a 100 millirems per year limit would increase the cancer risk in the population only slightly above its normal incidence rate (4657, 1728). One commenter believes that damage may be increased at smaller doses (2983). One commenter stated that one cancer death per 285 person-rem as conservative (3156) while another endorsed the number (1470). Other commenters stated that the 100 mrem per year limit under the NRC's present rules and the 3 mrem per year limit under the EPA's rules should be reconciled (522, 4660, 4860, 4861). See discussion also in Section 2.2.1. Some commenters recommended adoption of a radiation dose limit of 10 to 30 millirems per year (7496, 7498, 7501, 7503, 7508, 7608, 7747). Other commenters recommended adoption of a risk goal of 3 to 10 mrem per year (7696, 7842).

One commenter stated that a dose constraint in the range of 30 mrem/year is generally consistent with the EPA risk standard of ten to the minus four lifetime risk (8880).

Still other commenters recommended that the NRC should consider adopting a risk limit standard equating to a dose of one (1) millirem per year to an individual and 1 to 100 person-rem per year to the population around a site (3054, 3153, 7807, 7908). Other commenters stated that such dose limits are much too low to adopt (2241, 3232, 3352, 8155, 8377). Another commenter stated that the NRC's generic standard should be established at a level that is reasonably safe; however, "safe" has been defined at such a low level, trivial in comparison to natural background, that people have been unnecessarily frightened (3732).

Two commenters stated that the non-threshold theory may not be true and the imagined low-level effects do not occur (4143, 4151). One commenter believes there is an increased low dose effect at 0-5 rem (4797). Another commenter wants "chronic low dose exposure" considered (2454). Another believes that radiation risks are low and hard to quantify (3151). One commenter stated that small doses may adversely affect fetal development (half a rad) (3138).

The uncertainty of radiation effects is unimportant to decommissioning because the doses from decommissioning are relatively small (83).

One commenter suggested that NRC should consider hiring a medical doctor to lend credibility to its staff with respect to qualifications in the field of epidemiology and radiation biology (7260).

2.5.3 Background Radiation

Many commenters recommended that the NRC establish as its decommissioning standard a risk/dose limit on the order of the variability of natural background radiation occurring across the United States (93, 97, 98, 416, 1009, 1453, 2201, 2494, 2648, 2819, 2874, 2930, 3170, 3459, 3707, 3735, 3745, 4811, 7339, 7362, 7651, 8820, 8825). The reasons given were that no health risks are attributable to background variations (931, 2440, 2648, 2819, 3076, 3089, 3364, 8854) and studies show that there is no increase in cancer incidence over the wide range of background radiation in the U.S. (93, 98, 2494, 2718, 2874, 7323). One commenter recommended that the NRC establish its decommissioning standard at a small fraction of natural background radiation levels (few millirem per year) (7776). Some commenters disagreed that background radiation variations are safe (740, 1463, 3068, 3069, 3320, 3739, 3746).

One commenter suggested that experts will have to determine local benchmarks if a background limit is used (479). One commenter stated that all background measurements carry errors which must be dealt with (1307). One commenter stated that background is not a well defined concept (1452).

Natural background, excluding exposure to radon, in Colorado is on the order of 200 millirems a year and in the coastal states of Florida and Louisiana is on the order of 100 millirems (95, 96, 447, 1535, 4862, 7111, 7362, 8363). One commenter suggests that a reference to use for background radiation exposures to people in the United States is 360 millirem per year per person, and suggests expression of other exposures as multiples or fraction of that number (2400). Also, the variability of background at locations in the same state can be as much as 100 millirems a year (94). The difference of 100 millirems was recommended by many as the dose limit of choice. See discussion in Section 2.5.2. For discussion of those favoring a return-to-background standard see discussion in Section 2.4.3.

One commenter said that DOE makes allowances for radon concentrations that are predominately due to background (8934).

One commenter recommends creation of an advisory board, composed of federal and state environmental officials, environmental scientists, public health experts, representatives of environmental and citizen organizations, labor unions, and others from society affected by the issue, to make impartial, location specific assessments of background radiation (7347).

2.5.4 Individual and Collective Doses

Several comments were made concerning how risk standards should be applied to the population who may be exposed to residual radioactivity at a released site. Most commenters favored applying a risk limit to individuals (107, 114, 115, 1006, 1338, 1808, 2131, 2601, 3716, 4413, 4468, 4863, 7495, 7535, 7548, 7644, 7771, 7877, 8069, 8292, 8395, 8436, 8442, 8539, 8677) and believed it unnecessary to specify a collective dose limit (104, 106, 1499, 2134, 4413, 4468, 7037, 7042, 7443, 7547, 8069, 8088, 8139, 8295, 8395, 8442, 8472, 8581, 8586, 8590). Others stated that collective dose limits should be applied (103, 108, 2634, 3148, 3154, 3533, 7909, 7949, 8247, 8521, 8884). If collective dose limits are applied, they should be consistent with ICRP and NCRP recommendations (8041). One commenter remarked that if collective dose is used, it should be applied in a comprehensive manner; for example, in evaluating an appropriate cleanup standard the doses to the public from transporting material off site for disposal should be evaluated against the doses received by the public around the site if the material is left in place (8396).

With respect to the calculation of individual doses, some commenters favored applying a risk limit to a maximally exposed individual (106, 1006, 1108, 3143, 3716, 3784, 7037, 7041, 7567, 7826, 7909, 8329, 8670, 8752) while others favored applying it to some sample of a critical population group (114, 991, 2131, 2411, 2684, 2799, 3168, 3921, 4468, 4504, 7130, 7397, 7438, 7443, 7538, 7548, 7826, 7877, 8075, 8139, 8292, 8295, 8343, 8395, 8436, 8472, 8586, 8912). One commenter favored use of a credible population group, not a hypothetical individual (7281). Four comments argued that risk limits should be applied to the most susceptible people in the population (1367, 3124, 3133, 7156). Another commenter indicated that both individual and collective doses or population risk must be considered and based on realistic scenarios and average values if comparisons of alternatives are to be equitable (8866, 8915, 8916).

2.5.5 Modeling/Pathways

Several commenters pointed out that, whatever risk standard the NRC may adopt, compliance will likely need to be determined by a computer model (532, 812, 835, 988, 1693, 1755, 2132, 2285, 2620, 2803, 2806, 2808, 2810, 2821, 2921, 3114, 3144, 3169, 3419, 3453, 3509, 3650, 3656, 3673, 3717, 3799, 3893, 3922, 7445, 7542, 7552, 7913, 7964, 8073, 8086, 8140, 8466, 8491) except for small operations when contamination levels are within specified generic criteria (2809). Some commenters expressed reservations about the use of models stating that models can be slanted to the desired results (598, 684, 2805, 2807, 2924, 3591, 4063, 7048, 7694, 7916, 7989), different modeling assumptions will give you different answers (598, 720, 996, 2925, 4397), and modeling has large uncertainties (7004, 7393, 7442, 7910, 8076, 8089, 8674). One commenter stated that meaningful dose estimates must be calculated or measured using actual data and proven models and cautioned that risk models commonly overestimate doses and risks by factors of 10 to a thousand (G75). Some situations may not fit a model (997, 2216, 2615, 3060, 3790), and modeling is costly and slows down cleanup (1308, 2804, 7004). Other commenters stated that decontamination limits should be established and dose modeling should not be relied on to demonstrate compliance (2808, 7002, 7293, 7505, 7524, 7989, 8576). Other commenters defended the use of models and the integrity of individuals who use them (111, 525, 700, 835, 884, 2823, 4362). Two commenters stated that models will be needed even if a return-to-background standard were adopted (812, 2686). Other commenters cautioned that reasonable assumptions must be made (105, 7913, 8315) and the NRC/EPA should develop a standardized methodology (1363, 1895, 1898, 2660, 2912, 2913, 3238, 3246, 4160, 4375, 4406, 4508, 7419, 7448, 7514, 8086, 8109, 8476, 8576).

One commenter recommended that funds should be allocated for research and development on modeling and technology for evaluating and dealing with environmental effects (2618). A commenter suggested that NRC provide detailed guidance documents on acceptable methodology for performing assessments, including scenarios

for use of land, buildings, and equipment (7513). Another commenter stated that methods for accounting for exposure pathways are available in regulatory guides (2676).

Several commenters stated that all exposure pathways to man should be considered to assess possible future doses from a contaminated site (173, 1848, 2262, 2340, 2409, 2420, 2597, 2687, 2994, 3022, 3096, 3464, 4503, 4514, 4518, 7069, 7141, 7445, 7446, 7570, 7841, 7916, 7962, 8097, 8131, 8146, 8408, 8410, 8476, 8678, 8679, 8755, 8926).

Comments were split on whether risk limits might be needed for different exposure pathways. Some stated that standards for different pathways are essential to ensure environmental protection, particularly for groundwater and air pathways (867, 869, 1071, 1844, 1846, 1848, 1852, 1854, 2216, 2245, 2268, 2275, 2677, 2681, 2689, 2692, 2712, 2713, 2715, 2720, 2837, 2839, 2840, 2925, 3136, 3411, 4030, 4523, 7481, 8201, 8250). Others opposed establishment of separate limits for each exposure pathway (7050, 7054, 7446, 8146, 8408, 8487, 8540, 8678, 8925, 8928) and believed that risk standards set to protect humans would properly ensure environmental protection (730, 997, 1227, 1517, 2782, 3423, 3430, 3782, 4865, 8410). See discussion also in Section 2.14.

One commenter stated specific site inventories may be used for screening sites but such criteria must include consideration of all pathways (8931).

One commenter believes pathways are "totally trivial and ridiculous" (1230).

2.6 Balancing Risks and Benefits

2.6.1 Performing Assessments

Several commenters stated that the NRC should establish its decommissioning standards based on a complete assessment of the total costs and benefits associated with different options (216, 217, 224, 226, 323, 342, 1946, 2012, 2427, 2552, 2632, 2887, 3066, 3070, 3077, 3092, 3098, 3188, 3213, 3410, 3492, 3506, 3511, 3530, 3927, 4257, 4307, 4317, 4330, 4367, 4440, 4469, 4484, 4866, 4867, 7005, 7024, 7039, 7258, 7350, 7400, 7417, 7526, 7646, 7650, 7833, 7837, 8275, 8394, 8529, 8619, 8809, 8864). Other commenters added that the NRC must compare the risks that exist without remediating to the standard with the risks that exist with implementation of the standard (220, 230, 957, 1165, 1807, 2552, 2579, 2986, 4344, 4868, 4869, 7043, 8308, 8397). Still other commenters stated that resources should be expended only to reduce observable health effects and not remediation of calculated or hypothetical health effects (224, 227, 305, 772, 1110, 1927, 2640, 7280, 7295, 7439, 8313). One commenter expressed concern over the influence of groups with little or no scientific background which is causing expensive and misguided solutions for environmental problems (G915). Some commenters stated that whether risks are acceptable should depend on what the risk to benefit ratio is (230, 2632, 2887). One commenter placed public health before costs (317).

One commenter stated that a dose or risk constraint to ensure protection of individuals must be based on a realistic risk or impact analysis (8877).

One commenter stated that in assessing risks one should integrate over a time of at least 1000 years (3131). Other commenters stated that the time frame should be related to the radionuclides involved (7038, 7049, 8446). One commenter suggested that potential future risks might be discounted as is done in economic discounting (8920). Other commenters stated that there should be a screening level below which no further assessment is required (1405, 4870, 7539, 7646). Concentration screening levels (activity per unit mass or unit area) that could be measured and that are based on small doses could be used (8887), or specific site inventories may be a reasonable

approach (8929). Another commenter stated that computer models or tools should be made available for public use (3429).

Some commenters objected to cost-benefit balancing (794, 797, 1020, 3469, 3523, 3572, 4329, 8246). Other commenters offered admonitions concerning risk-benefit assessments (1270, 1910, 2889, 3071, 3326, 3405, 3542, 3651, 3761, 3788, 3883, 4370, 4473, 7942, 7946, 7951, 7994, 8072, 8077, 8078, 8194, 8310, 8331, 8347, 8404, 8591, 8858, 8862, 8890, 8913, 8914, 8917, 8918, 8919, 8923, 8927, 8947). One commenter stated that a multi-attribute analysis (e.g., ALARA analysis) allows consideration of practicality (8904) on the site-specific level (8906). Some commenters disagreed altogether with the use of economics in deciding decommissioning standards (781, 1893).

One commenter noted that there are many cost-benefit studies from other sources that might be used for comparison in evaluating cost-benefit for decommissioning and suggested that the NRC might compile some of this information to educate the public on the issues (1828). One commenter stated the NRC's previous estimates of decommissioning costs were inaccurate and too low (2980). Another commenter stated that the cost of decommissioning has not been adequately addressed (4311).

A commenter noted a problem when balancing risks, costs, and benefits is the assignment of a dollar value to such things as a life, discomfort, ecological impacts, and public concern. The commenter suggests that it may be desirable to implement some other unit of equivalency (8909).

2.6.2 What Risks Should Be Considered

Many commenters stated that for the most effective use of resources and fairness, the NRC must consider in the risk-benefit balance not only radiological risks to workers and the public, but also non-radiological risks and indirect risks associated with the regulation of decommissioning activities (211, 212, 214, 215, 219, 223, 419, 470, 578, 749, 750, 753, 756, 807, 970, 1029, 1163, 1236, 1277, 1359, 1399, 1443, 1485, 1505, 1544, 1804, 2178, 2260, 2343, 2535, 2883, 2953, 2954, 3091, 3110, 3132, 3159, 3304, 3329, 3363, 3404, 3406, 3407, 3428, 3455, 3641, 3763, 3808, 3811, 3816, 3925, 3932, 3944, 4093, 4115, 4202, 4319, 4338, 4371, 4383, 4441, 7074, 7099, 7259, 7440, 7528, 7612, 7700, 7941, 7945, 7988, 8014, 8204, 8241, 8267, 8285, 8297, 8304, 8314, 8345, 8365, 8380, 8383, 8391, 8430, 8499, 8530, 8535, 8584, 8620, 8648, 8691, 8949). Some commenters stated that non-radiological risks should not be considered (7137, 8243). Other commenters stated that the NRC should not base its decommissioning standards on cost/benefit arguments (7995, 8243). One commenter stated that the Health Physics Society concludes that, "there is no ecological or conservation basis for establishing radiation protection standards different from those...involved in any other health issue for which benefits are weighed against costs" (466).

Some commenters stated that risks only to man should be considered while others stated that risks to the environment should also be considered. If specific site inventories are used for screening sites, the criteria must be based on all possible detriments (8930). See discussion in Section 2.14.

Some commenters stated that the NRC should consider risks at a decommissioned site from both radiological and non-radiological substances (746, 1163, 1207, 1275, 1982, 2088, 2107, 2313, 2859, 3110, 3123, 3141, 3458, 3463, 3619, 3663, 3804, 3811, 4535, 7259, 7528, 7875, 7919, 8204, 8380, 8499). One commenter stated that the cost/benefit analysis for chemicals should be different than for radiological materials (7836). See discussion also in Section 2.2.1. The NRC should consider risks both to workers who perform decommissioning activities and to the general public who are exposed during and after the decommissioning (796, 1029, 2859, 2968, 2974, 3393, 3406, 3604, 4108, 4315, 4320, 4328, 7289, 7530, 8535). One commenter stated that occupational radiation exposures

received during decommissioning activities should not be a part of the decommissioning analysis (7058). Some commenters stated that all harmful effects of exposure to radiation in addition to fatal cancers should be considered (2630, 3742, 3777, 4373, 4871, 7040, 8209, 8241).

One individual commented that if the NRC is going to consider societal risks in the rulemaking, it would need to revisit things like the one-step licensing where it refused to consider this (16). A commenter stated that collective dose or population risk should be considered when conducting a multi-attribute analysis (8883).

Several commenters stated that the NRC should consider possible risks to humans that might result if the decommissioning standard causes a curtailment of medical uses of radioactive materials (336, 441, 1397, 1451, 1661, 1906, 2721, 2879, 3203, 3641, 4154, 4872).

Other commenters favored (1939, 3019, 3141, 3545, 3747, 4400) and disfavored (2430, 3158, 3351, 3382, 3397, 3421) distinguishing between voluntary and involuntary risks when making cost/benefit analyses.

One commenter wants all future potential land use evaluated and not just the next one (3765). A commenter noted that it is important to consider both current and future populations (8922, 8924).

2.6.3 ALARA Considerations

Under the ALARA concept, decommissioning activities are continued beyond meeting applicable risk/dose limits in efforts to reduce radiation exposures As Low As Reasonably Achievable (ALARA). Most commenters recommended that the NRC's radiological criteria should incorporate this principle (204, 310, 936, 959, 994, 1017, 1024, 1091, 1098, 1099, 1107, 1322, 1348, 1824, 1957, 2064, 2070, 2287, 2503, 2526, 2539, 2590, 2594, 2595, 2599, 2631, 2649, 2704, 2778, 2894, 2989, 3014, 3025, 3030, 3361, 3369, 3372, 3383, 3385, 3388, 3408, 3466, 3490, 3522, 3564, 3597, 3601, 3681, 3699, 3752, 3807, 3815, 3879, 3973, 4103, 4107, 4208, 4253, 4279, 4314, 4333, 4353, 4386, 4389, 4391, 4408, 4450, 4477, 4489, 4813, 7022, 7132, 7133, 7268, 7279, 7303, 7390, 7396, 7431, 7434, 7435, 7502, 7516, 7525, 7531, 7571, 7624, 7630, 7697, 7772, 7773, 7843, 7849, 7852, 7855, 7858, 7876, 7912, 8023, 8037, 8126, 8136, 8138, 8156, 8192, 8258, 8303, 8311, 8321, 8327, 8350, 8389, 8407, 8441, 8470, 8473, 8488, 8495, 8498, 8532, 8533, 8550, 8554, 8556, 8558, 8570, 8574, 8585, 8589, 8609, 8632, 8637, 8662, 8664, 8668, 8669, 8685, 8721, 8749, 8861, 8865, 8903, 8937). See discussion also in Section 2.4.1. Some commenters said that ALARA efforts to reduce dose should not be applied below a screening level (994, 1957, 2894, 3025, 4799, 7773, 8037, 8052, 8129, 8441, 8481, 8944). Several commenters disagreed with the use of an ALARA provision (524, 961, 1007, 1015, 1157, 1316, 2073, 2304, 2547, 2616, 2624, 2643, 2644, 2647, 2654, 3412, 3772, 3872, 4190, 4216, 4231, 4396, 4417, 4422, 4471, 4873, 7812, 7992, 8251). Some commenters stated that the meaning of ALARA should be specified in the rulemaking or in guidance documents (1024, 1157, 2604, 2647, 3322, 4226, 4393, 4402, 4412, 7023, 7036, 7097, 8085, 8882, 8897). Others stated that ALARA is already incorporated in NRC regulations and works effectively (1017, 2646, 2651, 2778, 3800, 4477, 7279, 8669). Several commenters stated that state and local governments should be involved in ALARA determinations (3872, 4190, 4216, 4394, 4414, 7920, 8749). Commenters both favored and cautioned against turning ALARA into site specific criteria (7133, 7303, 8907).

Several commenters stated that the upper risk/dose limit should be set at a sufficiently low level to assure adequate public protection and that ALARA costs should be considered only in connection with how far below the limit further decontamination will be carried out (195, 791, 936, 959, 1824, 4814, 7430). Organizations have used and proposed a wide-range of dollars spent per man-rem averted under ALARA operations (197, 198, 202, 1081, 2627, 7023, 7279, 8079, 8083, 8090, 8138, 8251, 8403). For applying ALARA, valuation of a health effect averted should be derived from data on health decisions that society, not government agencies, has made (8091).

One commenter cautioned that standards of ALARA must never be allowed to be determined by those with vested interests (G237).

Some commenters stated it is unrealistic to set a fixed value for this, because of the many variables at nuclear facilities (199, 200, 7036). Others stated that it is possible to develop such a number (1206, 1214, 4353). One commenter stated that in some cases, due to a reluctance or difficulty associated with assigning a dollar value to such things as a life, discomfort, ecological impacts, and public concern, it may be desirable to implement some other unit of equivalency (8910).

One commenter stated it is important to consider current and future populations and that under the ALARA process future doses could be discounted along with other future costs (8921).

Other commenters indicated that a complete ALARA cost-benefit assessment cannot be calculated without a population dose and that this may not be meaningful for decommissioned sites (201, 204, 1331, 8403, 8441). Notwithstanding, commenters stated that although a complete ALARA cost-benefit may not be possible, ALARA will help to establish bounds for protecting the public (204, 8403).

One commenter said that ALARA should be achieved by derating or shutting down nuclear reactors (1074).

One commenter said that ALARA in decommissioning should be distinguished from day-to-day operations (3359).

One commenter advised that the ALARA process address both radiological and non-radiological risks to the workers performing clean-up (8948).

2.6.4 Effective Use of Resources

Several commenters stated that cleaning up to any specified level is technically achievable; it is simply a matter of how much it will cost (228, 449, 565, 1123, 1201, 1798, 1815, 3345, 8735). Some said that they believed decommissioning costs to return sites to unrestricted use could be so high that the sites should be kept under continued control and maintained as a restricted area (558, 560, 8580). One commenter would like to see a large amount of money spent on resolving waste problems (3208).

Many commenters objected to a return-to-background standard and stated it would be a waste of money to try to do this (99, 400, 452, 489, 491, 688, 752, 780, 821, 1541, 1635, 1673, 1699, 1768, 1772, 1815, 1823, 1827, 2030, 2373, 2388, 2392, 3711, 3865, 3963, 4390, 4874, 7407, 7579, 7580, 7616, 7860, 8060, 8366, 8871). Those objecting indicated that under a return-to-background standard risks would be reduced below what is acceptable and decommissioning costs would be prohibitively high. Some favoring a return-to-background standard recognized that this could be expensive (2115, 3004). See the discussion also in Section 2.4.3. Other commenters objected to a best available technology standard, because it is believed to require unreasonable expense without regard to benefit (2642, 8057, 8450, 8606). See discussion also in Section 2.4.2.

Some commenters suggested that money saved on unnecessary decommissioning activities might be used in other activities more beneficial to the public (209, 218, 222, 464, 727, 1534, 1943, 2393, 2860, 3146, 3157, 3290, 3711, 3840, 3852, 3858, 3937, 4384, 4812, 4839, 7760, 7944, 8013, 8031, 8080, 8081). Other commenters stated that money saved on decommissioning costs would not necessarily be available for societal betterment (468, 3855, 4379).

Some commenters stated that a generic decommissioning standard would assure a better allocation of resources for

cleanup (1966, 2051, 2078). One commenter stated that efficient and effective allocation of resources is influenced by public perception which sometimes motivates public agencies (7755).

A number of other comments were made on the importance of costs in the setting of decommissioning standards as follows:

Some commenters stated that adoption of risk limits would assure appropriate expenditure of resources (2027, 2501), but these should be translated to measurable criteria for application by small users of radioactive materials (2067, 8888).

Superfund decommissioning costs have been high (1745, 8355).

Costs are likely to be the determining factor in all decommissioning standard choices and options (221, 1204, 1805, 2578, 2588, 3446, 8278, 8384).

Resources should be spent wisely (229, 662, 1201, 1267, 1281, 1662, 1729, 2328, 2360, 2392, 2410, 2428, 2438, 2610, 2860, 3001, 3244, 3345, 3346, 3353, 3375, 3426, 3531, 3535, 3620, 3631, 3711, 3818, 3840, 3852, 3915, 3918, 3934, 3943, 3963, 4005, 4092, 4144, 4238, 4241, 4347, 4366, 4482, 4875, 4876, 7116, 7120, 7282, 7305, 7311, 7561, 7565, 7640, 7760, 8057, 8080, 8157, 8333, 8337, 8355, 8384, 8392, 8767).

Costs of decommissioning should be considered before the plant is built (1329).

The amount of money spent on decommissioning to achieve health benefits should be in the same range as those spent for remediating other hazards in society (7529).

Decommissioning costs are not fungible, nor within the NRC's authority to disburse (210).

People will pay anything to clean up the environment (808, 2082, 2562).

Industry should not be producing radioactive contamination in the first place because the cost of cleaning up is so tremendously high (369, 802, 1993, 3417). One commenter said the cost is borne by the public (793).

Cleanup costs are minuscule compared to total costs of operations, but are substantial (4308).

Many commenters stated that the NRC should base its decommissioning standards upon risk/benefit analyses (7760, 7774, 8013, 8060, 8074, 8080, 8081, 8119, 8278, 8431, 8564). See discussion in Section 2.6.1.

One commenter stated that standards which minimize waste and permit recycle are in the national interest because they permit more effective use of waste disposal capacity and conserve resources (8952).

2.7 Intangible Characteristics of Criteria

2.7.1 Acceptability/Fairness

Several commenters recommended that NRC decommissioning standards be based on consensus judgments of acknowledged national and international radiation experts (330, 402, 649, 958, 1823, 3344, 3493, 3737, 4196, 8336, 8457, 8497). See the discussion also in Section 2.5.1 for additional information. One commenter stated the NRC should provide a thorough and reasoned explanation for whatever decommissioning standards are adopted and why it did not choose other suggested approaches (7871). Educating the public about background radiation may assist in the public's acceptance of cleanup criteria greater than background (7151). The standards adopted should provide needed protection of the public but should not go beyond this (2768, 2769, 2888, 3161, 3338, 3349, 3379, 3444, 3477, 3728, 3753, 3850, 3945, 4382, 7869, 8160, 8166, 8171, 8264, 8336, 8348, 8546, 8625, 8641, 8647). Some commenters observed that a generic decommissioning standard is important for public acceptability and fairness both to those regulated and those exposed to decommissioned sites (3659, 3671, 3686, 3697, 8354). Several commenters stated that regardless of the basis for assessing risk levels, the choice of what levels of risk are acceptable should be made by the public (11, 122, 124, 125, 633, 3569, 7658, 7706, 7810, 8701, 8712). The question of distinguishing between voluntary and involuntary risks bears on this issue (2286, 2432, 2864, 3061, 3142, 3197, 3350, 3543, 3905, 7753, 7791, 8272, 8274, 8286). Some commenters stated that safe risk levels should be established across the board for all substances (2316, 3941). See discussion also under Section 2.6.2.

Some commenters voiced a general distrust of corporations, the scientific community, federal agencies, and state governments (368, 396, 403, 654, 947, 948, 1004, 1014, 1401, 1420, 1435, 1489, 1492, 1563, 1581, 1707, 1734, 1738, 1925, 1932, 1938, 2036, 2104, 2207, 2319, 2405, 2626, 2729, 2736, 2737, 2738, 2739, 2741, 2743, 2744, 2745, 2748, 2750, 2753, 2848, 2977, 3108, 3172, 3174, 3176, 3315, 3433, 3516, 3581, 3757, 3774, 4348, 4356, 4381, 4425, 4492, 4816, 7100, 7266, 7675, 7706, 7724, 7731, 7791, 7869). One commenter advised not repeating past actions such as undue exposures for "expedient" reasons (2985).

Various comments were given concerning how to make decommissioning standards acceptable to populations near decommissioned sites. One commenter suggested that people living nearby would normally embrace decommissioning standards because decommissioning will reduce any existing radiation risks from ongoing operations (119). Another commenter stated that the public will not accept the concept of acceptable risk when there is scientific uncertainty about risks (7100). Others stated that the acceptability to nearby populations will depend on what voice a local community will have in deciding whether a decommissioning plan is satisfactory for a given site (248, 785, 1261, 2508, 2557, 2559, 2655, 2731, 2734, 3414, 3690, 4410, 7978, 8286, 8701). Site employees living nearby may regard the small exposures incurred as acceptable (1010, 1016). Whether or not it is satisfactory depends on what decontamination levels will be achieved (335, 409, 1008, 7575, 7598), what the ensuing risks will be (639, 661, 920, 1109, 1280, 1288, 4132, 7575, 7753, 7791, 8428), and how the decommissioned site may be used in the future (541). Other commenters stated that the NRC's new decommissioning standards should apply to all present, past, and future sites (8004, 8503). Some commenters recommended that licensees be required to set aside funds to facilitate local public information and participation and, perhaps, funds for financial compensation to people nearby who might be adversely affected (1044, 1571, 2731).

Commenters urged that decommissioning standards be established so that full costs of operating a nuclear facility throughout its decommissioning can be evaluated up front (120, 733, 737, 1342, 1497, 2052, 2757, 3493, 3659, 8266). This will enable utilities to plan for recovery of all decommissioning costs and permit regulatory agencies to hold nuclear organizations fully accountable for this activity (1497, 1531, 1554, 1777, 1992, 2095, 2469, 2869,

3051, 3129, 3902, 4541, 7706, 7731). Several commenters indicated that the NRC should make its decommissioning standards explicitly clear and explain how these will provide adequate protection of the public health, safety, and welfare (121, 333, 779, 3065, 8710). In particular, one commenter stated that it will be difficult to pick a risk standard and justify it with computer modeling unless the standard and modeling is understandable to the public (123). Another commenter stated that public confidence will be assured by setting a screening level that is measurable and verifiable (8128).

Two commenters stated that it would be unfair to permit states to set limits more or less restrictive than the national standard since that would result in unequal and involuntary transfer of risk to people in other states (4490, 8281). Another commenter rejected the idea that state regulations should not be more stringent than federal rules (7478). One commenter stated that it is imperative that the NRC and the EPA agree on underlying bases and assumptions prior to beginning a dialogue in a public forum on the appropriate value to be used in assessing site cleanup (8323).

2.7.2 Stability and Consistency

Several commenters stated that decommissioning standards are needed by the NRC to facilitate long-term planning by the nuclear industry (306, 353, 3496, 3660, 3676, 3706, 4201, 7083, 7564, 7766, 7799, 8527, 8599) and to provide stability against constantly changing standards over the years (127, 129, 130, 306, 938, 1177, 1203, 3639, 3724, 4195, 8527, 8542). These should be consistent with clean-up criteria applied in the past (2908, 3556, 4251, 4512, 8475). Without generic standards, the standards applied on a case-by-case basis will be wasteful of regulatory resources, non-uniform, and applied differently from place to place (353, 1279, 4277, 7083, 7599, 8159). Some commenters stated that even generic standards may not be completely stable (15, 128, 1181, 1196, 3181, 3272, 3297), because they will need to be changed as a result of newly perceived health effects (339, 1036) and improvements in technology (546). Other commenters stated that a risk-based standard with the ALARA principle will be the most stable standard (548, 1173, 1402, 2026, 3262, 4251). One commenter believes some sites should be treated differently and site cleanup not sacrificed for regulatory stability (3265).

Commenters stated that there is a need for compatibility and consistency between the regulations and standards of the EPA, the NRC, and the states (523, 529, 2106, 2880, 3243, 3260, 3328, 3496, 3498, 3517, 4184, 4201, 4213, 4221, 4247, 4267, 4277, 4291, 4507, 7799, 8021, 8438, 8654, 8830). It is difficult for state regulators to explain to the public why federal agencies do not always use the same numerical limits (1558). Other commenters said that the NRC's adoption of a risk/dose limit of 100 millirems per year, with a proper application of ALARA, would result in a risk of ten to the minus six per year and a ten to the minus four lifetime risk which would be consistent with the EPA's Superfund goal/limit (1153, 3767).

A state official recommended that a consistent approach should be established for radioactive materials used and produced in the nuclear industry and for naturally occurring radioactive materials (548, 3122, 3230, 3554, 3639, 8021). According to several commenters, a return-to-background standard would not ensure regulatory stability (1177, 1185, 1187, 1189, 1193, 1197, 2910, 4392, 8567). One commenter stated that only a return-to-background will achieve regulatory stability (8233). If a return-to-background standard is used and if consistency is to be achieved, farmers would have to clean up their fields, and people who buy Brazil nuts would have to ship their shells to a low-level radioactive waste site (548). Also, consistency is needed in the risks considered acceptable in the development of standards for chemical toxicants and those for radioactive materials and radiation (3576, 3625, 3834, 3844, 3862, 3867, 3949, 4507).

For stability and consistency the NRC should be careful about granting exceptions (3047). One commenter stated there was inconsistency in the NRC's positions on effects of low level radiation (3162).

2.7.3 Clarity

Several commenters stated that the rulemaking should give clearly defined direction on how to go about getting sites cleaned up and decommissioned (131, 742, 914, 1366, 1393, 1595, 2257, 3253, 3434, 4659, 7021, 7085, 7881, 8562, 8610, 8612, 8642) and emphasized the need for simple and unambiguous requirements (134, 288, 964, 1366, 1412, 1580, 1888, 3434, 3447, 7029, 7292, 7881, 8642, 8661). Quantitative definitions of decommissioning criteria for unrestricted release are needed (964, 1386, 1412, 1580, 2257, 7719). In this regard, the standards should not be subject to different interpretations by lawyers (132, 1580, 8665). Three commenters noted a lack of knowledge about concepts and terms regarding dose (7089, 7248, 8791).

Several commenters recommended that the standards should be set out as numerical and measurable quantities (132, 288, 742, 2257, 2813, 7021, 7719, 7881, 7953, 8118, 8772). Other commenters suggested that clear guidelines for demonstrating compliance should be provided (914, 7292, 7351, 7719, 7881, 8103, 8118, 8458, 8610, 8612, 8661, 8665).

One commenter said that we are not communicating effectively because "risk" means different things to different people (2398).

2.7.4 Flexibility

Many commenters requested that flexibility be provided in the NRC's decommissioning standards and criteria (33, 116, 135, 136, 298, 379, 382, 428, 743, 915, 1343, 1346, 1410, 1417, 1813, 1838, 1855, 1980, 2505, 3038, 3040, 3055, 3319, 3436, 3495, 3500, 3609, 3644, 3647, 3655, 3672, 3687, 3691, 3695, 4609, 7061, 7427, 7828, 7850, 8016, 8028, 8048, 8299, 8300, 8312, 8382, 8437, 8868). Flexibility was discussed with respect to the following considerations:

State and local concerns need to be addressed (116, 136, 3319, 3500, 4178).

The rule must be flexible enough to accommodate site differences, e.g., types of radionuclides present, the geology and environmental surroundings, individuals who may be exposed, and possible exposure patterns (33, 135, 743, 1310, 1855, 1961, 1971, 2001, 2023, 2381, 2903, 3038, 3040, 3055, 3288, 3495, 3618, 3647, 3655, 3672, 3687, 3698, 7061, 7427, 7779, 7831, 8028, 8344, 8489).

Exposure of future generations must be considered (382, 428).

Setting a return-to-background standard would reduce flexibility (1455, 7617).

Standards may need to be stricter as new scientific information comes to light (379, 380, 2498, 2542, 3609).

New technologies should be allowed without awaiting rulemaking changes (1199, 1813, 3249).

Provide flexibility where meeting restrictive requirements could result in exorbitant costs (4877, 8299, 8344).

Radon from naturally occurring radioactive materials will be encountered at sites (1838).

One commenter stated that care must be exercised to ensure that "flexibility" in generic rules does not translate to

"loopholes" that would impair the NRC's ability to protect public health (1421). Another commenter stated that too much flexibility can undermine standards (4158). Still another commenter suggested that the rulemaking address requests for exemption from codified dose limits (7512).

2.8 Implementation

2.8.1 Site Cleanup

Several commenters stated that they were concerned about licensee responsibility for cleanup of contaminated sites and whether sufficient funds are available to decommission each contaminated site (1972, 2797, 2865, 2870, 3217, 3367, 3380, 4357, 4359, 4542, 7707, 7726). Some of them stated that the NRC should assure that licensees are held strictly liable for any site not meeting the cleanup criteria (2820, 7817, 8237, 8244). Other commenters stated that sites should be decommissioned quickly while others disagreed (1161, 3370, 3954, 4516, 4528, 4531, 4542, 7590).

Commenters stated that the NRC should ensure citizen participation in decommissioning from the earliest stage of cleanup (1260, 1327, 1395, 1448, 1972, 1985, 1987, 2639, 4878, 7904, 8284, 8805, 8824), should provide for aid to local communities similar to the technical assistance grants under EPA Superfund rules (1160, 3296), and should be modeled on those of the Federal Facility Clean Up Board (SSAB) (2828, 2829). Another commenter suggested that public citizen groups should be involved in environmental monitoring and have an option to split samples with the NRC on a voluntary basis (2824).

According to several commenters the cost of decommissioning could be high (564, 789, 1998, 2548, 2561, 2587, 2611, 2797, 3515, 3866, 4088, 4170, 4240, 7809, 8244, 8736), but cleanup technologies are believed by most commenters to be available for achieving whatever level is set by the NRC (263, 264, 265, 277, 564, 824, 826, 828, 1022, 1096, 1640, 1998, 2102, 2301, 2349, 2352, 2587, 2746, 2793, 2794, 2795, 2796, 2941, 2966, 3250, 3895, 4150, 4242, 4361, 4368, 4427, 7319, 7603, 7809, 7907). The NRC should describe acceptable methodologies for cleanup and measurement to reduce subjective judgments (2790, 2792, 3251, 3520, 4341, 4407, 4416, 4433, 7291, 7422). Commenters suggested that decommissioning proposals should be submitted and approved at the design stage, and, consequently, newer facilities should be easier to decommission (3399, 3486, 4364).

A number of approaches to decommissioning were discussed, including levels to be adopted and possible restrictions on releases (429, 455, 501, 604, 789, 828, 831, 1005, 1022, 1067, 1111, 1210, 1360, 1376, 1395, 1459, 1692, 1767, 1774, 1923, 2096, 2099, 2213, 2299, 2365, 2521, 2527, 2797, 2798, 2876, 3056, 3072, 3073, 4433, 4531, 4817, 4879, 7044, 7053, 7121, 7123, 7135, 7312, 7319, 7385, 7425, 7544, 7667, 7680, 7687, 7777, 7809, 7817, 7830, 7999, 8001, 8038, 8198, 8237, 8244, 8294, 8544, 8568, 8757). Some commenters gave views on whether criteria should be developed for selecting a cleanup contractor (1345, 1456, 1457, 1467). Other commenters stated that workers who perform cleanups should be appropriately trained and protected (2899, 3437, 3608, 4321, 4327, 7108, 7291, 7613). Some sites have been released to unrestricted use (3683).

Some commenters requested that sites undergoing decommissioning under NRC regulations be simultaneously held to standards for chemical non-radiological contamination under other agencies' applicable regulations (758, 1160, 2827, 4324, 7982). The EPA's RCRA and CERCLA regulations were specifically mentioned (1683, 8180, 8639). Some commenters spoke favorably about Superfund while others spoke against it (2795, 3294, 3296, 3301, 3305).

Several commenters stated that the costs of decommissioning are a primary consideration and that risk/benefit balances should be performed to ensure that the amount of health benefit gain justifies the effort and costs necessary

to achieve it (564, 789, 2794, 2795, 2890, 3348, 3448, 4316, 4318, 4331, 4343, 4351, 4365, 4442, 4470, 8757, 8885). One commenter was concerned that "small messes" might be cleaned up while ignoring larger ones (3062).

2.8.2 Demonstrating Compliance with the Criteria

Several commenters recommended that the NRC should establish numerical limits that are measurable in its decommissioning standards and cautioned against reliance on models for demonstrating compliance (133, 267, 283, 898, 776, 913, 1202, 1354, 2000, 2003, 2324, 2780, 2881, 3356, 3521, 3590, 3603, 3627, 4016, 4387, 4480, 4818, 4821, 4880, 4881, 7504, 7573, 7622, 7699, 7758, 7873, 7991, 8101, 8293, 8332, 8367, 8414, 8427, 8604, 8855). One commenter recommended full-scale characterizations of representative sites, using the same methodology to be implemented to demonstrate compliance with the final standard (G1121). See discussion on modeling also under Section 2.5.5. If we have a regulation that says risk levels shall be such and so, we still need to know how many picocuries per gram can be left in the soil, because that is what we will analyze for (276, 1093, 2701, 2868, 2893, 3058, 3059, 3095, 3356, 3510, 4360, 7718, 8105, 8197). Other commenters stated that NRC should provide flexibility in implementation of the standard to avoid high cost of compliance actions that produce little or no reductions in risk (7778, 8889). Commenters cautioned that the NRC cannot leave it to the licensee and whatever he says goes (275, 1174, 1296, 1794, 2041, 2982, 3152). There must be no misunderstanding about the objective in a decommissioning project (287, 4826, 8039, 8604). The NRC should avoid regulatory requirements that are extremely difficult or impossible to enforce and should avoid giving optional methods of compliance (7636, 7882, 7897, 7991). Other commenters suggested that historically there has been insufficient monitoring at sites which have undergone decommissioning (542, 963, 1070, 3058, 4820). Licensees must carry out appropriate monitoring to demonstrate that the standards have been met, and the NRC must make sufficient confirmatory measurements to check this and appropriately enforce them (286, 898, 932, 1041, 1263, 1720, 1779, 1912, 2987, 2988, 4486, 4818, 4824, 4826, 7015, 7071, 7124, 7129, 7267, 7301, 7353, 7597, 7668, 7718, 7787, 7906, 8709).

Several commenters stated that demonstration of compliance with NRC decommissioning rules and applicable radiological limits is a major issue (266, 269, 270, 337, 913, 1641, 7636, 8293). The NRC must provide clear guidelines with respect to the kinds of measurements that are necessary and the models that are acceptable to demonstrate compliance. With respect to measurements, guidance should cover:

Acceptable measurement methods (279, 763, 927, 7148, 8577, 8901).

Extent of measurements needed (266).

Use of field instruments versus laboratory instruments (266, 8332, 8334).

Statistical sampling (266, 279, 8577).

Calibration standards and measurement certification (279, 7148).

With respect to models and methodologies, guidance should be provided on their use, uncertainties, and how to apply site specific characteristics (285, 327, 344, 1220, 1265, 1354, 1434, 1849, 2685, 2688, 3067, 3095, 3152, 3356, 3510, 3521, 3590, 4825, 4882, 7550, 7886, 7965, 8039, 8105, 8108, 8387, 8577, 8680, 8876). A generic screening should be devised that can decide a generally applicable level below which cleanup is not required (7051, 8039, 8101, 8102, 8127, 8334, 8341, 8353, 8552). One commenter indicated that logically, there is little to be said for the concept of a generic site inventory level (7144). Commenters recommended that guidance for determining dose from different pathways be consolidated (1226, 1237, 1894, 7447). Other commenters remarked

that whatever standards and criteria the NRC adopts must be practical and able to be implemented in the field (268, 308, 322, 8197).

One commenter stated that a big problem in decommissioning a site is disappearing records and fading collective memory; NRC decommissioning standards should address this (7368).

Several commenters stated that it would be technically difficult to meet and enforce a return-to-background standard because of continuing measurement fluctuations in background radiation and inherent measurement uncertainties (statistics) of instruments (273, 274, 451, 1441, 1676, 2091, 2348, 2434, 2576, 2584, 2701, 2705, 4086, 4273, 4350, 4358, 4387, 4563, 4821, 4822, 4883, 8063, 8367, 8452, 8616).

Some commenters stated that historically the NRC has failed to enforce its rules diligently and better performance is needed (2987, 2988, 2998, 3582, 4265, 4296). One commenter stated that the NRC should require licensees to certify compliance, and this will put the burden of documentation and proof of compliance on the licensee (7636).

One commenter recommended that the NRC should not grant exemptions from its decommissioning standards (1968). Another commenter recommended that the NRC consider granting exceptions if alternative means of protecting public health and safety can be demonstrated (1172).

2.9 Finality/Grandfathering

Commenters stated that the NRC's decommissioning standard should be long-lasting and provide a final solution for decommissioning sites that are contaminated with radioactive material (143, 332, 387, 543, 937, 1400, 1747, 2068, 2087, 2389, 2507, 2512, 2549, 2699, 2886, 3704, 4161, 4169, 4176, 4179, 4204, 4222, 4239, 4256, 4446, 7011, 7583, 7757, 7857, 7911, 7924, 7980, 8018, 8058, 8110, 8112, 8144, 8167, 8193, 8338, 8358, 8449, 8595, 8614, 8630, 8633, 8643). The NRC's standard should be consistent with EPA rules to assure that a site remediated under NRC rules will not require further remediation under EPA rules (521, 3242, 4166, 4191, 8206).

One commenter suggested that states should be required to adopt federal decommissioning standards (3330). Other commenters disagreed (1967, 4171, 4305). Several indicated that state and local governments should have a say in what is acceptable at a site (2482, 2507, 4205, 4232).

Some commenters questioned whether it is possible to have finality in decommissioning standards, because of likely new information and improved technology in the future (1325, 2084, 2093, 2300, 2308, 2530, 4232, 7153, 7604). They stated that sites should continue to be remediated as necessary to meet new standards (138, 139, 140, 515, 516, 573, 575, 617, 1151, 1156, 1967, 4166, 7017, 7604, 8003, 8236). Those opposed stated that rules should be changed only if a substantial increase in public safety can be demonstrated (141, 142, 3242, 3391, 4161, 4169, 4204, 4239, 4256, 7278, 7300, 7402, 7583, 7924, 7929, 8018, 8112, 8144, 8163, 8338, 8595, 8597, 8633).

Some commenters argued against the NRC's licensing a site forever to cover possible residual contamination, but some commenters favored a continuing NRC license and regulatory control (1414, 1718, 2084, 2518, 2566, 2935, 4217).

Some commenters stated that a return-to-background approach would provide regulatory stability (1659, 2146, 2308, 2518, 4171, 4205, 8236) and that finality would be best served because anything less stringent will make industry legally liable for inadequate cleanup (1659, 1750). Others thought a return-to-background standard would cause more instability (1695, 2500, 2529, 2537, 2549, 2699, 8150, 8193, 8369).

2.10 Generic Versus Site Specific Considerations

Most commenters favored the NRC's establishing a generic standard over site specific standards (157, 345, 352, 354, 357, 361, 363, 414, 417, 659, 954, 979, 982, 983, 1002, 1033, 1089, 1097, 1321, 1326, 1406, 1407, 1408, 1409, 1411, 1413, 1415, 1418, 1419, 1424, 1425, 1426, 1442, 1445, 1447, 1450, 1822, 1953, 1965, 1981, 1999, 2021, 2024, 2040, 2043, 2044, 2049, 2050, 2054, 2058, 2062, 2065, 2075, 2076, 2089, 2166, 2203, 2378, 2495, 2656, 2850, 2857, 3002, 3013, 3020, 3021, 3027, 3035, 3037, 3039, 3041, 3048, 3053, 3084, 3632, 3633, 3637, 3642, 3643, 3646, 3653, 3654, 3658, 3670, 3674, 3678, 3685, 3688, 3692, 3694, 3696, 3700, 3705, 3710, 3712, 3715, 3727, 4022, 4200, 4254, 4280, 4444, 4447, 4526, 4536, 7098, 7276, 7304, 7507, 7563, 7592, 7600, 7767, 8020, 8211, 8346, 8351, 8526, 8541, 8624, 8634). While supporting the establishment of a generic standard, some urged the NRC to:

Permit site-specific considerations (160, 349, 357, 360, 585, 651, 1627, 1953, 2040, 2043, 2049, 2054, 2062, 2076, 2872, 3021, 3037, 3039, 3053, 4022, 4884, 7592, 7781, 7816, 7832, 7891, 8346, 8372, 8504, 8706, 8738, 8750, 8756, 8770) and site-specific modeling for licensees to demonstrate compliance (156, 681, 982, 1002, 2621, 3508, 3649, 3654, 3670, 4022, 7507).

Recognize differences in the kinds of nuclear operations carried out at a site (159, 1407, 1409, 1415, 2065, 2203, 2522, 3008, 3021, 3503, 3674, 7304, 7781, 7816, 8756).

Define the terms used in the standard and include quantitative limits so that there is an understanding of the requirements, equal application of them, and avoidance of wastage of time and resources (348, 966, 1411, 1413, 2065, 2166, 3677).

Establish one acceptable limit rather than upper and lower limits (363, 1426, 8640).

Base the generic standard on technology and not on politics (375).

Establish return-to-background as the acceptable standard (1422, 1468, 2021, 2058, 2522, 3002, 3015, 3041, 3665, 3713). What flexibility would be allowed if no pre-operational readings were taken (2901)?

Avoid establishing return-to-background as the acceptable standard (1450, 3027, 3708).

Assure new risks are not created somewhere else (1442).

Assure participation by local communities in establishing site-specific limits (1447, 2040, 2044, 2054, 2872, 3084, 3665, 3692, 3700, 3723, 4200, 7903, 8706, 8738, 8750).

Provide flexibility to accommodate stricter standards dictated by newly acquired scientific information (378, 2495).

Provide flexibility for parties to come to agreement (659, 1002, 1120, 1409, 1415, 2058, 2495, 2904, 3037, 3039, 3053, 3646, 3670, 3685, 3694), but ensure there are no "loopholes" (1419, 1425, 3632, 3653).

Adopt a risk-based standard and provide for practical implementation (1097, 1822, 1953, 2024, 2203, 2850, 3027, 3084, 3536, 3633, 3643, 3649, 3678, 3715, 4022, 4254, 8351, 8469, 8634).

Some commenters expressed reservations or voiced objections to the establishment of a generic standard (348, 366, 371, 488, 656, 897, 986, 1117, 1306, 1318, 1428, 1525, 2033, 2534, 3202, 3286, 3401, 3669, 4064, 4532, 7062, 7142, 7360, 7937, 8053, 8121, 8232). Reasons given were:

A generic standard should be developed only after public airing of the many issues and scientific information not supported by the nuclear industry (366, 371, 4064, 4532).

Site specific parameters and past experience should be considered (488, 897, 986, 1117, 1306, 1318, 1481, 2033, 2534, 3202, 3286, 7062, 7142, 7863, 8053, 8121, 8232, 8372, 8504).

Political considerations should influence radiation exposure guidelines, and political compromise may cause a generic standard to provide less protection than would a collection of standards (7937, 8232).

A generic standard may not be compatible with certain Indian treaty rights and may not address important environmental and cultural conditions (656).

A federal generic regulation must not preempt more restrictive state or municipal regulations and requirements (8232).

Verification of compliance with a generic standard is purely theoretical. Modeling depends on the good faith of licensees, and assuring compliance places a burden on intervenors or the NRC staff (986).

There is a lack of technical information and a problem with modeling (1117).

The scientific and medical communities do not agree on the effects of low-level radiation (1525, 4064).

One commenter stated it would be a grave mistake to use a generic ALARA for all sites (7134). Several commenters recommended site-specific ALARA assessments (7134, 7433, 8137, 8390, 8905, 8946).

2.11 Sites Which Cannot Be Released for Unrestricted Use

Most commenters stated that the NRC should establish standards for both unrestricted and restricted release of sites (166, 167, 169, 170, 172, 555, 559, 562, 764, 830, 906, 919, 1027, 1030, 1077, 1083, 1121, 1126, 1128, 1394, 1427, 1432, 1653, 1654, 1691, 1698, 1701, 1956, 1974, 2032, 2037, 2220, 2315, 2318, 2320, 2368, 2445, 2480, 2489, 2516, 2520, 2532, 2556, 2623, 2702, 2862, 2937, 3009, 3046, 3049, 3050, 3057, 3113, 3164, 3180, 3185, 3264, 3273, 3275, 3287, 3289, 3291, 3293, 3308, 3331, 3332, 3362, 3394, 3512, 3537, 3548, 3559, 3562, 3567, 3586, 3623, 3648, 3675, 3679, 3718, 3726, 4237, 4261, 4271, 4276, 4289, 4295, 4298, 4322, 4524, 4534, 4827, 7096, 7122, 7138, 7387, 7409, 7411, 7527, 7584, 7588, 7605, 7722, 7780, 7796, 7829, 7862, 7879, 7896, 7901, 7918, 8002, 8017, 8045, 8047, 8096, 8120, 8161, 8175, 8187, 8270, 8305, 8309, 8317, 8373, 8381, 8399, 8418, 8445, 8461, 8501, 8578, 8594, 8600, 8622, 8658, 8673, 8728, 8898). Some commenters disagreed and recommended that the NRC decommission sites only if these are maintained under continued regulatory controls (355, 388, 436, 536, 550, 1039, 1134, 1137, 1140, 1490, 1603, 1665, 1684, 1802, 1926, 1991, 2017, 2477, 2480, 2939, 3080, 3106, 3116, 3128, 3175, 3183, 3281, 3307, 3482, 3634, 4026, 4378, 4494, 7389, 7702, 7712, 8235, 8238) while still others recommended that the NRC require sites in all instances to be cleaned up suitably for unrestricted release (359, 362, 478, 675, 765, 1124, 1556, 2775, 2842, 2853, 3011, 3057, 3318, 3323, 3583, 3594, 3613, 3667, 3968, 3979, 4174, 4275, 4283, 4285, 4543, 4885, 7045, 7325, 7345, 7355, 7370, 7551, 7555, 7558, 7631, 7785, 7955, 8008, 8235, 8238, 8522). Some commenters cautioned that unrestricted release may not be possible if groundwater is contaminated (590, 1121) or if previously buried wastes are on site (8760, 8945).

Some commenters stated that sites should continue to be licensed by the NRC if they cannot be reasonably decontaminated (2536, 2928, 7033, 7409, 7424, 7588, 7683, 7702, 7785, 7808, 7819, 7879, 7896, 7901, 8002, 8309, 8505, 8578, 8600, 8658). Some commenters suggested that the NRC consider different levels of decommissioning or decontamination for different categories of licensees (562, 572, 2520, 3185, 3221, 3264, 3332, 3675). Others recommended that decommissioning of nuclear sites should be delayed (moth-balling) (355, 642, 1560, 1924, 7373, 7411, 7956, 8505, 8626) or that radioactive materials should be stored or entombed on site (163, 299, 355, 510, 1432, 1083, 1119, 1603, 2189, 2318, 2320, 2368, 2380, 2471, 2489, 2939, 3080, 3106, 3128, 3183, 3307, 3482, 7722, 7829, 8164, 8510) under continuing licensing responsibility. Also, commenters stated that the NRC should consider the option of restricted future use of decommissioned facilities only after a rigorous public participation process (7471, 8510, 8753). Several commenters stated that the NRC should provide public access to decommissioning records and maintain oversight of decommissioned sites (171, 1394, 1490, 1603, 1991, 2017, 3057, 3106, 3183, 3307, 3482, 3634, 4378, 4494). Other commenters stated that citizen groups should participate in determining what constitutes unrestricted use (8705, 8747, 8753) and in the oversight of contaminated sites (1336, 1394, 1714, 2556, 3298, 3318, 3667, 3726, 4322). Another commenter cautioned that regulating the restricted release cases could involve some expensive and difficult zoning problems for local authorities (832, 7471). One commenter stated that if a site cannot be decontaminated to acceptable levels, it should become the property of a state or the federal government (7033). Another commenter stated that every piece of property should have, as part of its deed record, information about its former contamination with radioactive materials (7066). Still another commenter suggested that if contamination is covered up by paint, concrete, or plaster so as to be undetectable, it is questionable whether that area of the facility is truly contaminated (7122).

Those favoring both restricted and unrestricted release standards, those favoring restricted release standards, and those favoring unrestricted release standards gave the following reasons for their positions:

- **FOR BOTH RESTRICTED AND UNRESTRICTED RELEASE STANDARDS**

Unrestricted release should be the goal, but realistically some sites cannot be cleaned up suitably for such release (169, 906, 1121, 1394, 1427, 1432, 1654, 2516, 2623, 2862, 2937, 3049, 3164, 3275, 3293, 4237, 4271, 4289, 4298, 4322, 4524, 7588, 7722, 7683, 7796, 7862, 7896, 7901, 8705, 8717, 8719, 8728, 8891).

Whether to require clean-up to unrestricted release standards or require continued restrictions should depend on the total risk and cost-benefit of the decommissioning operations (172, 2037, 3009, 3024, 3113, 3180, 3273, 3287, 3362, 3623, 3648, 3718, 4276, 7138, 7387, 7722, 7780, 7901, 8017, 8047, 8096, 8305, 8317, 8373, 8381, 8399, 8501, 8578, 8622, 8717).

Standards for both restricted and unrestricted release would minimize costs (555, 559, 2702, 3113, 3308, 3331, 3537, 3679, 4276, 7780, 7862, 8017, 8045, 8047, 8381, 8399, 8501, 8717, 8733, 8743).

Such standards would build public confidence that the NRC is protecting public health and not just industry's interests (919, 1030, 2445).

Only a return-to-background standard is acceptable for unrestricted release and restricted use standards are needed for other decommissioned sites (1077, 1138, 1394, 2037, 2320, 2489, 2520, 2556, 3101, 3548, 3586).

Limiting of decommissioning standards to unrestricted release misleads the public because it excludes real

circumstances where risk assessment might show that some restriction on use is necessary (1128).

The EPA's Superfund implementation covers both unrestricted and restricted releases (1701, 3332).

- **FOR RESTRICTED RELEASE STANDARDS**

If a problem develops down the road, restricted release gives you an opportunity to address it (164, 1603, 1665, 2017, 3106, 4026, 4378, 4886).

Perpetual care will be required for sites (165, 405, 1991, 2939, 3106, 3116, 3128, 3175, 3183, 3482).

Nuclear power plants could be converted to other alternative power production (4545).

Sites are economically and technologically not feasible to remediate to unrestricted release standards in the foreseeable future (341, 436, 536, 1802, 1991, 3116).

Licensees should have continuing responsibility, expense, and liability for wastes they have generated (388, 550, 944, 1131, 1134, 1137, 1490, 1991, 2477, 2480, 2939, 3106, 3128, 3130, 3183, 3482, 3634).

Although unrestricted release might be an appropriate goal, all decommissioned sites should be posted so the public is aware and can decide whether they want to come on site (1140).

Sites should be restricted until the public's uncertainty about the credibility of the industry, the EPA, and the NRC is resolved (1926, 2017).

- **FOR UNRESTRICTED RELEASE STANDARDS**

Companies may not be around any longer when additional remedial actions may be required (168, 2775).

Sites should be made available for subsequent use (359).

Maintaining continuing controls over a site under restricted release standards would be costly and possibly ineffective (432, 478, 7955, 8008).

In no case should a site be permitted to have residual radioactive materials under continued controls beyond 100 years (765).

If a site is not suitable for unrestricted release, it should be considered case-by-case (1119, 7325, 7342, 7355, 7370, 7373, 7411, 8831). There should not be any health risks to people off-site after decommissioning (2250).

Restricting use of sites creates problems of jurisdictional authority and control for state and local governments (1124, 2775, 4174).

If sites cannot be returned to background, they should not be decommissioned (1556, 2842, 3623, 7325, 7342, 7345, 7355, 7370, 7551, 7555, 7558, 7785, 8238).

Restrictions on land use could deprive access to sacred American Indian sites, homelands and historical sites (1783, 3583, 7315).

Several commenters made suggestions with respect to the kinds of restrictions that might be placed on decommissioned sites which are not released for unrestricted use. These included:

Perpetual care requirements (164, 165, 169, 388, 480, 510, 572, 2532, 2814, 3106, 3425, 4547, 4887); including devolving trusteeship upon each successive owner the liability for intended future use (G319).

Indefinite extension of liabilities through possession-only type licenses; require present and past landowners, operators and waste generators to be responsible for cleanup (G799).

Deed restrictions or easements, including restriction against use for any single-family, multiple-family, schools, motel, or recreational facilities (167, 170, 405, 1135, 1653, 7409, 7424, 7584, 7631, 7918, 8047, 8501, 8578, 8594, 8600, 8658).

Zoning restrictions permitting certain uses but not others (170, 1027, 1040, 1083, 4544, 8161, 8418, 8501, 8578).

Government take-over and continued oversight (1609, 7033, 7819).

Use of covenants based on half lives of radioactive materials onsite with a finite period for specified restrictions (1691).

Some sites can not be released under any condition (900).

One commenter suggested that land use not be restricted on the basis of a small amount of man-made radioactivity that presents no perceivable or calculated health risk (1166).

One commenter suggested that the restricted use decommissioning should be viewed as a factor influencing any of the alternative approaches for codifying residual radioactivity criteria rather than as a separate alternative approach (G1285). Another believed that assessments of future land use should be integrated as four sub-alternatives (residual, agricultural, recreational, and commercial/industrial) within each alternative considered, instead of being treated as an independent sixth alternative (G1134).

2.12 Waste Management Implications/Transference of Risk

Several commenters questioned whether there is enough space at a regional disposal facility for the voluminous soils and other materials that are expected from decommissioned sites (148, 154, 668, 1038, 1613, 1700, 1983, 2006, 2015, 2298, 2336, 2724, 3195, 3729, 3961, 4085, 7331, 7374, 7465, 7609, 7792, 7984, 8123, 8189).

Other commenters stated that irrespective of where or how wastes are disposed the costs of nuclear wastes management will be high (1752, 7374, 7705, 7709, 7714, 7725, 7746, 7792, 7802, 7821, 8009, 8216, 8221, 8222, 8224, 8228, 8254, 8603). Some suggested that until existing waste disposal problems are solved the rulemaking should be delayed (151, 356, 643, 668, 679, 1547, 1561, 2773, 3730, 7371, 7413). See also discussion in Section 2.11. One commenter hoped the NRC has learned from past experience and will require new licensees to provide a waste management plan before, not after, they contaminate a site or generate wastes (7331).

The extent to which low-level waste disposal space will be a problem depends on how low the NRC sets its radiological decommissioning standards (146, 1139, 2613, 3566, 3596, 3729, 3975, 4089, 4097, 4515, 7307, 8196, 8379, 8400, 8536, 8603). The lower they are set the more the volume of contaminated wastes will exponentially increase (146, 1139, 1594, 1619, 1633, 4091, 4236, 8379, 8603). The extent to which the ALARA principle is applied will also affect the amount of waste to be produced (1082, 4134, 8536, 8582). Several commenters

suggested that the volume of waste required to be placed in a regional waste disposal site should be kept to a minimum (13, 148, 154, 7309, 8536). Other commenters stated that if a permissive standard is set this could result in the spread of contamination into the environment (3970, 7329, 7371, 7659, 7671, 7674, 7677).

Several commenters stated that if a return-to-background standard for decommissioning is established, this would create the most waste (570, 1060, 1633, 2114, 2291, 2347, 4101, 4236, 7406, 8368) and result in unnecessary and costly effort that would merely transfer the small risks involved (394, 503, 514, 686, 1444, 1542, 1628, 1746, 2271, 2337, 2354, 2363, 2387, 2408, 2528, 3187, 3216, 3729, 3916, 3919, 3926, 3961, 3964, 4080, 4087, 4095, 4096, 4099, 7386, 7406, 8061, 8400). Other commenters suggested that the NRC consider the impact that its standard would have on naturally occurring radioactive materials (1599, 2397, 2401, 7866, 8061, 8196) and phosphogypsum if it were applied to that material (1649). Many commenters stated that a return-to-background standard is needed while many others disagreed. See discussion also in Section 2.4.3.

Several commenters stated that waste volumes should be reduced (583, 612, 614, 1144, 2291, 2332, 2468, 2817, 2911, 4094, 4098, 4101, 4134, 7309, 7313, 8165, 8196, 8513). Other commenters stated that there should be lower cost alternatives for the disposal of very low level wastes (2358, 2359, 2375, 2387, 3187, 7307). One commenter stated that consideration should be given to permitting disposal of low-level wastes in a solid waste landfill (2390). Other commenters disagreed (1474, 1476, 3075, 7329, 7371, 7659, 7671, 7674, 7677, 7743, 8222, 8513). Two commenters stated that shipment of wastes to foreign countries or dumping into international waters should be prohibited (7088, 8254).

Many commenters recommended that consideration be given to keeping radioactive wastes on-site and not moving these to off-site disposal facilities (149, 150, 152, 153, 213, 304, 318, 373, 477, 483, 492, 551, 577, 583, 586, 628, 1046, 1055, 1058, 1059, 1065, 1084, 1370, 1380, 1431, 1561, 1577, 1586, 1591, 1602, 1605, 1616, 1628, 1686, 1801, 2298, 2317, 2325, 4369, 7046, 7059, 7068, 7073, 7139, 7374, 7386, 7406, 7415, 7465, 7586, 7666, 7676, 7682, 7713, 7735, 7786, 7984, 8176, 8189, 8228, 8268, 8316, 8379, 8398, 8400, 8420, 8502, 8621). Reasons given included minimizing the total risk (213, 7068, 7139, 7406, 7415, 8061, 8316, 8379, 8398, 8400, 8621), avoidance of transference of risk (304, 373, 1046, 1058, 1084, 1527, 1631, 7386, 8268, 8398, 8621), avoidance of contaminating new pristine sites (150, 594, 799, 3204, 7386, 7786), making use of security systems already in place (7068), lack of waste disposal facilities (2325), avoidance of net land loss (583, 2233, 7682), selection of the most cost effective disposal alternative (7139, 7406, 7415, 8379, 8400, 8502, 8621), and questions about the safety of transporting wastes off-site (304, 577, 628, 1616, 7068, 7139, 7306, 7406, 7415, 7586, 7666, 7735, 8061, 8268, 8316, 8379, 8398). One commenter requested the rule require that all communities along transportation routes for radioactive materials be informed of the potential hazards and emergency procedures (G197).

Some commenters recommended that on-site retrievable-storage facilities be established and that wastes be required to be stored on-site (213, 304, 318, 373, 483, 583, 1058, 1084, 2379, 2449, 3079, 3184, 7068, 7374, 7676, 7735, 7984, 8165, 8228, 8507). Commenters suggested that appropriate actions should be taken to assure that the stored wastes do not threaten public health and safety (1591, 2085, 3190, 3340, 7676, 7735), including such requirements as continued licensing by the NRC (1561, 1602, 2478, 2481, 2565, 3127, 3184, 3395, 3960, 8507), continued licensee responsibility and financial liability (485, 511, 551, 923, 1488, 1561, 1566, 1628, 2565, 3184, 7656, 7682, 8507), public oversight (1561, 1637), encapsulation or other containment of wastes to minimize leakage to the environment (475, 492, 628, 1065, 1560, 1586, 1602, 1637, 2280, 7735, 7984, 8214), storage of wastes above ground (1065, 7676, 7735), continual health and safety monitoring (628, 2565, 7374, 7676, 7682, 7735, 7984, 8228), and denial of public access (security) (477, 1561, 1586, 1602, 7676, 8228). Some commenters suggested that the option of leaving radioactive wastes on-site should be considered as a temporary or intermediate option to permit decay of radioactive wastes and allow time for resolving long-term waste disposal problems (483, 492,

2326, 3967, 4527, 4530, 7609, 7957, 8165, 8507).

Some commenters recommended that radioactive wastes should be stabilized in place on-site and that appropriate steps should be taken to minimize and monitor for releases to the environment (149, 150, 152, 153, 477, 492, 551, 577, 583, 586, 628, 1031, 1046, 1055, 1059, 1065, 1577, 1801, 2367, 3340, 7139, 7415). One commenter stated that there should be no finality for wastes; those generating the wastes should have continuing liability (4233). Some commenters recommended that an inventory of contaminated sites be compiled (149, 150, 152, 153) and that these sites be considered for designation as low-level waste disposal sites (149, 150, 152, 153, 1055, 1801, 2915). Other commenters suggested that decommissioning wastes should be disposed of at existing mill-tailings sites (155, 2338, 2350). One commenter said it might be more cost-effective to buy out nearby residents and move them elsewhere than to move the waste (1577).

Several commenters stated that many of the existing contaminated sites may not be acceptable for waste storage or disposal and perhaps could not meet NRC waste storage and waste disposal licensing requirements (586, 1057, 1059, 1076, 1079, 1136, 1605, 1611, 1721, 2190, 2369, 2382, 3193, 3207, 3207, 3210, 3975, 7072, 8254, 8512). Others stated that hearings should precede the licensing of any designated site (1623, 8183). Also, citizen input should be sought before a decision is made permitting on-site storage or movement to another site (8183, 8508, 8512).

Some commenters expressed reservations about decommissioning nuclear utilities to the status of low-level waste sites (1144, 1176, 1349, 3220, 3487, 8151). Others favored movement of long-lived radioactive waste to a central or regional waste management facility to reduce the number of sites and to improve safety (1607, 2696, 2711, 2714, 2716, 2719, 3440, 3978, 4448, 7543, 7549, 7606, 7632, 8143, 8151). Commenters observed that if all decommissioned sites were designated as low-level waste repositories there would be over 200 such sites, and this many is not needed (1072, 7682). Others indicated that the use of decommissioned sites as radioactive material waste repositories could affect states which are planning to establish low-level waste facilities, because income from wastes at decommissioned sites is anticipated and expected (1055, 8185).

One commenter stated you cannot satisfy everyone about disposal of radioactive wastes whether on-site or off-site (1587). Another stated that there is not overwhelming opposition to low-level waste facilities (4140). Another commenter wants the results of analysis publicly available to make informed decisions (4128).

Some commenters suggested that the government should take over and assure perpetual care of restricted release sites (1605, 1607, 1764, 2417, 3395, 3424, 3470, 4539, 7034). Two commenters stated that perhaps the law should be changed to have the DOE take title to waste disposal sites and have them licensed in perpetuity by the NRC (1605, 1607). A similar proposal for NRC licensing of the DOE was made by another commenter with respect to high-level waste storage facilities at Hanford (579). Other commenters cautioned that in the long-term even governments are likely to change (1604, 2513).

Several commenters stated that new definitions of high-level wastes and low-level wastes are needed (596, 878, 1372, 1591, 1881, 1886, 1892, 1947, 2372, 2483, 2784, 3465, 3539, 3540, 3589, 3891, 4066, 4090, 7084, 7866, 8513). Other commenters said that the term low-level waste is confusing (1947, 3891, 7866); when you get into the nuts and bolts of waste classification under current regulations in 10 CFR 61, it is not all low-level (1947). It was suggested that waste categories should be classified by risk (2372, 2784, 4090, 7866, 8513), longevity and half-life (597, 878), dispersibility and biological pathway (878, 7309, 7866, 7971, 8513), longevity and toxicity (877, 1372, 7084, 7866) and intensity and longevity (1552, 7866). Several commenters recommended that toxic waste should not be reclassified to a category such as below regulatory concern (1491, 7364, 7371, 7659, 7661, 7671, 7674, 7677, 7743, 7792, 8222, 8513). Other commenters warned against classifying radioactive materials

too low, because it could adversely affect non-nuclear commercial operations (2342, 2397, 2401, 8196). One commenter expressed concern that states might set different definitions for what to consider as non-radioactive material, inasmuch as this could result in difficulty moving materials from place to place (4248).

One commenter stated that the NRC was in the process of changing its definitions and standards for high-level and low-level radioactive wastes and this is causing delays in resolving waste management problems (574). Other commenters stated that the States of Washington and Oregon had petitioned the NRC to give a decision on the appropriate fractionation of high-level to low-level waste to use in a high-level waste treatment process such as vitrification (591, 596). Still another suggested that the NRC look at a law passed by the State of Vermont for their low-level waste act in which a study is required of the separation of long-lived and short-lived radionuclides (880).

Other commenters stated that properly designated high-level and low-level wastes should be separated; less hazardous wastes should not be intermixed with more hazardous wastes (1586, 1591, 7309, 7971). Some wastes are more difficult to deal with than other wastes (2020, 2421, 2468, 4082, 4325, 7971). Another commenter stated that ninety-nine percent of decommissioning wastes are low-level wastes (978). Other commenters stated that the problems of handling radioactive wastes are more socio-political than technical (3200, 3976, 4100, 4520). One commenter implied that the form of the waste might change during cleanup (1052).

Some commenters stated that they did not believe recommendations for reclassifying wastes were relevant to decommissioning because the material of interest is only residual waste at the site (690, 895). Another commenter agreed that decommissioning is not affected, but the problems of low-level waste disposal are generally affected (690).

One commenter stated that continued delays in establishing high-level and low-level nuclear waste repositories detracts from the value of setting decommissioning standards (902). Another commenter stated that technology is not available for establishing a high-level waste repository (1809). Still another commenter stated that when there is someplace available to send high-level wastes, suitable technology will be developed (699). In this connection, one commenter stated that NRC should monitor an investigation of health and safety standards by a National Academy of Sciences Committee on Technical Bases for Yucca Mountain (8739). Other commenters stated that these wastes could presently be placed in independent fuel storage facilities (377) or that dry cask storage could be used (694, 696, 697, 698, 839).

Some commenters suggested that certain waste disposal methods may not be safe (618, 1302, 1460, 1479, 1548, 1549, 1632, 1884, 2467, 7077, 7704, 7998, 8254). Disposal of low-level liquid wastes into municipal sewer systems (1382, 1548, 1632), solid wastes into a primitive trench in the sand (618), incineration (1465, 2680, 2690, 2693, 7998, 8254), and dilution (4119) were identified as unacceptable practices. Several commenters stated that groundwater must be properly protected under all disposal methods (1302, 2280, 4211). The NRC should make known to research institutions and to Congress the continuing need for waste disposal research (7077, 7371, 7786). One commenter advocated a complete reevaluation of waste policies (1301). One commenter suggested that a solid waste landfill would be cost effective (2391). One commenter suggested that waste be placed "deep in the earth" (3097).

Some commenters noted that once nonhazardous wastes pass out of the NRC's regulation, the NRC must not attempt to further regulate these wastes or to preempt state regulation; from the point these materials enter the solid waste stream they will be managed under the Resource Conservation and Recovery Act (RCRA) and applicable state solid waste laws and regulations (7457, 7459, 7464, 7465, 7467, 7474, 7485, 8174, 8178).

One commenter indicated that nuclear utilities represent less than two percent of all licensees but their decommissioning waste is about 80 percent of the volume and caution is needed because the utilities want to minimize expense (7010). One commenter noted that power plants produced 98 percent of the total activity shipped in Pennsylvania (2019). Another commenter noted that government and industry conceal the fact that nuclear power generates nearly all the radioactive contamination (7333).

Some commenters suggested that medical radioisotope wastes should be distinguished from nuclear power-plant and industrial-research generated wastes, because they differ in volumes, masses, and half-lives (605, 1596, 1763, 1883, 2369, 2394, 2463, 2483, 4456, 7082, 7622, 7652). According to other commenters, medical wastes can be dealt with by simple on-site storage until these decay to safe levels since the half-lives of medical radioisotopes are short (1596, 7082). If requirements on low-level waste disposal are made too stringent and costly, these will adversely affect the use of radioisotopes for medical research and for medical diagnosis and treatment (2353, 3201). Other commenters stated that there are important legitimate uses of radioactive materials in medicine that should be protected (2945, 7082, 7298). Other commenters questioned why medical wastes should not be required to meet the same decommissioning standard as other radioactive wastes (508, 4454), and another questioned why the medical community cannot find alternatives to the use of radioactive materials (2958, 7935).

Commenters stated that the rulemaking must include full consideration of the transference of risk issue (304, 1278, 1287, 1444, 1585, 2098, 2108, 2233, 2291, 2655, 3111, 3199, 3578, 3809, 3874, 3926, 4007, 4101, 4105, 4156, 4491, 4888, 7386, 8268, 8398). Some commenters stated that wastes should be transferred to other locations only if this will result in a reduction of risk (614, 3578) and should not be sent off-site if equivalent risks are transferred from one place to another (632, 1058, 2271, 7387). Another commenter disagreed stating that transferred material will be in a better place than when it was at the original site of use (144) and will entail no significant transference of risk (2291). Several commenters stated that people generally do not want wastes moved nearby where they live (1294, 1298, 2310, 2722, 3209). One commenter stated that transfers of radioactive wastes are presently governed in practice by considerations of the transference of risk issue (1804).

Another commenter stated that the federal government had already decided that risk will be transferred under provisions of the 1980 Low-Level Radioactive Waste Policy Act (145).

2.13 Special Considerations

2.13.1 Mixed Waste

Several commenters recommended that the NRC's decommissioning rulemaking should address the issue of mixed radioactive wastes which consist of radioactive materials from NRC licensed operations intermixed with other hazardous materials (176, 599, 943, 1601, 1951, 1975, 3043, 3045, 3191, 3236, 3528, 3965, 4326, 7257, 7466, 7469, 7484, 8421, 8761). Some commenters expressed a concern that under NRC regulations radioactive materials licensed by the NRC might be cleaned up, but other hazardous materials could be left there (1715, 7257).

Some commenters recommended that there should be consistency between the regulation of radioactive materials and chemically hazardous materials (775, 955, 1387, 2396, 3226, 3528, 3577, 3614, 3626, 7257, 8724). The regulations should be developed as generic standards equally applicable to all hazardous materials (955, 1387, 1951, 1975, 2223, 3236, 3837). Other commenters cautioned that development of generic standards equally applicable to chemical wastes as well as radioactive materials would be difficult (2424, 3239, 3622, 3803, 3813, 3846, 3863, 3869, 3888, 3896, 3950).

Some commenters stated that they disapproved of the jurisdictional arrangements between the NRC and the EPA for dealing with mixed chemical and radioactive wastes (909, 3236, 3965). One commenter recommended that instead of having more than one regulator the NRC should be the one to regulate mixed waste (770). Another commenter stated that in applying for a Part B permit under mixed waste regulations, they got hit by dual regulations such that they could not be in compliance with either one of them or meet both (775). Other commenters recommended that the rulemaking make clear that mixed wastes continue to be regulated under the hazardous waste regulatory system and that issues related to these should be resolved under the Resource Conservation and Recovery Act, Subtitle C (4081, 7455, 7469, 8179).

Several commenters raised the question of needed standards also for the regulation of naturally-occurring and accelerator-produced radioactive materials (599, 600, 1356, 2008, 3043, 3064, 3226, 8019).

2.13.2 Doses from Radon and Radon Daughters

Many commenters recommended that the NRC should impose limits to control exposure from radon emissions at decommissioned sites because radon exposures could be a significant health problem (182, 1231, 1289, 1832, 1834, 1835, 1839, 1896, 2659, 2666, 2668, 3451, 4496, 4498, 4501, 4506, 7145, 7451, 7452, 7540, 7844, 7887, 7917, 8042, 8092, 8249, 8412, 8465, 8490, 8635, 8651, 8758). Another commenter stated that radon standards should be approached the way the ICRP approaches general standards setting --- justification, optimization, and limitation (702, 7451, 7844). Other commenters stated that the Health Physics Society recommends that a specific concentration limit for the precursors of radon be applied to contaminated soil (4501, 4502, 4505, 4511, 4513, 7452, 7540, 8412) and that a radon screening level of one picocurie per gram above the normal concentration for the region be established for soils containing radium 226, radium 228 or thorium 232 (2658).

Other commenters disagreed and recommended that the NRC not regulate radon for many reasons, including technical difficulties in distinguishing between man-induced and naturally-occurring radon (182, 184, 185, 188, 724, 725, 1285, 2544, 4509, 8617). One commenter stated that it was unfathomable how one could remediate a site to levels on the order of those being considered in the rulemaking when the outdoor air concentration of radon corresponds to about 0.002 working levels and the EPA has recommended that the public's exposure to radon be limited to 0.02 working levels, which corresponds to about one (1) rem per year depending on occupancy (864).

Commenters in favor of the NRC setting a radon standard stated the following:

Control radon exposures by limiting the quantities of precursors permitted in soil (7540, 7844, 7887, 8042, 8092, 8412, 8490).

Radon should not be regulated locally; it should be done at the federal and Agreement State level (183). Many Agreement states regulate NORM (2671).

Although in favor, it would not serve the public's best interest to revisit thousands of residential structures or reinstate people's property (702).

Radon standards should be consistent with EPA requirements (8651, 8675, 8681).

It should be possible to make a good estimate of how much radon comes from licensed materials (1829).

It is not understandable why one would not want to look at the radon issue just because it is technically difficult (1834, 4496, 7145).

If radon exposure in excess of EPA guidelines can be shown to be background, requirements for cleanup should not be specified by the NRC (7451, 7452, 7515, 7880, 7917, 8688).

Commenters not supporting the NRC's setting a radon standard stated the following:

Health effects from radon exposure can be mitigated through padding your basement, venting it, and not letting your kids sleep in it (177, 179, 8617).

The need to deal with radon at licensed sites should be considered site-to-site (182, 1837, 3722).

The biggest problem with radon is demonstrating compliance (184, 7056, 7515).

Radon control should be left to local zoning boards and housing authorities (185, 8617).

If you take care of thorium and uranium in the soil, you have probably taken care of the radon problem (186).

The costs make cleanup unfeasible; it becomes a matter of isolating the site (2674).

Standards should not be clouded by background radiation issues or radon complexities (188, 724, 725).

The NRC should embrace existing regulations for controlling exposures from radon and other naturally-occurring radionuclides (321).

Other commenters not necessarily favoring or disfavoring the NRC's setting a radon standard stated the following:

Radon should be treated separately from and differently from other radioactive materials (1831, 7515, 7844, 7938, 8092, 8207, 8635, 8686, 8933).

We can distinguish, through sampling, contributions from natural background sources and those from introduced sources (2661, 4499). The results of a national survey by the EPA will be available soon (866).

DOE requirements for radon are patterned after EPA's 40 CFR Part 192; however, other alternatives such as the higher limit recommended in NCRP Report No. 116 should be considered (8935, 8936, 8938, 8941).

Attempts to determine the source of radon or thoron are difficult (7056, 8683).

For a background based standard, we would have to be able to model a temporal variation of background (815, 3451, 3457).

The radon problems point out the need for a convergence of regulations for controlling radiation from all sources in a less confusing way (2663, 3376, 3449).

Radon calculations for background have too large a dose factor of 200 where it should be twelve (1215, 1234).

Radon should not become a scapegoat for decommissioning issues (1466).

Standards should not be set which are not practicable to achieve (3450, 3452).

The average exposure of every person in this country is on the order of 200 millirems per year from radon in their houses (3456).

Radon exposures can be changed by altering the physical conditions at the site (4500, 8617).

Reducing natural background levels would represent a new public policy direction and demonstration of excessive health effects in a particular location (7056).

2.13.3 Handling Previously Buried Waste

Almost all commenters stated that previously buried radioactive wastes on-site at the time of decommissioning should be considered for remediation against the NRC's decommissioning standards even if the wastes in question were permitted under past NRC waste disposal provisions (193, 194, 576, 615, 1150, 1154, 1171, 1350, 1620, 2311, 2533, 3206, 4077, 4131, 4136, 4137, 4141, 4167, 7057, 7454, 7520, 7737, 7915, 7931, 7958, 8000, 8095, 8147, 8226, 8393, 8401, 8593, 8689, 8692, 8759, 8943). One commenter stated that formerly buried waste should be left alone unless it presents a real problem (2296). Some commenters stated that a pathway analysis and independent epidemiological studies should be carried out whenever buried wastes are on-site (1897). One commenter cited examples of cases of previously buried wastes on-site when NRC records indicated no wastes were buried there (1666, 7369, 7737). One commenter stated that efforts must be made to induce the licensee to provide full disclosure about previous radioactive releases, accidents, and burials of materials on site. The commenter recommended the NRC draw from NRC files, citizen's records and citizen testimony (G839). A commenter from an Agreement State noted that several Agreement States prohibited on-site burials before the NRC did this in 1981 (582).

One commenter suggested that perhaps jurisdiction over health and safety could pass after decommissioning from the NRC to the EPA under the EPA's RCRA and Superfund programs (4167).

2.13.4 Minimizing the Generation of Contamination and Radioactive Wastes

Many commenters recommended that the NRC should discourage or stop licensing those nuclear operations which generate nuclear wastes (493, 637, 648, 673, 949, 1066, 1092, 1115, 1256, 1291, 1300, 1480, 1495, 1816, 1945, 2357, 2760, 2897, 2932, 2955, 2970, 2990, 3078, 3100, 3107, 3173, 3182, 3194, 3205, 3365, 3422, 3481, 3598, 3958, 7238, 7357, 7398, 7610, 7653, 7665, 7703, 7711, 7734, 7934, 7936, 7996, 8210, 8225, 8694). Some commenters requested specifically that the operation of nuclear power plants be stopped (629, 673, 805, 891, 916, 949, 1075, 1141, 1232, 1235, 1291, 1334, 1518, 1642, 1903, 1913, 2103, 2162, 2399, 2657, 2723, 2735, 2949, 2951, 3078, 3083, 3107, 3109, 3215, 3219, 3314, 3378, 3468, 3491, 4111, 4123, 4124, 4474, 4889, 7657, 7970, 8265, 8694, 8698). Several commenters stated that environmental organizations would be willing to talk about ways to decommission nuclear operations and to dispose of radioactive materials only if nuclear power plants were no longer permitted to operate (916, 2723, 2735, 3219, 4111, 4123, 4127, 7657, 7703, 7795, 8623). Other commenters, while stopping short of recommending a cessation of nuclear power, stated that they believed nuclear power was not a useful activity (1286, 1494, 2261, 2446, 2473, 3418). One commenter suggested that other energy options, which produce less pollution than nuclear and coal, should be explored (554).

Other commenters supported the continuation of nuclear power (620, 671, 2963, 2964, 3473, 3475, 4133, 8277).

Some cautioned that stopping the generation of nuclear wastes would prohibit important medical procedures (2944, 2947, 2950, 3214). Some commenters excluded the diminishment of medical radioisotope usage from their recommendation to stop the generation of nuclear wastes (1066, 2949, 7653). One commenter recommended that the medical community find alternatives to the use of nuclear-generated materials (2959).

Some commenters recommended that the rulemaking should deal with source reduction of nuclear wastes (181, 486, 949, 2487, 2491, 2947, 3052, 3165, 3215, 3565, 4084, 4122) and NRC evaluation of ways of minimizing waste production before a license is issued (191, 192, 2511, 2878, 3908). One commenter stated that reduction of waste generation does not belong in the NRC's decommissioning regulation (180).

One commenter believes it is in the national interest to minimize waste volumes. Standards which permit recycle of valuable materials conserve our national resources and allow effective use of our radioactive waste disposal capacity. (8950).

Some commenters observed that high costs of decommissioning and waste disposal could help to minimize waste generation (190, 370, 2080). Another commenter stated that high costs while reducing the amount of wastes generated could work against good cleanup at the time of decommissioning (189). Other commenters suggested that the future costs of waste handling might be taken care of by requiring operators of nuclear power plants to pay into a fund established to maintain long-term institutional controls over nuclear wastes (804, 2491, 4354).

One commenter urged the NRC not to take sides for or against nuclear power and stated that the policy debate on the relative merits of various power-generating options should be held in another forum (4130).

2.14 Environmental and Social Considerations

Many commenters recommended that the NRC develop standards for protecting natural ecosystems in addition to standards for protecting humans (258, 261, 425, 544, 622, 625, 735, 795, 1118, 1122, 1132, 1239, 1511, 1520, 1860, 1937, 2255, 2679, 3086, 3166, 4525, 7585, 7591, 8215, 8220). Others expressed a concern for environmental protection without recommending for or against separate environmental standards (635, 792, 795, 1303, 1333, 1390, 1398, 1473, 1483, 1493, 1850, 1976, 1996, 2094, 2192, 2264, 2619, 2752, 2754, 2758, 2971, 3333, 3341, 3472, 3534, 3538, 3624, 3822, 3887, 4028, 4212, 4274, 4299, 4337, 4493, 7290, 7414, 7663, 7678, 7708, 7715, 7740, 7751, 7800, 7948, 8010, 8426, 8700, 8730). Some commenters recommended that the NRC should develop a biocentric standard rather than an anthropocentric standard whether or not separate environmental and health standards are developed (255, 257, 262, 407, 8220). A large number of commenters recommended that protection of human health is sufficient to protect any known ecological system, so only a standard for protecting humans is needed, and this is the view of the International Commission on Radiological Protection (256, 462, 465, 730, 1048, 1498, 1513, 1516, 2269, 2425, 3750, 3780, 3783, 3930, 7391, 7441, 8068, 8409). One commenter stated that natural systems standards would be extremely difficult or impossible to enforce (259).

Some commenters indicated that it is important for the NRC to consult with professional ecologists and geologists in connection with the rulemaking (1508, 1520, 1530).

Other commenters recommended that the decommissioning standards should be sufficiently flexible to afford protection into future generations (383, 430, 2419, 7591, 7948, 8010, 8215) and information concerning radioactive materials left at a site should be passed on (833). If this is not done, individuals may be unknowingly exposed (260, 294).

Several commenters recommended that special attention should be given to the protection of groundwater (425,

1122, 1239, 1624, 1841, 1858, 1862, 1901, 1915, 2679, 3413, 4212, 4525, 7948). Other commenters recommended against establishing a separate risk-level for protection of groundwater as long as a limit-based standard is applied overall to external and internal exposure pathways (43, 2122, 3427, 3432).

Many commenters recommended that case-by-case consideration should be given for special environmental and social/cultural issues associated with homeland, historical sites, and Native American lands, because they contain religious sites and sacred areas (250, 253, 300, 358, 540, 658, 1358, 1784, 3585, 3787, 4302, 7063, 7316); in particular, Indian people depend on their lands for water, natural food, medicine, and traditional use (250, 580, 995, 1733, 1787, 3787). One commenter stated that the American Indian Religious Freedom Act requires federal agencies to consider the impact of proposed actions on sacred site areas and the Native American Grave Protection and Repatriation Act governs the uncovering of burial sites (250). Other commenters stated that it is beyond Native American language or thought processes to accept the loss of sacred lands indefinitely (1358, 3585) and contaminated lands should within 100 years be returned for any unrestricted use (540). Still other commenters recommended that valuable land or water should eventually be returned for society's unrestricted use (584, 1032, 3585, 7318).

Several commenters cautioned against establishment of unnecessarily restrictive decommissioning standards that could cause severe environmental damage trying to clean up soil and vegetation to background levels (385, 471, 1634, 2266, 2992, 3762, 3819, 4243, 8362, 8860, 8872, 8892), because such actions could totally change a site's ecology (254).

Many commenters stated that the rulemaking process should take into consideration societal needs and costs in relationship to decommissioning requirements (1478, 2007, 2014, 2609, 2725, 2844, 2856, 2866, 2969, 3082, 3099, 3149, 3485, 3573, 3640, 3856, 3859, 3933, 3938, 4109, 4129, 4145, 4203, 4299, 4312, 4313, 4339, 4342, 4345, 4346, 4355, 4372, 4495, 7086, 7391, 7436, 7581, 7641, 7943, 7950, 8084, 8271, 8273, 8276, 8362, 8534, 8579, 8583).

2.15 Recycle of Contaminated Materials

Comments were offered for and against the question of whether the NRC should permit recycling of contaminated materials. Those favoring (292, 611, 613, 616, 823, 1148, 1615, 3552, 4117, 4121, 7310, 7372, 7479, 7489, 8142, 8405, 8592, 8672, 8951) recommended recycling to save resources. Those opposing (592, 609, 1158, 1283, 1477, 1593, 1639, 1652, 1667, 1687, 2297, 2303, 2466, 3198, 3342, 3971, 4029, 4125, 4135, 7014, 7670, 7736, 7966, 7997, 8227, 8260) recommended against recycling to limit public risk. Some commenters recommended that the NRC consider this matter carefully, perhaps separately from the decommissioning rulemaking (290, 293, 2402, 3211, 4083, 4249, 4538). Other commenters stated that the IAEA has recommended that the maximum dose to any individual from recycled materials not exceed one (1) millirem per year (3335, 8374, 8378). Other commenters stated that if a radiation level limit is specified for decommissioning, this in effect will establish a level that is exempt from further control and result in recycling of materials contaminated to the extent permitted by the decommissioning rulemaking (291, 535, 1630). One commenter, who favored recycling contaminated materials, suggested that the NRC require full public knowledge and informed consent in each case involving the reuse and recycling of such materials (7479). One commenter stated the NRC has a site release criterion as zero detectable above background (2708). One commenter recommended that the NRC include a regulatory requirement for the regulated entity to state how it proposes to recycle and meet the standards demanded by the receiving recycling facilities and the appropriate State and local regulatory agencies (G862).

One commenter stated that NORM issues are important in recycling of radioactive wastes, e.g., coal ash and fly ash recycled into building materials are more radioactive than permitted under standards for mill tailings cleanup (4142).

APPENDIX A

ISSUES FOR DISCUSSION AT WORKSHOPS

**PROPOSED RULEMAKING TO ESTABLISH
RADIOLOGICAL CRITERIA FOR DECOMMISSIONING**

ISSUES FOR DISCUSSION AT WORKSHOPS

SUMMARY

The Commission proposes to revise 10 CFR Part 20 to include radiological criteria for termination of licenses and release of land and structures for unrestricted use. It is the Commission's intent that the criteria developed in this rulemaking would apply to almost all licensed facilities and sites.¹ However, it would not apply to sites already covered by a Commission approved decommissioning plan. An estimate of the numbers and types of facilities expected to be covered by this rulemaking is provided in the BACKGROUND section of this paper. A discussion of how the Commission proposes to implement the criteria can be found in the section entitled PROPOSED COMMISSION ACTIONS. There may be a small number of sites where cleanup to criteria for unrestricted release developed in this rulemaking may not be practical. The approach to handling such cases is an issue for discussion.

The purpose of this issues paper is to describe the background and issues that would be associated with a rulemaking to establish radiological criteria for decommissioning, and to focus discussions in a series of public workshops on rulemaking issues. The format for each issue is arranged by first describing the general issue to be considered, then providing a background discussion of the issue with potentially useful information for the workshop discussions. A list of sub-issues is also provided.

The description of issues is divided into two parts. First are two primary issues dealing with: 1) the objectives for developing radiological criteria; and 2) the application of practicality considerations. The objectives constitute the fundamental approach to the establishment of the radiological criteria, and the NRC staff has identified four distinct alternatives including: 1) Risk Limits, where a limiting value is selected and criteria are

¹ The criteria would not apply to the disposition of uranium mill tailings, low-level waste disposal facilities, or high level waste repositories since these have already been addressed in separate regulatory actions. They would apply, however, to uranium mills and ancillary facilities that support radioactive waste disposal (e.g., surface facilities for the high level waste repository).

established below the limit using practicality considerations; 2) Risk Goals, where a goal is selected and practicality considerations are used to establish criteria as close to the goal as possible; 3) Best Effort, where the technology for decontamination considered to be the best available is applied; and 4) Return to Preexisting Background, where the decontamination would continue until the radiological conditions were the same as existed prior to the licensed activities.

Following the primary issues are several secondary issues that are related to the primary discussions, but which were believed to warrant separate presentations and discussions. These include additional considerations such as the time frame for dose calculation, the individuals or groups to be protected, the use of separate criteria for specific exposure pathways such as groundwater, the treatment of radon, and the treatment of previously buried materials.

BACKGROUND

The Nuclear Regulatory Commission (NRC) has the statutory responsibility for protection of health and safety related to the 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 nuclear facilities which it licenses, and to provide guidance to licensees on how to plan for and prepare their sites for decommissioning. Decommissioning, as defined by the NRC, means 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.²

Once licensed activities have ceased, licensees are required to decommission their facilities so that their licenses can be terminated. This requires that radioactivity in land, groundwater, surface water, buildings, and equipment

² A glossary of other terms generally used by the NRC can be found in Appendix A.

resulting from the licensed operation be reduced to levels that allow the property to be released for unrestricted use. Licensees must then demonstrate that all facilities have been properly decontaminated and that, except for any residual radiological contamination found to be acceptable to remain at the site, radioactive material has been transferred to authorized recipients. Confirmatory surveys are conducted by NRC, where appropriate, to verify that sites meet NRC radiological criteria for decommissioning.

There are currently about 24,000 licensees in the United States. About one third of these are NRC licensees, while the remainder are licensed by Agreement States through an agreement entered into under the Atomic Energy Act, Section 274. These licensees include universities, medical institutions, radioactive source manufacturers, and companies that use radioisotopes for industrial purposes. About 50% of NRC's 7,500 materials licensees use either sealed radioactive sources or small amounts of short-lived radioactive materials. Decommissioning of these facilities should be relatively simple since there is usually little or no residual radioactive contamination to be cleaned up and disposed of. Of the remaining 50%, a small number (e.g. radioactive source manufacturers, radiopharmaceutical producers, and radioactive ore processors) conduct operations which could produce substantial radioactive contamination in portions of the facility. The population of nuclear fuel cycle facilities which will require decommissioning includes 112 nuclear power plants (at 75 sites); 74 non-power (research and test) reactors; 14 fuel fabrication plants, 2 uranium hexafluoride production plants, 49 uranium mill facilities, and 9 independent spent fuel storage installations. These facilities will have to be decontaminated to acceptable levels before they can be safely released for unrestricted use.

The facilities listed in the NRC's Site Decommissioning Management Plan (SDMP), discussed later in this issues paper, provide an illustration of how a facility or equipment might become contaminated through the use of radioactive material in forms which are not encapsulated to prevent the spread or dispersal of material. Sealed sources, including items such as check sources, do not pose a contamination problem unless the encapsulation is broken. When radioactive material in unsealed forms is used, such as in the nuclear fuel

fabrication industry, in production of radiopharmaceutical medicines, or in research the equipment used to process and handle the material becomes contaminated by the small quantities of material that adhere to surfaces of valves, piping, etc. If material is spilled, then the area of the spill becomes contaminated.

Essentially everything which comes in contact with the radioactive material must be considered as contaminated and checked for the presence of residual radioactive material. Thus areas surrounding facilities could become contaminated by the movement of materials, equipment, and people into and out of the areas containing the radioactive material. NRC requires that contamination control procedures be used to minimize or prevent the movement of radioactive materials into other areas. Nevertheless, some areas may become contaminated over the course of time due to breakdowns in the control procedures. Contamination may also be spread by the movement of water or other fluids containing the radioactive materials through or along piping, equipment, walls, floors, sumps, drains, etc. In some cases, this has resulted in significant quantities of radioactive material in the ground under or around buildings and facilities.

In addition to contamination, some licensed operations can produce radioactive materials through the process of activation. Examples of such operations are nuclear reactors. These activated materials can also lead to the need to decontaminate or dispose of the radioactivity during decommissioning.

Several hundred NRC and Agreement State licenses are terminated each year. The majority of these licenses involve limited operations, 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. However, as the nuclear industry matures, it is expected that more and more of the larger nuclear facilities which have been operating for a number of years will reach the end of their useful lives and have to be decommissioned. Thus both the number and complexity of facilities that will require decommissioning is expected to increase.

The NRC has a program underway to effect timely decommissioning of about 40 problem sites which either have not been decommissioned properly or have been engaged in the decommissioning process for an extended time. The Commission has established a Site Decommissioning Management Plan (SDMP) for effecting timely decommissioning of these problem facilities. Sites being handled under the SDMP vary in degree of radiologic hazard, cleanup complexity, and cost. Some sites comprise tens of acres that require assessment for radiological contamination, whereas other sites have contamination known to be limited to individual buildings or discrete piles of tailings or contaminated soil. Many sites involve active licenses, but some sites involve formerly licensed sites, or sites where the responsible party is unable or unwilling to perform cleanup. These sites also vary in degree of completion of decommissioning. At some sites, little or no decontamination work has been done, whereas at other sites, decommissioning plans have been submitted or license termination is in the offing.

The effort to have these SDMP sites cleaned up and decommissioned has been hampered in part because licensees view the absence of definitive decontamination criteria as an incentive to defer decommissioning pending issuance of formal NRC requirements. The General Accounting Office (GAO), which has been critical of the Commission's inability to effect timely decommissioning of these sites, has recommended that NRC enhance its decommissioning efforts by reconsidering its radiological criteria for decommissioning³.

Until new criteria are in place, the Commission intends to proceed with decommissioning nuclear facilities on a site-specific basis as the need arises considering existing criteria coupled with the concept that residual radioactivity be as low as is reasonably achievable (ALARA). Case and activity-specific decisions concerning decommissioning of sites will continue to be made as necessary during the pendency of this process. Since the SDMP sites could pose unnecessary environmental and public risk or financial burden

³ GAO Report to Congress, "NRC's Decommissioning Procedures and Criteria Need to Be Strengthened", GAO/RCED-89-119, May 1989

if they are not cleaned up and decommissioned in a timely manner, the Commission's effort to effect timely decommissioning of these sites is proceeding in parallel with this proposed rulemaking action. The NRC published an Action Plan to ensure timely remediation of sites listed in the SDMP in the Federal Register.⁴ It should be noted that as a matter of current policy the NRC does not plan to require additional cleanup of sites in response to criteria established in this rulemaking, provided that the licensee or responsible party cleaned up the site, or was in the process of cleaning up the site in full accordance with an NRC-approved decommissioning plan at the time of promulgation.

Internationally, most efforts have been focussed upon derivation of criteria for waste and recycle, using guidance published by the International Atomic Energy Agency. Decommissioning criteria have generally been established on a case specific basis, and the NRC staff is not aware of other international efforts similar to this rulemaking to define radiological criteria for decommissioning.

NEED FOR RULEMAKING

The Commission believes that there is a need to incorporate into its regulations radiological criteria for termination of licenses and release of land and structures for unrestricted use. The intent of such an action would be to provide a clear and consistent regulatory basis for determining the extent to which lands and structures must be decontaminated before a site can be decommissioned. The Commission believes that inclusion of criteria in the regulations would result in more efficient and consistent licensing actions related to the numerous and frequently complex site decontamination and decommissioning activities anticipated in the future. In addition, a rulemaking effort would also provide an opportunity to reassess the basis for the residual contamination levels contained in existing guidance in light of

⁴57 FR 13389, April 16, 1992.

changes in basic radiation protection standards⁵ and decommissioning experience obtained during the past 15 years.

Current regulations do not explicitly address radiological criteria for decommissioning.⁶ Pending NRC rulemaking on generic radiological criteria for decommissioning, the NRC continues to use its current criteria and practices.⁷ The NRC could continue to decommission on a site-specific basis using existing guidance. However, the Commission believes that codifying radiological criteria for decommissioning in the regulations would: (1) result in more efficient use of NRC and licensee resources; (2) lead to more consistent and uniform application across all types of licenses; (3) provide a more stable basis for decommissioning planning; and (4) eliminate protracted delays in decommissioning which results as licensees wait for generic regulatory criteria before proceeding with decommissioning of their facilities.

The criteria would apply to the decommissioning of all types of NRC licensed facilities, including materials licensees, power reactors, non-power reactors, fuel reprocessing plants, fuel fabrication plants, uranium hexafluoride

⁵ As codified in the May 21, 1991 revision of 10 CFR Part 20 [56 FR 23360]

⁶ In June 1988 the Commission published a final rule on General Requirements for Decommissioning Nuclear Facilities (53 FR 24018, 27 June 1988). However, this rule did not specifically address radiological criteria for decommissioned sites.

⁷ Regulatory guidance, criteria, and practices include the following with emphasis on contamination levels that are ALARA: "Disposal or On-site Storage of Thorium or Uranium from Past Operations" Branch Technical Position, October 23, 1981, 46 FR 52061; "Termination of Byproduct, Source, and Special Nuclear Materials Licenses", Policy and Guidance Directive FC 83-23, November 4, 1983; "Termination of Operating Licenses for Nuclear Reactors" Regulatory Guide 1.86, June 1974; letter to Stanford University from James R. Miller, Chief, Standardization and Special Projects Branch, Division of Licensing, Office of Nuclear Reactor Regulation, NRC, Docket No. 50-141, April 21, 1982; "National Primary Drinking Water Standards," 40 CFR 141; "Radiation Dose Guidelines for Protection Against Transuranium Elements Present in the Environment as a Result of Unplanned Contamination," 42 FR 60956, November 30, 1977. Guidance is specified in terms of acceptable levels of residual contamination at decommissioned sites.

production plants, and independent spent fuel storage installations.⁸ They would apply to nuclear facilities that operate through their normal lifetime, as well as to those that may be shut down prematurely. There may be a small number of sites where cleanup to criteria for unrestricted release developed in this rulemaking may not be practical. The approach to handling such cases is an issue for discussion.

On July 3, 1990, the Commission published a Below Regulatory Concern (BRC) Policy Statement in the Federal Register. The BRC Policy was intended to guide a broad range of Commission actions, including exemptions from Commission regulations, as well as the development of generic health and safety standards such as those involved in this rulemaking. Subsequent to the publication of the BRC Policy, the Commission placed an indefinite moratorium on the implementation of the BRC Policy because of the broad public concern expressed over the new Policy.⁹ After the Commission placed the indefinite moratorium on the implementation of the BRC Policy, it decided to initiate this rulemaking to address the critical need for generic site cleanup and decommissioning standards for NRC-licensed facilities. The Commission determined that it should proceed with a fresh approach to the development of these standards that is independent of the now defunct BRC Policy.

⁸ The criteria would not apply to the disposition of uranium mill tailings, low-level waste disposal facilities, or high level waste repositories since these have already been addressed in separate regulatory actions. They would apply, however, to uranium mills and ancillary facilities that support radioactive waste disposal (e.g., surface facilities for the high level waste repository).

⁹ Section 2901 of the recently enacted National Energy Policy Act of 1992 (H.R. 776) revoked the Commission's July, 1990, BRC Policy Statement. Section 2901 also revoked the Commission's policy statement of August 29, 1986 that established criteria to guide Commission exemption decisions on specific low-level radioactive waste streams. This latter policy was developed in order to comply with Section 10 of the Low-level Radioactive Waste Policy Amendments Act of 1985. The Commission will be issuing a formal withdrawal of these two policy statements in the Federal Register in January, 1993.

Concurrent with the NRC rulemaking on site cleanup standards, the Environmental Protection Agency (EPA) is proceeding to develop standards and guidance for Federal agencies in the area of radiation protection, including standards for the cleanup of contaminated sites. The NRC and EPA plan to coordinate their efforts in this area in order to ensure that effective and consistent site cleanup standards are established, while minimizing duplication of effort. Accordingly, the EPA will not only be an important participant in the NRC rulemaking workshops but the NRC also plans to consult extensively with EPA throughout the rulemaking process. It is anticipated that the information gathered during the workshops on the NRC standards will also be relevant and useful to the EPA efforts in the area of site cleanup standards. The NRC will also participate in EPA efforts in this area, such as the activities of the EPA Interagency Working Group on Radiation Protection. The objective of the NRC and EPA cooperative efforts is to attempt to reach an agreement that the NRC standards established in the enhanced participatory rulemaking are sufficient to provide adequate protection to the public health and safety for NRC-licensed sites. The EPA efforts could then focus on the site clean-up standards for non-NRC licensed sites, such as DOE and DOD facilities. This is consistent with the principles and procedures set forth in a recent Memorandum of Understanding between the NRC and EPA to guide each agency's actions in areas of mutual regulatory concern.¹⁰

PROPOSED COMMISSION ACTIONS

The normal pattern for NRC rulemaking is the development of a proposed rule by the NRC staff for Commission consideration, publication of the proposed rule for public comment, consideration of the comments by the NRC staff, and preparation of a final rule, as appropriate, for Commission approval. As directed and approved by the Commission, the NRC staff plans to enhance

¹⁰ Federal Register, Vol. 57, 54127, November 16, 1992, "Memorandum of Understanding Between the Nuclear Regulatory Commission and the Environmental Protection Agency"

participation in this process through a series of workshops for interested parties. The workshops are planned to elicit informed discussions of options and approaches, and the rationale for options and approaches. While these workshops are not designed to seek "consensus" in the sense that there is agreement (or at least a lack of disagreement) on the issues, the workshops are to be conducted at a very early stage of rulemaking to enhance participation of interested parties and the public with the following objectives: a) to ensure that the relevant issues have been identified; b) to exchange information on these issues; and c) to identify underlying concerns and areas of disagreement, and, where possible, approaches for resolution. It is the Commission's hope that the interactions that will take place among the participants in the workshop environment will foster a clearer understanding of the positions and concerns of the participants.

The proposed rulemaking activities, if pursued, are expected to result in publication of a proposed rule and a draft Generic Environmental Impact Statement (GEIS). It is the Commission's intent that the criteria developed in this rulemaking would apply to almost all licensed facilities and sites.¹¹ However, it would not apply to sites already covered by a Commission approved decommissioning plan. An estimate of the numbers and types of facilities expected to be covered by this rulemaking can be found in the BACKGROUND section of this paper.

The Commission intends to publish a Notice of Intent to prepare a GEIS for this rulemaking effort. Separate meetings will be held with interested Federal, state, and local agencies and organizations to discuss the scope of the GEIS. However, information, comments, and suggestions from the discussion of the issues in this paper would be taken into account by the NRC in preparing the GEIS. In addition, one or more Regulatory Guides would be

¹¹ The criteria would not apply to the disposition of uranium mill tailings, low-level waste disposal facilities, or high level waste repositories since these have already been addressed in separate regulatory actions. They would apply, however, to uranium mills and ancillary facilities that support radioactive waste disposal (e.g., surface facilities for the high level waste repository).

published to provide licensees with guidance on how licensees could demonstrate compliance with the regulation.

The Commission's plan for implementing the rule is described below. The Commission would issue supporting documents concurrent with the rule which provide guidance on implementation of the residual contamination criteria in the rule. These documents would include a "Guidance Manual for Conducting Radiological Surveys in Support of License Termination" (NUREG/CR-5849) and a Technical Basis Document, "Residual Radioactive Contamination from Decommissioning: Technical Basis for Translating Contamination Levels to Annual TEDE" (NUREG/CR-5512). The Guidance Manual for Conducting Radiological Surveys is intended to provide licensees with specific guidance on planning, conducting, and documenting site surveys which could be used to demonstrate that the site has been decontaminated to a level consistent with the Commission's criteria. The Technical Basis Document would provide an acceptable method for translating residual radioactivity levels (measurable quantities) to doses to individuals. Generic dose rate conversion factors are being developed for screening. In addition, the technical basis is expected to include a computer model which can be used for conducting a screening scenario/pathway analyses with site-specific parameters so that site-specific dose rate conversion factors can be calculated. The NRC anticipates that in most cases these dose rate conversion factors could be used to determine compliance with criteria resulting from the rulemaking action.

Work on the supporting documents is already underway, and drafts are available for information. However, these documents are not intended to constrain the approach taken by the Commission in developing radiological criteria. Instead, they are intended to provide a technical underpinning which would be useful irrespective of the approach or the criteria finally adopted by the Commission. These documents will be revised as necessary to conform to the final criteria.

In addition to the activities directly supporting a rulemaking action on decommissioning criteria, the NRC has a number of other related activities in progress in the general area of decommissioning. These activities include:

(1) rulemaking to define the timeliness of decommissioning, and (2) rulemaking to require licensees to list in one location all land, buildings, and equipment involved in licensed operations. These activities will not be specifically considered as part of the discussions on radiological criteria for decommissioning.

ISSUES FOR DISCUSSION

Before the Commission formally proposes to proceed with rulemaking as described above, it is prepared to consider a wide range of alternative approaches, including maintaining the status quo. The basic question before the Commission is, "What level or levels of risk, dose, residual radioactivity, or other decommissioning criteria, would provide acceptable protection of health and safety and the environment?" The answer to this question must be reasonable and practical to implement and to enforce for the broad range of facilities which require decommissioning.

The Commission believes that the key issues and sub-issues discussed below are at the foundation of the basic question posed above. Therefore, the Commission solicits comments and information on these issues before proceeding with a proposed rulemaking. These issues, and other relevant and substantial issues identified by interested parties, will serve as the basis of discussion at a series of workshops. Workshop participants will be expected to present the rationale for their preferences and positions in the workshop setting. The workshop discussions will be used by the NRC staff in developing a proposed rule or, if considered appropriate, pursuing an alternative strategy for decommissioning.

The discussion of issues is divided into two parts. First are two primary issues dealing with the objectives for developing radiological criteria, and the application of practicality considerations. Following these issues are several secondary issues that are related to the primary discussions, but which were believed to warrant separate presentations and discussions. The format of discussion for each issue is arranged by first describing the general issue to be considered, then providing a background discussion of the

issue with potentially useful information for the workshop discussions. A list of sub-issues is also provided to focus the discussions. It is important to recognize that the Commission does not regulate natural background or fallout from weapons or other sources beyond its authority. Therefore, the following decommissioning issues are to be considered as they apply to radioactivity that is both attributable to licensed operations and is above background levels.

The Commission does not intend to include the issue of Agreement State compatibility with NRC requirements as a topic for discussion in the workshops. The Commission has a concurrent process to establish a general policy on compatibility and does not believe it would be efficient to have two separate forums focussing on the same subject. The Commission believes that the ongoing process to establish the general policy on compatibility would be the more appropriate forum to discuss all compatibility issues. In addition, parties will be afforded the opportunity to comment on compatibility issues at the time of the publication of a proposed decommissioning rulemaking. This approach will allow the workshops to focus upon the central technical issues and approaches to the radiological criteria for decommissioning.

PRIMARY ISSUES FOR DISCUSSION

Issue I: What objective(s) should serve as the basis for establishing radiological criteria for decommissioning?

Discussion:

There are four fundamental kinds of objectives that could serve as the starting point for developing radiological criteria for decommissioning (i.e., release for unrestricted use). They are described briefly below.

1. RISK LIMITS--Establishment of limits above which the risks to the public are deemed unacceptable. The objective in this case would be to find a limit above which risks would be unacceptable, and then establish

additional criteria to further reduce exposures to levels below the unacceptable to the extent practical. With this objective, a site could be released for unrestricted use if there were reasonable assurance or demonstration that members of the public would not be exposed to an unacceptable risk from radioactivity remaining at the site.

In practical terms this objective would mean that the radioactivity remaining at the site must be below some upper limit established by the NRC as representing the boundary of unacceptable exposure to an individual or group of individuals. Below this upper limit, exposures would be further reduced to levels which are "As Low As Reasonably Achievable" (ALARA) taking into account various factors of practical implementation (cost versus benefit), and socioeconomic considerations. (See Issue 2)

2. RISK GOAL--Establishment of risk goals below which the risks to the public are deemed trivial. This objective would be to find a level of public and environmental risk below which risks are considered trivial, and then require decontamination to levels which are either below the goal, or as close to those goals as practical. Using this objective, a site would be released for unrestricted use if the radioactivity remaining at the site were as close as practical to the goals selected. If the decontamination goals were met or exceeded, then no further consideration of decontamination would be required.

In practical terms, residual radioactivity levels greater than the corresponding risk goals would be accepted provided they are as close as reasonably achievable to the risk goals. If the levels of radioactivity were below the levels corresponding to the goals, then no decontamination would be required, regardless of feasibility.

3. BEST EFFORT -- Best effort emphasizing use of available technology. The objective in this case would be to establish criteria representing what is achievable using the "best" available technology. A site would be released for unrestricted use if the only residual radioactivity

remaining at the site is that material which cannot be removed using the best available technology. This objective is technologically driven. Theoretically, it could lead to removal of all radioactivity attributable to licensed activities or to an undefined level limited by the efficiency of the technology. Cost can be a factor, but is not taken into consideration on the basis of cost versus benefit balancing.

4. RETURN TO BACKGROUND LEVELS. This objective would be to remove all radioactivity attributable to licensed activities. A site would be released for unrestricted use only if all radioactivity attributable to licensed activity were removed. This objective could be difficult to implement either because of the costs associated in reducing residual radioactivity to background levels or because of the difficulty in demonstrating that a return to background levels had been achieved. Demonstrating a return to background levels could be especially difficult at sites where the background levels were not recorded prior to beginning licensed operations, or at facilities licensed to use nuclides such as uranium or thorium which already exist in varying degrees in the natural background.

The following information is provided to aid discussion and is focused first on the Risk Limits and Risk Goals objectives and secondly on the Best Effort and the Return to Background objectives:

The fundamental principle underlying all NRC regulations and activities has been that radiation doses to members of the public from licensed activities must be reduced to levels established as limits (Risk Limits objective).¹² The limits pose the boundary of unacceptable public risk regardless of the cost required to achieve such reduction, and risks should be further reduced to levels which are ALARA. This principle is articulated in 10 CFR Part 20, and the Commission currently uses this principle as the basis for decommissioning nuclear facilities. For example, the typical practice in

¹²Although NRC regulations are designed to limit risk, not all limits in the regulations were established on the basis of risk.

decontaminating an area is to remove contamination through sweeping, washing, chemical stripping, scabbling thin layers of concrete, etc. The area is then surveyed and the results compared to the appropriate established criteria. If the area does not meet the criteria, then further steps are taken to reduce the level of radioactivity remaining. Once the levels are met, then further steps are considered to lower the remaining levels, but the decision to use these steps take into account the costs of the step and the reduction that is anticipated. This principle is also the basis for certain actions by the Environmental Protection Agency in the area of radiation protection, and is a fundamental principle outlined in both national and international recommendations.

In its recent recommendations on radiation protection, the International Commission on Radiological Protection (ICRP) has introduced the concept of a "constraint" in establishing the appropriate level of protection for any particular source of radiation exposure such as a decommissioned facility.¹³ A constraint is a selected level, below the dose limit (the dose limit corresponds to an acceptable risk), to provide assurance that any given individual would not receive a dose in excess of the dose limit, even if that individual were to be exposed to several sources simultaneously. As described by the ICRP, the concept of ALARA would be applied after the constraint was met. This approach is similar to the approach already utilized by the NRC in establishing criteria for effluents from nuclear power plants in 10 CFR Part 50 Appendix I and by the Environmental Protection Agency in the generally applicable environmental standards such as 40 CFR Part 190 and in 40 CFR Part 61, the regulations implementing the Clean Air Act.

The Risk Goals objective was recently applied by the Environmental Protection Agency in the selection of values for radionuclides in drinking water. In its proposal, the EPA established maximum contaminant level goals (MCLGs) for radionuclide levels, then established maximum contaminant levels (MCLs) which were greater than the goals in recognizing factors such as availability of

¹³International Commission on Radiation Protection, ICRP Publication 60, November 1990.

technology, costs to remove radionuclides, and numbers of individuals involved. This is an extreme application of the risk goal principle, because the risk goal was legislatively set equal to zero. It is recognized that these goals may not be literally achievable. Furthermore, confusion has resulted from failure to distinguish between levels and goals.

In addition, several national and international agencies and organizations, including the NRC, have adopted or proposed numerical risk or dose levels for public exposure from activities and practices involving radioactive materials. These risk levels may provide a basis for initiating a dialogue on numerical levels of risk or dose which would provide an acceptable basis for establishing radiological criteria for decommissioning. In addition, EPA has established or proposed other risk objectives that should be considered, such as EPA standards related to the Clean Air Act, the Resource Conservation and Recovery Act (RCRA) and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA also known as "Superfund") which may need to be considered in establishing criteria. For example, the EPA has established health based limits for numerous chemicals under RCRA. On May 20, 1992, (57 FR 21450) the EPA published a proposed rulemaking on the identification of hazardous waste which included, as an option, the use of multiples of these health based limits in determining the appropriate approach to management of the waste as hazardous or other solid waste. Although The proposed approach has been withdrawn, EPA plans to continue assessing the merits of approaches used by others (57 FR 49280, October 30, 1992).

The Commission's current radiological criteria for decommissioning, are stated in terms of acceptable levels of residual contamination and external dose rates at one meter from contaminated surfaces. These criteria have been conservatively estimated, considering the most highly exposed population group of individuals, to result in potential doses ranging between one and several

tens of millirem per year Total Effective Dose Equivalent (TEDE/y) (exclusive of doses from radon and its daughter products).¹⁴

The EPA Clean Air Act and regulations provide practical examples of the application of the Best Effort regulatory principle. Among other things, the Clean Air Act requires the EPA Administrator to set new standards for emission of air pollutants based on the best, adequately demonstrated, technological system, taking into account the cost of achieving emission reduction, energy requirements, and any non-air impacts on the quality of health and the environment. Another section of the Clean Air Act permits the EPA Administrator, based on the same considerations as listed above, to set standards based on a design, equipment, work practice, or operational standard, or combination of these.¹⁵ The EPA uses several implementing concepts in promulgating Clean Air Act regulations, including maximum achievable control technology (MACT), generally available control technologies (GACT), and best demonstrated technology (BDT), and each of these concepts include considerations of cost and other factors listed in the Clean Air Act.¹⁶ These terms are defined in Appendix B.

The Return to Background objective for clean-up of facilities has been applied particularly for chemical hazards which do not normally exist in nature, and the approach often taken is to establish the clean-up objective at zero contaminants. In situations where some type of background, or natural concentrations of chemicals already exist, such as contaminants in a groundwater aquifer, the objective is sometimes expressed in terms of non-

¹⁴ For some radioisotopes (e.g., ²³⁸U), acceptable residual levels may be based on non-radiological effects (e.g., the chemical toxicity of uranium) if the non-radiological effects are potentially more hazardous than the radiological effects.

¹⁵Public Law 101-549 (104 STAT. 2399) November 15, 1990, (Clean Air Act Amendments of 1990, Sections 111 and 112).

¹⁶For examples, see 56 FR 64382, December 9, 1991, "National Emission Standards for Hazardous Air Pollutants for Source Categories: Perchloroethylene Emissions From Dry Cleaning Facilities," (Proposed Rule), and 55 FR 26953, June 29, 1990, "Standards of Performance for New Stationary Sources; Volatile Organic Compound (VOC) Emissions From the Synthetic Organic Chemical Manufacturing Industry (SOCMI) Reactor Processes" (Proposed Rule).

degradation of the existing situation, meaning that no additional materials should be present beyond those already existing.

There may be some sites where the cost of meeting the selected criteria would be exorbitant. Consideration should be given to the disposition of such sites. Such sites could be handled in a manner similar to, or reflect elements of, the way the Commission deals with uranium mill tailings sites under the provisions of the Uranium Mill Tailings Radiation Control Act of 1978, As Amended (UMTRCA). Under the provisions of UMTRCA, mill tailings sites are partially decontaminated, stabilized, and subject to requirements for restricted use and long-term care and are not released for unrestricted use. EPA's CERCLA/Superfund Program also allows cost to be a consideration in site cleanup; however, cost is typically not a primary consideration in setting environmental levels under RCRA or the Clean Water Act (CWA). Implementation under these programs is primarily focussed on "Best Demonstrated Available Technology" (BDAT).

The NRC has several possible approaches to codifying radiological criteria for decommissioning. One approach is to establish limits in terms of dose in the regulation and then provide listings of specific residual radioactivity levels for different radionuclides either as an appendix to the regulation or as a Regulatory Guide. This is the approach of 10 CFR Part 20 for the dose limits, where the values in Appendix B of Part 20 serve as a method for demonstrating compliance with the dose limit, rather than being a limit themselves. Alternatively, the Commission could codify specific values for residual radioactivity for each radionuclide of concern as part of the regulation. Similarly, a Risk Goal could be codified in terms of a dose or a risk, or alternatively, as specified levels of radioactivity. If the chosen decommissioning objective were Best Effort, then the method of determining the appropriate technology could be codified or the technology itself could be codified. For the Return to Natural Background objective, the method for determining background and accuracy of determinations could be the substance of the regulation or quantitative levels of radioactivity could be codified.

The terms of the regulation could be important to the extent that they could affect the Commission's flexibility in applying the regulation and also the flexibility the licensees would have in demonstrating compliance. If objectives were codified in terms of specific measurable quantities such as concentrations of radioactive materials, neither the Commission nor the licensees would have flexibility to take site specific factors into account when trying to demonstrate compliance. However, if the objective were codified, individual licensees could conduct a site specific analysis to demonstrate to the Commission that their site would meet the objective with different residual radioactivity levels than those determined by the Commission based on a generic, conservative analysis.

Past experience has shown that changes to the regulations containing specific criteria are much more difficult to complete and require more resources than if the criteria are contained in a Regulatory Guide. However, past experience has also shown that enforcement of specific, measured values is unambiguous, direct, and unencumbered by lengthy litigation.

Sub-issues:

1. At what numerical level would the regulatory objective for decommissioning provide an acceptable basis for protection of the public health and safety and the environment?
 - a. If the Commission chooses a Risk Limit objective, should the Commission use the public dose limits in 10 CFR 20 (100 mrem/y) as the limit on doses from residual radioactivity at decommissioned sites or establish separate constraints for decommissioning? If separate constraints are set, what should be the basis for these constraints?
 - b. If the Commission chooses a Risk Goal objective as its basis for establishing criteria, on what basis should the goal be established?
 - c. If the Commission chooses a Best Effort objective as its basis for establishing criteria, what level of technological availability should

be used? How often should the applicable areas of technology be updated for this criteria? What criteria should govern the number of applications of the technology to achieve lower levels of residual radioactivity, i.e., how would the point of diminishing returns be established? Recognizing that application of technology could result in widely varying levels of residual radioactivity, should an additional limit be placed on the level of residual radioactivity? If new technologies become available that are significantly more efficient in decontaminating a site, should these new technologies be applied to previously decommissioned sites? If so, what criteria should require the reopening of a site for decontamination?

d. If the Commission chooses the Return to Background objective as a basis for establishing criteria, how should background levels of radiation and radioactive material be established? For example, should a single level be chosen for each naturally occurring radionuclide, or should the local level of background be used, or some other criterion? How should the chosen approach, single or local level, be measured and to what accuracy?

2. What other alternatives should be considered as a general framework for establishing objectives? Should the Commission consider combinations of the fundamental objectives and if so, which combinations and on what basis?

3. What role should EPA initiatives play in setting objectives? For example, the EPA used about a 10^{-4} lifetime risk of fatal cancer for members of the most highly exposed population group and a general lifetime risk level on the order of 10^{-6} as a basis for National Emission Standards for Hazardous Air Pollutants.¹⁷ Are there other established or proposed risk objectives that should be considered?

¹⁷ 40 CFR Part 61, "National Emission Standards for Hazardous Air Pollutants; Radionuclides." Final Rule and Notice of Consideration, 54 FR 51654, December 15, 1989

4. What consideration should be given to standards or objectives proposed or adopted by other groups (e.g. International Atomic Energy Agency, (IAEA))?
5. What should be done in those cases where sites cannot reasonably be decontaminated to the point where they are appropriate for unrestricted use?
6. How prescriptive should the regulation on radiological criteria for decommissioning be? For example, should the Commission codify the decommissioning objective(s) and provide details (e.g., residual radioactivity concentration, etc.) of a method of compliance elsewhere, such as in a Regulatory Guide, or should the regulation be more prescriptive?

Issue II. How should practicality considerations be applied, particularly if the Commission were to adopt either the Risk Limit objective or the Risk Goal objective in its radiological criteria for decommissioning rule?

Discussion:

ALARA is an acronym for as low as is reasonably achievable and means making every reasonable effort to reduce or maintain exposures to radiation as far below established dose limits as is practical taking into account the state of technology, the economics of improvements in relation to the state of technology, the economics of improvement in relationship to the benefits to the public health and safety, and other societal and socioeconomic considerations, and in relation to the utilization of nuclear energy and licensed material in the public interest. This covers a broad spectrum of actions and activities including cost-benefit analysis of procedures and proposals, availability and application of measurement technologies, and availability of disposal facilities. The same factors that have been traditionally used in radiation protection (Risk Limit objective based) are also the factors that would be used in determining how close practical criteria can be made to a Risk Goal objective. Thus, in the present context, the term ALARA can be used to represent the practical process (that is, cost versus benefit evaluation process) of reaching either the lowest acceptable

risk below an Risk Limit or the lowest risk above a Risk Goal as discussed in Issue I.

The employment of practicality considerations, including costs, availability of technology, etc., has been recognized as valid in a number of contexts, both in the area of radiation protection and in the regulation of hazardous chemicals and wastes. For example, in recommendations approved by the President on Radiation Protection Guidance to Federal Agencies for Occupational Exposure, the concept of ALARA was specifically included.¹⁸ Likewise, the EPA has acknowledged the validity of considering costs and benefits in determining levels for regulation of chemicals in various arenas, as illustrated by the EPA response to a petition requesting revocation of food additive regulations.¹⁹ The NRC rulemaking is being conducted under the Atomic Energy Act, which allows consideration of ALARA, provided the public health and safety are protected.

There are a variety of ways the principle of ALARA can be applied. In both the Risk Limit and Risk Goal objectives, ALARA can be applied on a case-by-case basis with a site-specific analysis required for each site. Alternatively, generic ALARA criteria could be established which would be applicable to all sites or to categories of sites. This latter alternative is equivalent to combining both the Risk Limit and the Risk Goal objectives.

A credible ALARA analysis must consider all of the costs and benefits associated with decontaminating a site to different residual radioactivity levels and must be carefully documented to demonstrate that all reasonable alternatives and technologies have been considered. It should take into account: (1) radiation doses (public and occupational) and environmental impacts both from the process of decommissioning the site and from the residual radioactivity which will remain at the site after it has been decommissioned, and (2) all of the costs and other risks (e.g. occupational,

¹⁸52 FR 2822, January 27, 1987.

¹⁹56 FR 7750, February 25, 1991.

transportation) associated with the decontamination and decommissioning the site. It should also include an analysis which clearly demonstrates how overall costs and benefits change with changing residual radioactivity levels. The analysis must be properly documented. This should include documentation of the methodology and the sources of data used in the analysis, and include an assessment of the uncertainties associated with the results of the analysis. ALARA analyses can be carried out on either a generic or site specific basis. Generic analyses by their very nature will produce results with higher uncertainty than those that can be obtained from a site specific analysis. Therefore, a more conservative approach would have to be adopted when conducting a generic analysis to assure that the results of the analysis are appropriate to all of the sites and activities to which the analysis is expected to apply.

Sub-issues:

1. Should the Commission require that ALARA be determined on a site-specific basis for each site to be decommissioned? If not, how should ALARA be applied? Should the Commission establish generic ALARA criteria (i.e., Meeting the generic criteria would be considered ALARA for any site without need for further site specific cost versus benefit analysis.)? If generic ALARA criteria are used, should a single ALARA criterion be established for all sites, or should different ALARA criteria be established for different categories of sites or facilities. If ALARA criteria are established for different categories of sites, on what basis should the different categories be established?

2. Irrespective of whether ALARA is applied on a site-specific basis or generically, on what basis should the ALARA analysis rest? What level of review by the NRC staff should be required to evaluate this basis? For example, if a cost versus benefit analysis were to be used, what monetary value per averted collective dose (i.e. dollars/person-rem) should the Commission use as a basis for making the determination? How should the level of difficulty in measuring certain radionuclides in some circumstances be

handled? How should the staff address societal and socioeconomic aspects of the ALARA analysis?

SECONDARY ISSUES FOR DISCUSSION

Secondary Issue A.: *What additional considerations should be taken into account when establishing radiological criteria for decommissioning?*

Discussion:

In developing criteria, there is often a question of exactly who the standard is designed to protect. For example, the criteria may be established to protect a theoretical, maximally exposed individual, regardless of whether such an individual could actually exist. Alternatively, the criteria could be established on the basis of providing protection for more realistically exposed individuals, and could include consideration of a so called "critical group" which would be a small number of individuals that are representative of that population likely to receive the greatest dose. A "critical group" approach would often mean that it would be possible for the exposure of some single individual to be greater than the average of the group, and therefore experience a dose or risk in excess of the criteria.

Related to the question of the characteristics of the individual to be protected is the question of whether protecting individuals assures that the population, as a whole, that might be exposed is adequately protected. Various positions have been advanced on this subject, with some indicating that protection of each individual automatically assures protection of the population as a whole, and others indicating that additional criteria might be needed to protect the population. The hypothesis usually used for the regulation of radiation dose is a linear relationship between dose and risk, implying that an increment of dose, no matter how small, and no matter when delivered, will have an equal impact. This reasoning has been used to support

the position, in some cases, that an additional criterion should be applied to the collective dose from a particular facility or source. On the other hand, each decommissioned facility can only expose a limited number of people.

In developing criteria for decommissioning, the codified definition of decommissioning, i.e. to reduce radioactive materials levels to a point where the site is suitable for unrestricted use, becomes important. Once a site has been released, an individual or group could use the property and any structures on the property in any legally acceptable way they wished, including renovating the structures for other purposes, excavation or other property modifications, and removal of materials from the site for use in other locations or for other purposes. Thus, when considering the appropriate criteria for unrestricted use, consideration may also need to be given to the potential for reuse, recycling, or disposal of structures or materials remaining on the site.

An additional consideration in the selection of radiological criteria is the time frame over which the criteria should be applied. There have been a number of different values suggested and used in various standards of the NRC and EPA, ranging from 100 years to over 10,000 year radionuclides with relatively short half-lives, decay negates the need for evaluations in the distant future. However, for long-lived radionuclides, and particularly for chains of radionuclides where daughter products will gradually increase until equilibrium is reached (e.g., uranium and thorium), the time frame for considerations is potentially important. Time periods are also important when certain pathways, such as a groundwater pathway, are considered, since the movement of radionuclides through the pathway may be very slow under certain circumstances.

Sub-issues:

1. Should the Commission base its considerations on a theoretical, maximally exposed individual, or upon some type of "critical group" approach? What endpoint(s), such as cancer fatalities or cancer incidence, genetic effects, etc., should be used in establishing the radiological criteria?

2. Should the Commission include consideration of an exposed population in addition to providing criteria for individuals? If so, how should this influence the criteria?

3. Should the Commission consider the potential, after release for unrestricted use, for reuse of building structures and the removal of soil from a site in determining the appropriate criteria? If so, how should these factors be included? Should the removal of materials lead to a different standard than if materials were to remain on the site? If so, what is the rationale or basis? Should consideration be given to consistency or linkage with waste disposal regulations, particularly in situations where large quantities of material may require removal during the decommissioning process?

4. How far into the future should calculations be carried out when making estimates and determining the applicability of criteria? Should the Commission place a maximum value on the time frame to be considered, or should the criteria be applicable irrespective of time as which a maximum exposure could occur? For low levels of radioactivity should other changes in the environment, such as global warming and ice age cycles, geologic changes, etc., be factored into considerations of the applicability of the criteria?

Secondary Issue B.: If the objective the Commission adopts is either the Risk Limit or the Risk Goal, how should the regulation be structured with respect to exposure pathways? Should the rule apply comprehensively to all major pathways (routes) of exposure to the public or should the rule have criteria to limit specific exposure pathways, such as radionuclides in groundwater?

Discussion:

This issue arises because, over long periods of time residual radioactivity from decommissioned sites could contaminate groundwater that would later be used for drinking or irrigation. Furthermore, groundwater could be contaminated from more than one decommissioned site if another site were

nearby. The Environmental Protection Agency has established limits for radioactivity in drinking water²⁰ and, under the authority of RCRA and CERCLA, applies these limits to most potable ground water, but there are no Federal standards for groundwater contamination at decommissioned facilities.

In 10 CFR Part 20, the Commission has adopted the International Commission on Radiation Protection (ICRP) recommendations to account for doses from all pathways in one term. The Commission combines the doses from external exposures, ingestion and inhalation into the term, "Total Effective Dose Equivalent" (TEDE). That is, there is an internationally recognized methodology for weighing the doses and combining them into a single number, TEDE, that enables comparison of doses regardless of the pathway of exposure--external, ingestion or inhalation.²¹

Conceptually, the NRC could establish an overall limit or goal for a site, and allow the contribution (dose or risk) from each pathway of exposure (e.g. air, water, direct radiation, food) to vary so long as the total remained consistent with the overall limit or goal. Alternatively, a secondary limit or goal in addition to the overall criterion could be established to limit the extent to which a particular pathway could contribute to the total. A third possibility is that separate criteria could be established for each particular exposure pathway, independent from each of the other pathways.

²⁰ 40 CFR Part 141. EPA regulations are applied to public water systems and not individual users. For beta and/or gamma emitters the dose to the whole body or an organ is limited to 4 mrem/y, while for alpha emitters Maximum Contaminant Levels are set in terms of pCi/l and exclude radon and uranium. The EPA has published a proposed revision of these regulations, expressed in terms of a 4 rem/y effective dose equivalent (see 56 FR 33050). The proposed revision also includes specific limits on radon and uranium.

²¹ For example, the technical basis document translating radioactivity in the environment to dose (PROPOSED COMMISSION ACTIONS section above, p. 9) accounts for radiation doses from major sources originating in soil, air, and water and combines the respective pathway doses into a conversion factor for TEDE.

If a separate limit or goal were chosen for groundwater, then details of the method for estimating doses or risk due to water use at future times after decommissioning would be required. One method could be to establish Generic Site Inventory Levels²², as a screening criterion based upon an analysis for a generic site. The basis for this approach could be that residual radioactivity from sites meeting these generic screening levels would not be expected to contaminate drinking water supplies in excess of EPA standards under any reasonably foreseeable circumstances regardless of the type of facility, or size, location, or hydrogeologic features of the site. Such an approach would also need to consider the possibility that building structures remaining onsite at the time of unrestricted release could be demolished and become part of the overall site inventory available to the groundwater. It is noted that Generic Site Inventory Levels that provide a reasonable margin of safety for all sites are likely to be extremely restrictive and thus impractical for some sites. Potential impracticality could be addressed by providing licensees who demonstrate that Generic Site Inventory Levels are unnecessarily restrictive for their particular site with the option of conducting a site specific analysis to project compliance with EPA drinking water standards or other criteria specified in the rule.

Sub-issues:

1. What consideration should be given to the potential for cumulative drinking water contamination from two or more decommissioned sites in the same general area?
2. If specific exposure pathway criteria were chosen, which pathways should have specific criteria and on what basis should these criteria be established?

²² A Generic Site Inventory Level would be total amount of radioactive material from the licensed operation which could be left at a decommissioned site without having to conduct a site specific analysis to determine whether allowing this radioactive material to remain at the site might result in unacceptable contamination of drinking water supplies.

3. If the Commission chooses specific criteria for groundwater or water use, should it establish Generic Site Inventory Levels for screening residual radioactivity at decommissioned sites? Should the basis for such levels be to provide reasonable assurance that EPA drinking water standards will not be exceeded? Should a single Generic Site Inventory Level be established for all sites, or should levels be tailored to specific class of decommissioned sites (e.g., all nuclear power plant sites)? If so, on what basis should sites be categorized? Alternatively, should the Commission require that a site specific assessment of drinking water contamination potential be carried out for each site or a combination of the above?

Secondary Issue C.: For sites where uranium, radium or thorium contamination may have resulted from licensed activities, how should exposures from radon (^{222}Rn and ^{220}Rn) and its decay products be considered when the facility is decommissioned?

Discussion:

Small quantities of uranium, radium and thorium are present in all soil types throughout the United States. These naturally occurring materials are responsible for part of the natural background radiation exposure to members of the public, and are precursors for radon gas--the single greatest contributor to natural background exposures. Because radium occurs naturally in the environment, accurate determinations of doses from radon resulting from licensed operations can be very difficult. First, radium from licensed operations contaminating building structures will produce radon within the structure. This radon will be in addition to radon present due to naturally occurring radium within or under the building. Radon concentrations from natural sources in buildings are known to be variable, and may be subject to variations due to factors such as building ventilation, weather, etc. Secondly, a fraction of the radium in the soil of the site could be from licensed operations and could contribute to indoor radon levels of any building later constructed on the site. The correlation between soil concentrations of uranium, radium or thorium have been shown to be not well

correlated with the eventual levels of radon within a building. Given the above factors, approximate estimates of the amounts of uranium and thorium and their decay products (including radium) on site as a result of licensed operations might be made by taking direct measurements at a site in conjunction with offsite measurements to establish background levels. However, the estimation of indoor radon concentrations attributable to licensed operations for the present and future structures appears elusive.²³

Based on information available to the NRC, there appears to be no practical way, using current technology, to distinguish between small amounts of radon from licensed operations and that radon resulting from natural background. This inability appears to be due to (1) the natural background levels of radium in rocks and soils and the resulting concentrations of radon²⁴, (2) the variability of doses at a given site from naturally occurring radon²⁵, and (3) the difficulty in correlating indoor radon levels with the concentrations of radon in the soil outside the structures.²⁶ There are some who believe it may be virtually impossible to demonstrate that doses from

²³Radon may also be a problem for a licensee that has never possessed materials containing uranium or thorium if they are located in an area of elevated natural radon levels. In these cases an individual in the structure could receive doses in excess of the criteria for decommissioning from sources outside the original responsibility of the licensee.

²⁴ Soil radium concentrations in the U.S. average about 1.5 pCi/g. The average indoor radon concentration is about 1.5 pCi/l which produces an estimated dose to a resident (assuming 75% occupancy) of about 150 mrem/y. EPA Radon Reference Manual, EPA 520/1-87-20, September, 1987, pp.3-5 and 7-2.

²⁵ The transport of radon through the environment is subject to considerable uncertainty and variability. In the case of indoor radon, variables such as highly localized geology, structural features, and changing weather, among others, combine to make accurate prediction of doses very difficult.

²⁶ As is the case for transport of radon through the environment, there are considerable uncertainties in the modeling of the movement of radon into a structure and the concentrations of radon that will exist at any given time. Numerous studies have shown that seemingly identical structures in similar environments can nevertheless have considerably different radon concentrations.

radon which result from licensed operations have been reduced to levels much below the EPA suggested action level of 4 pCi/l for indoor radon.²⁷

Sub-issues:

1. For sites where licensed activities have involved uranium, thorium, or other materials which decay to radon, are there practical and reliable ways to distinguish between radon and its daughter products attributable to residual radioactivity from licensed operations at a site and that radon attributable to natural background? Are there methods for estimating such doses with reasonable assurance using modelling techniques, direct measurements, or some combination of the two? At what dose levels can these distinctions be made?
2. If there is no way of distinguishing doses from radon resulting from licensed operations at levels well below the 100 mrem annual limit for public doses (10 CFR Part 20.1301), what alternatives would be considered acceptable? For example, would it be acceptable to require the licensee to demonstrate the site had been cleaned up to levels approaching ambient background levels measured at nearby representative sites or buildings? Would this alternative be acceptable even when these background levels would result in doses which are a large fraction of, or even exceed 10 CFR Part 20 limits for the public (100 mrem/y)?
3. Should the Commission consider criteria similar to existing EPA guidelines and standards even though these doses may be higher than the public dose limits in the revised 10 CFR Part 20 (100 mrem/y)? Alternatively, should the Commission require licensees to reduce doses from radon and its daughter products as far below the EPA standard as reasonably achievable? How would compliance with such a requirement be judged (see Issue II)?

²⁷ The level at which EPA suggests action be taken to reduce radon concentrations in homes. See "A Citizen's Guide to Radon, 2nd Edition - "The Guide to Protecting Yourself and Your Family from Radon", 402-K92-0001, Office of Air and Radiation; U.S. Environmental Protection Agency, June, 1992.

4. How should the Commission handle radon exposures in excess of EPA guidelines in facilities of licensees that have never possessed uranium, radium, or thorium materials?

Secondary Issue D.: How should the Commission regard materials previously buried on-site under disposal provisions in 10 CFR Part 20 in the context of decommissioning?

Discussion:

Under certain conditions, licensees may dispose of radioactive wastes by burial on their own property. Before 1981, NRC regulations (10 CFR 20.304) allowed disposal, without prior approval, of limited quantities of specified nuclides under prescribed conditions. On July 28, 1981, 10 CFR 20.304 was revoked. However, onsite disposal can still be undertaken by individual licensees under 10 CFR 20.302, provided the disposal is specifically approved by the NRC or an Agreement State.

NRC requirements in 10 CFR 20.302 and 20.2002 allow licensees to request specific approval to dispose of licensed radioactive material in a manner not otherwise authorized by the regulations. In accordance with 10 CFR 20.2002, any such request must be accompanied by specific data and analyses necessary for the staff to determine whether such disposal would have an adverse effect on the health and safety of the public or the environment. The radioactive material involved in the requests is generally very low activity waste contained in large volumes of material, such as sludge from sanitary sewers and storm drains, soils contaminated by spills and leaks, and dredged material from discharge canals and settling ponds.

The requirements in 10 CFR Part 20 do not explicitly limit the quantity or concentration of the radioactive material. Past practices have limited approvals to small concentrations of radioactive material and correspondingly low to very low potential doses to members of the public and the environment.

Maximum potential doses have generally been less than a few millirem per year.

Sub-issues:

1. When preparing their sites for decommissioning, should licensees be required to consider radioactive materials disposed of on-site in accordance with provisions of NRC or Agreement State regulations as part of the total inventory of residual radioactivity that must be considered when preparing a site for decommissioning?
2. Should a site specific analysis of the risks, costs, and benefits be performed before a decision is made to take any remedial action (e.g. exhumation and removal of buried radioisotopes, or delaying release of a site to allow decay of short lived buried radioisotopes) involving radioactive material previously disposed of at a site?

APPENDIX A

A GLOSSARY OF GENERAL TERMS USED BY THE NRC²⁸

Activity (Radioactivity) is the rate of disintegration (transformation) or decay of radioactive material. The units of activity are the curie (Ci) and the becquerel (Bq).

ALARA (acronym for "as low as is reasonably achievable") means making every reasonable effort to maintain exposures to radiation as far below the dose limits in this part as is practical consistent with the purpose for which the licensed activity is undertaken, taking into account the state of technology, the economics of improvements in relation to state of technology, the economics of improvements in relation to benefits to the public health and safety, and other societal and socioeconomic considerations, and in relation to utilization of nuclear energy and licensed materials in the public interest.

Background radiation means radiation from cosmic sources; naturally occurring radioactive materials, 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. "Background radiation" does not include radiation from source, byproduct, or special nuclear materials regulated by the Commission.

Byproduct material means --

(1) Any radioactive material (except special nuclear material) yielded in, or made radioactive by, exposure to the radiation incident to the process of producing or utilizing special nuclear material; and

(2) The tailings or wastes produced by the extraction or concentration of uranium or thorium from ore processed primarily for its source material content, including discrete surface wastes resulting from uranium solution extraction processes. Underground ore bodies depleted by these solution

²⁸ 10 CFR Part 20.1003 [56 FR 24018, May 21, 1991]

extraction operations do not constitute "byproduct material" within this definition.

Collective dose is the sum of the individual doses received in a given period of time by a specified population from exposure to a specified source of radiation.

Commission means the Nuclear Regulatory Commission or its duly authorized representatives.

Committed dose equivalent ($H_{T,50}$) means the dose equivalent to organs or tissues of reference (T) that will be received from an intake of radioactive material by an individual during the 50-year period following the intake.

Committed effective dose equivalent ($H_{E,50}$) is the sum of the products of the weighting factors applicable to each of the body organs or tissues that are irradiated and the committed dose equivalent to these organs or tissues ($H_{E,50} = \sum w_T H_{T,50}$).

Dose or radiation dose is a generic term that means absorbed dose, dose equivalent, effective dose equivalent, committed dose equivalent, committed effective dose equivalent, or total effective dose equivalent, as defined in other paragraphs of this section.

Dose equivalent (H_T) means the product of the absorbed dose in tissue, quality factor, and all other necessary modifying factors at the location of interest. The units of dose equivalent are the rem and sievert (Sv).

Effective dose equivalent (H_E) is the sum of the products of the dose equivalent to the organ or tissue (H_T) and the weighting factors (w_T) applicable to each of the body organs or tissues that are irradiated ($H_E = \sum w_T H_T$).

Exposure means being exposed to ionizing radiation or to radioactive material.

External dose means that portion of the dose equivalent received from radiation sources outside the body.

Generally applicable environmental radiation standards means standards issued by the Environmental Protection Agency (EPA) under the authority of the Atomic Energy Act of 1954, as amended, that impose limits on radiation exposures or levels, or concentrations or quantities of radioactive material, in the general environment outside the boundaries of locations under the control of persons possessing or using radioactive material.

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

Individual means any human being.

Internal dose means that portion of the dose equivalent received from radioactive material taken into the body.

License means a license issued under the regulations in Title 10, Code of Federal Regulations, Parts 30 through 35, 39, 40, 50, 60, 61, 70, or 72.

Licensed material means source material, special nuclear material, or byproduct material received, possessed, used, transferred or disposed of under a general or specific license issued by the Commission.

Licensee means the holder of a license.

Limits (dose limits) means the permissible upper bounds of radiation doses.

Member of the public means an individual in a controlled or unrestricted area. However, an individual is not a member of the public during any period in which the individual receives an occupational dose.

Monitoring (radiation monitoring, radiation protection monitoring) means the measurement of radiation levels, concentrations, surface area concentrations or quantities of radioactive material and the use of the results of these measurements to evaluate potential exposures and doses.

Nonstochastic effect means health effects, the severity of which varies with the dose and for which a threshold is believed to exist. Radiation-induced cataract formation is an example of a nonstochastic effect (also called a deterministic effect).

NRC means the Nuclear Regulatory Commission or its duly authorized representatives.

Occupational dose means the dose received by an individual in a restricted area or in the course of employment in which the individual's assigned duties involve exposure to radiation and to radioactive material from licensed and unlicensed sources of radiation, whether in the possession of the licensee or other person. Occupational dose does not include dose received from background radiation, as a patient from medical practices, from voluntary participation in medical research programs, or as a member of the general public.

Public dose means the dose received by a member of the public from exposure to radiation and to radioactive material released by a licensee, or to another source of radiation either within a licensee's controlled area or in unrestricted areas. It does not include occupational dose or doses received from background radiation, as a patient from medical practices, or from voluntary participation in medical research programs.

Radiation (ionizing radiation) means alpha particles, beta particles, gamma rays, x-rays, neutrons, high-speed electrons, high-speed protons, and

other particles capable of producing ions. Radiation, as used in this part, does not include non-ionizing radiation, such as radio- or microwaves, or visible, infrared, or ultraviolet light.

Restricted area means an area, access to which is limited by the licensee for the purpose of protecting individuals against undue risks from exposure to radiation and radioactive materials. Restricted area does not include areas used as residential quarters, but separate rooms in a residential building may be set apart as a restricted area.

Site boundary means that line beyond which the land or property is not owned, leased, or otherwise controlled by the licensee.

Source material means--

(1) Uranium or thorium or any combination of uranium and thorium in any physical or chemical form; or

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

Special nuclear material means--

(1) Plutonium, uranium-233, uranium enriched in the isotope 233 or in the isotope 235, and any other material that the Commission, pursuant to the provisions of section 51 of the Act, determines to be special nuclear material, but does not include source material; or

(2) Any material artificially enriched by any of the foregoing but does not include source material.

Stochastic effects means health effects that occur randomly and for which the probability of the effect occurring, rather than its severity, is assumed to be a linear function of dose without threshold. Hereditary effects and cancer incidence are examples of stochastic effects.

Survey means an evaluation of the radiological conditions and potential hazards incident to the production, use, transfer, release, disposal, or pre-

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sence of radioactive material or other sources of radiation. When appropriate, such an evaluation includes a physical survey of the location of radioactive material and measurements or calculations of levels of radiation, or concentrations or quantities of radioactive material present.

Total Effective Dose Equivalent" (TEDE) means the sum of the deep-dose equivalent (for external exposures) and the committed effective dose equivalent (for internal exposures).

Unrestricted area means an area, access to which is neither limited nor controlled by the licensee.

Uranium fuel cycle means the operations of milling of uranium ore, chemical conversion of uranium, isotopic enrichment of uranium, fabrication of uranium fuel, generation of electricity by a light-water-cooled nuclear power plant using uranium fuel, and reprocessing of spent uranium fuel to the extent that these activities directly support the production of electrical power for public use. Uranium fuel cycle does not include mining operations, operations at waste disposal sites, transportation of radioactive material in support of these operations, and the reuse of recovered non-uranium special nuclear and byproduct materials from the cycle.

Whole body means, for purposes of external exposure, head, trunk (including male gonads), arms above the elbow, or legs above the knee.

APPENDIX B

TERMS AND CONCEPTS ASSOCIATED WITH THE BEST EFFORT (TECHNOLOGY-BASED) APPROACH PUT FORTH IN THE CLEAN AIR ACT²⁹

Best Available Control Technology (BACT) - An emission limitation based on the maximum degree of emission reduction which (considering energy, environmental, and economic impacts and other costs) is achievable through application of production processes and available methods, systems, and techniques. In no event does BACT permit emissions in excess of those allowed under any applicable Clean Air Act provisions. Use of the BACT concept is allowable on a case by case basis for major new or modified emissions sources in attainment areas and applies to each regulated pollutant.³⁰

Best Demonstrated Technology (BDT) - The technology on which the EPA will base the standards, i.e., application of the best technological system of continuous emission reduction which (taking into account the cost of achieving such emission reduction, and any nonair quality health and environmental impact and energy requirements) the Administrator determines has been adequately demonstrated.³¹

Generally Available Control Technologies (GACT) - The EPA Administrator may elect under certain circumstances to promulgate standards or requirements which provide for the use of generally available control technologies or management practices to reduce emissions of hazardous air pollutants.³²

²⁹ Public Law 101-549 (104 STAT. 2399) November 15, 1990, (Clean Air Act Amendments of 1990).

³⁰ "EPA Glossary of Environmental Terms and Acronym List", OPA-87-017, August 1988.

³¹ Clean Air Act Amendments of 1990, Section 111(a)(1)

³² Clean Air Act Amendments of 1990, Section 112(d)(5)

Maximum Achievable Control Technology (MACT) - Emissions limitations based on the best demonstrated control technology or practices in similar sources to be applied to major sources emitting one or more of the listed toxic pollutants.³³

Residual Risk - The quantity of health risk remaining after application of the MACT (Maximum Achievable Control Technology).³⁴

³³ Glossary of Terms - Clean Air Act Amendments of 1990

³⁴ Glossary of Terms - Clean Air Act Amendments of 1990

APPENDIX B

DECOMMISSIONING CASE STUDIES

Decommissioning Case Studies

A Sampling of Actual Decommissioning Case Studies for Review by the Participants in the Workshops that Support the U.S. Nuclear Regulatory Commission's Enhanced Participatory Rulemaking on Radiological Criteria for Decommissioning

**January 1993
U.S. Nuclear Regulatory Commission**

Decommissioning Case Studies

Introduction

The Nuclear Regulatory Commission recently initiated an Enhanced Participatory Rulemaking to develop radiological criteria for decommissioning for NRC-licensed facilities. NRC is enhancing opportunities for participation of affected interests on the rulemaking issues before the NRC staff develops the proposed rule. Consistent with this objective, NRC is conducting a series of workshops to solicit commentary from affected interests on the fundamental approaches and issues that must be addressed in establishing radiological criteria for decommissioning. As announced in the Federal Register on December 11, 1992 (57 FR 58727), the workshops will be held in January through May 1993 at seven locations throughout the United States.

In approving the plan for the Enhanced Participatory Rulemaking to develop Radiological Criteria for Decommissioning, the Commission directed the NRC staff to prepare summaries of actual decommissioning cases and provide them to workshop participants as background information. The Commission intended the cases to include several types of facilities and cover a range of sites. The objective of providing the cases to the workshop participants was to illustrate the practical aspects of decommissioning facilities with radiological contamination, including examples of cases where decommissioning was hampered by technical, cost, administrative, or other factors.

This paper presents a suite of six case studies to illustrate "real world" decommissioning experiences and make tangible the abstract concepts, such as radiation dose, risk, and monitoring limitations, that lie at the root of the discussions at the workshops. The case studies represent a range of facilities, including a research power reactor, two fuel cycle facilities, two nuclear materials facilities, and a nuclear missile accident site. Two of the facilities primarily involved naturally occurring radioactive materials; the other four primarily involved artificially produced radionuclides. The sites are also distributed geographically in the States of Connecticut, New Hampshire, New Jersey, New York, Oklahoma, South Dakota. The sites are summarized in Table 1.

Although not all of the facilities were licensed under the Atomic Energy Act by NRC or an Agreement State, they all illustrate practical aspects of decommissioning nuclear facilities. Three of the facilities are currently licensed by NRC. One of the facilities was licensed by an Agreement State prior to decommissioning, after which the license was terminated. One site was licensed by an Agreement State, but is currently being remediated under the Environmental Protection Agency's (EPA's)

Superfund Program under the Comprehensive Environmental Response, Compensation, and Liability Act. One of the facilities was not licensed and is being remediated under the Installation Restoration Element of the Defense Environmental Restoration Program by the Air Force. Cleanup activities at this site are being monitored by EPA as if the site was in the Superfund program.

For each case study, NRC staff has assembled summary information that illustrates specific decommissioning issues. The summaries include brief descriptions of the facility, nature and extent of contamination, decommissioning criteria, decommissioning approach, current status, and lessons learned. Where appropriate, maps and diagrams have been included to provide the reader with a visual image of the extent and nature of decommissioning action. Although more detailed information is available for each site, the case studies have been intentionally kept brief and focused to illustrate generic issues and avoid undue attention during the workshops to individual cases.

Table 1. Summary of Decommissioning Case Studies

Name	Location	Facility Type	Principal Radionuclides	Regulatory Status
UNC-Naval Products	Montville, CT	Fuel Facility	High Enriched Uranium	Active NRC License
Kerr-McGee Cimarron	Crescent, OK	Fuel Facility	Low Enriched Uranium, Plutonium	Active NRC License
Pathfinder Atomic Power Plant	Sioux Falls, SD	Research Power Reactor	Activation Products (^{60}Co , ^{63}Ni , ^{59}Fe)	Active NRC License
GTE-Sylvania	Manchester, NH	Materials Facility	Thorium	Terminated NH License
Radium Chemical Company	Woodside, NY	Materials Facility	Radium	Terminated NY License; Superfund Site
BOMARC Missile Accident Site	Ocean County, NJ	Nuclear Weapons Site	Plutonium	Defense Installation Restoration Program

The decommissioning case studies follow. Readers with questions should contact Michael Weber, NRC, Mail Stop 5E4, Washington, DC 20555 or (301) 504-1298.

***UNC-Naval Products
Septic Leach Field
Montville, CT***

Decommissioning Issues

- Technical basis for translating residual contamination into radiological dose and/or risk
- Averaging of residual contamination concentrations over clean soil due to heterogeneous nature of contamination

Facility Description

The UNC Incorporated (UNC) Naval Products Facility fabricated nuclear fuel for naval reactors at a facility in Montville, CT. Beginning in 1974, the Montville facility made operational discharges of small concentrations of highly enriched uranium to an onsite septic field as an effluent from the liquid radioactive waste treatment facility. These effluents were discharged in accordance with the license for the UNC-Montville facility. Discharge of enriched uranium to the leach field terminated in November 1987, when NRC authorized discharge of the waste water directly to the sanitary sewer system of Montville, CT, which was acceptable because of the low concentrations of the enriched uranium in the effluent.

In March 1990, UNC announced plans to decommission the Montville facility and terminate their license. UNC-Montville submitted a plan for decommissioning the facility on June 1, 1990. One part of this plan specifically addressed the decommissioning of the formerly used septic leach field. The final revision of the septic leach field decommissioning plan was submitted on May 22, 1992. The site also contains numerous buildings. These are being decommissioned in accordance with the June 10, 1991 decommissioning plan.

Nature and Extent of Contamination

The septic leach field consisted of two parts. Septic field 1 consisted of 43 4-inch diameter perforated pipes of varying lengths, arranged in parallel 2.5 feet wide by 2.5 feet deep stone-filled trenches, each separated by 5.5 feet of clean soil and buried 3 to 8 feet below the soil surface. Septic field 2 consisted of 2 groups of 6 six-foot diameter perforated concrete drywells spaced in a polygonal pattern approximately 40 feet apart and each surrounded by 2 feet of crushed rock. The size and orientation of septic leach field 1 is illustrated in Figure 1 and septic leach field 2 in Figure 2. Gross alpha concentrations averaged >100 pCi/g for samples of the fine-grained material between the stones in the trenches in septic field 1. When averaged over the mass of the stones as well as the fine grained material between the stones, this activity concentration was about 38 pCi/g. Ingrowth of decay products was not significant due to their virtual absence in the original enriched uranium and the limited amount of time since discharge.

Decommissioning Criteria

The major regulatory criteria applied to cleanup of the septic leach field included the following:

1. Option 1 Concentration Criteria from the 1981 NRC Branch Technical Position (BTP) on *Disposal or Onsite Storage of Thorium or Uranium Wastes from Past Operations* (46 FR 52061; October 23, 1981) - 30 pCi/g for enriched uranium.
2. The dose via the groundwater-drinking water pathway was limited to a maximum of 2.3 millirem/yr Total Effective Dose Equivalent (TEDE), consistent with the dose basis for Option 1 concentrations for enriched uranium in NRC's 1981 BTP (in lieu of EPA's proposed drinking water standard of 4 millirem/yr EDE or limit of 20 µg/l for uranium (30 pCi/l)).

UNC proposed a value of \$25,000 per person-rem averted be used in calculations to show that residual contamination would be as low as reasonably achievable (ALARA), if above the Option 1 concentrations. UNC concluded, however, that the Option 1 criterion in the 1981 BTP would be applied to the site. Therefore, no additional effort was necessary to reduce contamination levels below the Option 1 criterion.

Decommissioning Approach

UNC removed, packaged, and shipped for off-site disposal all distribution and service pipes, distribution boxes, sludges, and drywell cylinders. UNC also removed the residually contaminated materials in excess of the decommissioning criteria described below. UNC verified compliance with the cleanup criteria using a biased survey of the leach field with samples taken every 10 m along the centerline of the exposed trenches. Hotspots were identified and surveyed in a manner consistent with the approach described in NUREG/CR-5849. In determining compliance with the hotspot criteria, the licensee averaged samples along a single horizontal planar surface and not vertically over the trench depths.

To demonstrate compliance with the groundwater protection criteria, the licensee will use the RESRAD dose assessment computer code to estimate potential doses to hypothetical future onsite residents, who could consume potentially contaminated groundwater. The modeling done in support of the groundwater pathway assessment assumed that the total activity in the septic field was distributed over the mass of the septic field (including the clean soil between trenches and drywells).

The decommissioning project for the entire leach field cost approximately \$2,000,000 dollars and was completed in 12 months.

Current Status of Site

The licensee has completed decontamination of the septic field to BTP option 1 levels. The licensee has also completed its termination survey for the leach field. NRC's contractor has performed a confirmatory survey, but the results of this survey have not been received.

Lessons Learned

The contamination in the leach field existed in a fine-grained matrix between or on the 1.5-inch diameter stone used in the leach field. This raised an issue about whether to allow the stone to constitute part of the mass of the soil samples taken in the field because the interior of the stone was not contaminated. Resolution of this question affected the calculations that translate residual radiological contamination into dose to an potential site resident. In response to the licensee's proposal, NRC decided that the stone should be included in the mass of the sample (thus reducing the concentration of each sample) because it was not reasonable to assume that the fine-textured material would be separated from the stone to any significant degree in reasonable exposure scenarios.

The licensee initially attempted to correlate gross alpha data from the field to uranium concentrations. This did not work because natural background gross-alpha measurements were too variable. In addition, the chemical form of the uranium in the field did not lend itself to the type of gross alpha analytical technique attempted on these samples. Further, the laboratory chosen by the licensee for analysis of soil samples generated gross-alpha values that were consistently lower than measured uranium concentrations, whereas the gross-alpha values should have been greater than uranium concentrations. The licensee expended considerable effort trying to resolve the apparent disparities between the gross-alpha values and the uranium concentrations. Consequently, the licensee wasted time, money, and effort trying to evaluate the adequacy of the septic field decommissioning using gross-alpha analysis. The licensee ultimately selected alternative laboratories and analytical techniques to determine uranium concentrations directly.

Based on this experience, the licensee and NRC learned the following lessons:

- The hotspot criteria in NUREG/CR-5849 are applicable to heterogenous contamination.
- Licensees can complete ALARA analyses in planning decommissioning for various levels of clean-up.
- The adequacy of licensee or contract laboratory Quality Assurance/Quality Control programs for radiological analysis should be confirmed by the licensee, in consultation with NRC, before radiological surveys to ensure that compatible and proper techniques will be used.

Figure 1. Size and Orientation of Septic Leach Field 1

Figure 2. Size and Orientation of Septic Leach Field 2

Kerr-McGee, Cimarron Plants Crescent, Oklahoma

Decommissioning Issues

- Technical basis for allowing on-site burials of uranium contaminated soils
- Approach to termination of multiple licenses
- Appropriate time period for dose calculations

Facility Description

Kerr-McGee operated two fuel fabrication plants, one for mixed-oxide fuels and one for low-enriched uranium fuels, near Crescent, Oklahoma. The 1100-acre site is located in a rural part of central Oklahoma, 30 miles north of Oklahoma City, in a farming area. The Cimarron site is listed in the NRC's Site Decommissioning Management Plan.

In addition to the two fuel fabrication plants on the site, the licensee operated several waste-water treatment settling ponds and a burial area (for burials previously allowed under 10 CFR 20.304), which were licensed as part of the uranium plant. Both buildings were contaminated with uranium and plutonium. The settling ponds are contaminated with uranium, while the burial areas (two additional areas recently discovered) contain uranium and trace amounts of thorium from waste disposals associated with offsite activities. Fuel fabrication operations at both plants were terminated in 1975. Major contaminated facilities include the plutonium plant (~26,000 ft²), the uranium plant (~60,000 ft²), 3 waste-water treatment settling ponds, and waste burial areas. There were also five previous waste water treatment ponds; these ponds were closed in 1977 and 1978.

Nature and Extent of Contamination

Decontamination of the mixed oxide facility began in 1979, and in 1989, an NRC contractor completed a confirmatory survey that demonstrated that this facility met decommissioning guidelines. No plutonium contamination has been identified outside of the mixed oxide building. The yard outside this facility is contaminated with small concentrations of uranium from the nearby uranium plant. Cimarron Corporation submitted a request for license termination for this facility in August 1990, followed by a request in November 1990 to allow renovations in order to facilitate non-nuclear operations, which NRC approved.

The soil around the uranium plant and the uranium plant building are contaminated with low-enriched uranium (ranging from 2 to 9.1 percent ²³⁵U). Soil in the settling ponds and the burial grounds are also contaminated with uranium with concentrations generally in the range of 30 to 100 pCi/g of about

1.3 percent average enrichment. Although a known burial area was exhumed and resulting wastes shipped offsite for disposal, other apparent 10 CFR 20.304 burials exist at the site. In addition, elevated uranium concentrations were documented in samples taken during the closure of the five former waste water ponds at the site. The waste-water treatment lagoons also contain chemical contamination (primarily nitrate contamination (NO_3)). Groundwater in one area of the site is also contaminated with uranium and non-radiological constituents (e.g., NO_3).

About 400,000 ft^3 of soil contaminated with enriched uranium with concentrations averaging 70 pCi/g in the top 1 to 2 feet of the ground surrounding the processing buildings. Samples from the closed ponds indicated that appreciable portions of the bottoms of two ponds consisted of contaminated soils in the range of 300 to 400 pCi/g uranium prior to tilling, which occurred at the time of closure of the ponds. Consequently, concentrations of uranium in the bottom sediments would now be expected to be lower due to mixing of the contaminated material with clean sediments during tilling.

Decommissioning Criteria

The major regulatory criteria applied during decommissioning include the following:

1. *Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material*, July 1982 (An Enclosure to Policy and Guidance Directive FC 83-23)
2. *Acceptable Soil Contamination Levels*, Enclosure 3 to Policy and Guidance Directive FC 83-23, November 4, 1983
3. Option 2 Concentration Criteria from the 1981 NRC Branch Technical Position (BTP) on *Disposal or Onsite Storage of Thorium or Uranium Wastes from Past Operations* (46 FR 52061; October 23, 1981) -- for enriched uranium, the criterion is 100 pCi/g (soluble), 250 pCi/g (insoluble)

The first group of criteria defined acceptable surface contamination levels on building surfaces; the second group of criteria were applied to the soils surrounding the buildings. The soil criteria were consistent with the criteria in the 1981 BTP and included a value of 25 pCi/g for total plutonium. The BTP was applied to a proposed onsite burial of soil contaminated with uranium in accordance with 10 CFR 20.302.

Decommissioning Approach

Kerr-McGee has finished decontaminating the plutonium plant under an NRC-approved decommissioning plan. At the uranium plant, Kerr-McGee has excavated and shipped for disposal the contents of the initially-identified burial area and has continued decontaminating the building. The licensee has surveyed the soil around the building to detect uranium contamination and submitted a

request for authorization (pursuant to 10 CFR 20.302) to dispose of 400,000 ft³ of uranium-contaminated soil onsite under Option 2 of the 1981 BTP. Staff has estimated that an on-site disposal would reduce decommissioning costs by \$10 million or more due to the avoidance of costs for disposing of the contaminated soil offsite. The proposed burial also has the advantage of reducing radiation exposure to remediation workers. The licensee's evaluation of the potential for future groundwater contamination beneath the site concluded that it was unlikely for any uranium to reach groundwater in a well located immediately adjacent to the burial area within 1000 years due primarily to the retardation of the uranium by the bedrock at the site.

Current Status

- NRC termination of the license for the mixed oxide facility is pending
- Termination of the license for the uranium fuel facility is dependent upon proper completion of the following steps:
 - Adequate site characterization
 - Authorization of onsite disposal in accordance with 10 CFR 20.302
 - Decontamination of the building and adjacent soils in accordance with existing criteria

Lessons Learned

- Limited characterization of the extent and distribution of contaminated material at the site complicated decommissioning
- Prudent measures to reduce the likelihood of human exposure to the contamination and other prescribed conditions on disposal of contaminated soil may be perceived as being inconsistent with the "unrestricted use" standard for decommissioning

Northern States Power Pathfinder Atomic Power Supply Sioux Falls, South Dakota

Decommissioning Issues

- Technical basis for the release of residual contamination on building surfaces containing gamma-emitting radionuclides
- Advantages and disadvantages of phased decommissioning approaches

Facility Description

The Pathfinder Atomic Power Plant was a 66 Megawatt-electric (~200 Megawatt-thermal) boiling water reactor operated by Northern States Power (NSP) on a site 5.5 miles northeast of Sioux Falls, South Dakota. The plant ceased operations in September 1967. The fuel was removed from the site and the facility was placed in a Safe Storage (SAFSTOR) condition in 1971. At that time, NSP decontaminated portions of the facility by reducing surface activity and filling the reactor vessel with gravel. About 3,000 ft³ (400 drums) of radioactive waste were generated in this decontamination effort and shipped offsite for disposal. NSP stored contaminated equipment and piping that was too large to be drummed in the reactor building and spent fuel pool. As a part of the SAFSTOR program, contaminated equipment and material was transferred to a byproduct materials license in August 1972 and the operating reactor license was terminated. NSP installed non-nuclear boilers in the facility and continued to generate electricity until the present using the plant's turbine generator.

Nature and Extent of Contamination

Because of Pathfinder's limited operating history (e.g., about 80 days) and lack of any identifiable nuclear fuel leaks during operation, radioactive contamination levels were relatively low and caused only by neutron activation. The primary radionuclides were ⁶⁰Co, ⁶³Ni, and ⁵⁵Fe; ⁶⁰Co dominated in terms of radiological significance. Total activity prior to removal of the reactor pressure vessel was about 563 Curies (Ci), all but 0.044 Ci of which was contained in the pressure vessel and its internal hardware. Decommissioning generated about 34,450 ft³ of waste containing essentially all of the 563 Ci. Figure 1 depicts a cross-section of the reactor and fuel handling buildings. Figures 2 and 3 depict the extent of surface contamination within the reactor and fuel handling buildings, respectively.

Decommissioning Criteria

The criteria used for unrestricted release of the reactor building and fuel handling building were the acceptable surface contamination levels stated in Table 1 of Regulatory Guide 1.86, *Termination of Operating Licenses for Nuclear Reactors*. The NRC applied an additional criterion that gamma exposure

rates measured one meter from the building surfaces shall not exceed 5 μ R/hr above background.

Decommissioning Approach

NSP initiated final dismantlement and decontamination activity in the late 1980s. In 1990, NSP removed and shipped the reactor vessel intact along with other waste to the low-level radioactive waste disposal facility in Richland, Washington by rail and truck. Dismantlement also included partial demolition of the reactor building (the lower portion of the concrete containment structure will be buried in place) and decontamination of portions of the fuel handling building. The project caused a total estimated exposure to workers of about 4 person-rem and required about one year to complete. Total cost of the decommissioning action was about \$13 million.

NSP set action levels for contamination below the criteria in Regulatory Guide 1.86 during the radiological survey. Any scan exceeding the criteria triggered additional direct contamination measurements. Those areas exceeding the criteria were decontaminated and resurveyed. Final survey of the site showed that nearly all the areas were remediated to levels less than the "best estimate" of local background radiation.

Some contamination remains in the turbines that are still being used to generate electricity at the plant in conjunction with the non-nuclear boilers. This contaminated equipment will remain at the site under the control of the licensee until it has been properly removed and disposed of or decays below acceptable contamination criteria.

Current Status

- NRC approved release of the Reactor Building, Fuel Handling Building, and Waste Storage Building for unrestricted use in November 1992

Lessons Learned

- Remediation and measurement technology for surface contamination is readily available and implementable

Figure 1. Cross-Section of the Reactor and Fuel Handling Buildings (Ref: *Pathfinder Plant Decommissioning Plan*, Northern States Power, 1989)

Figure 2. Contamination survey of the Reactor Building at the Equipment Floor Level (Ref: Pathfinder Plant Decommissioning Plan, Northern States Power, 1989)

Figure 3. Contamination survey of the Fuel Handling Building at the Basement Level (Ref: *Pathfinder Plant Decommissioning Plan*, Northern States Power, 1989)

GTE/Sylvania Manchester, New Hampshire

Decommissioning Issues

- Long-term reliance on institutional controls for limiting exposure to residual radioactive materials

Facility Description

GTE/Sylvania was licensed by the Atomic Energy Commission in 1965 to use thorium dioxide in coating electrodes for high-intensity light bulbs. These operations were conducted at a manufacturing plant in an industrial area in Manchester, New Hampshire. The thorium was suspended in methanol and vacuum-deposited on the electrodes, which were then cleaned and fired at high temperatures to fuse the coating into a ceramic solid. The electrodes were then encapsulated in gas-tight, fused, silica capsules. GTE/Sylvania continued this process until February 1986, when the facility initiated decommissioning of the thorium operation. The site was licensed by the State of New Hampshire from 1966 until the license was terminated at the conclusion of decommissioning in July 1991.

Nature and Extent of Contamination

Prior to decommissioning, contamination consisted of processed thorium oxide dust (^{232}Th , ^{228}Th , and some decay products) distributed throughout three rooms (light room, chemistry laboratory, and high temperature furnace room (with two high temperature furnaces)). Other contaminated areas included soil beneath a waste storage area, an underground settling tank, and electrical cables and five conduits inside an underground electrical vault. The settling tank was 7.5 feet high with a diameter of about 8 feet and contained about 1 foot of thorium sludge in the bottom. The electrical vault was 5 x 5 x 8 feet and contained about 1.5 feet of thorium sludge on the bottom. Contamination in the settling tank and electrical vault was discovered late in the process of decommissioning; contamination within the electrical vault was not anticipated because it was not involved in the processing or application of the thorium.

About 600 millicuries of thorium was removed during decommissioning; the decommissioning project generated a total of about 3800 ft³ of low-level radioactive waste, which was sent offsite to a licensed low-level waste disposal facility. Contamination on the surface of the electrical cables three feet underground feeding the electrical vault was about 22,000 disintegrations per minute (dpm) beta-gamma per 100 cm². After covering with plastic to contain any removable contamination, the surface activity was lowered to about 14,000 dpm/100 cm². The conduit entrances measured up to 9600 dpm direct beta-gamma/100 cm². Soils beneath the waste storage area are contaminated with thorium up to 500 pCi/g.

Decommissioning Criteria

The major regulatory criteria applied to cleanup of the GTE/Sylvania included the following:

1. Acceptable surface contamination levels from New Hampshire's "Permissible Levels of Surface Contamination" of 170 dpm/100 cm² (removable), 850 dpm/100 cm² (average fixed) contamination, and 2450 dpm/100 cm² (maximum fixed) surface contamination.
2. Option 4 Concentration Criteria from the 1981 NRC Branch Technical Position (BTP) on *Disposal or Onsite Storage of Thorium or Uranium Wastes from Past Operations* (46 FR 52061; October 23, 1981) - 500 pCi/g for natural thorium.

Decommissioning Approach

When decommissioning of this site began in June 1986, it was expected to be a routine, short-term project. The original goal of the project was to release the site for unrestricted use (i.e., remove and dispose of all thorium contamination to release the site without restriction because of the presence of radioactive material). Decommissioning was significantly complicated, however, by the discovery of the contaminated settlement tank and electrical vault and by proposed reliance on institutional controls to restrict long-term access to contaminated soil beneath the waste storage area. Most of the excavation and radiological survey work was completed by April 1988. The license for the facility was terminated in July 1991.

Decommissioning activities included the following: a detailed characterization survey; removal and packaging of contaminated equipment; dismantling and packaging of entire section of the plant (two chemistry labs, a hallway, two exterior walls, and roof); removal of High Efficiency Particulate (HEPA) filter; cleanup of the surface of the waste storage area; removal of over 100 feet of contaminated pipe; decontamination of the settling tank and electrical vault; decontamination of two high temperature furnaces; soil sampling; entombment of contaminated soil; shipping all waste to low-level radioactive waste disposal facility; final termination survey; and amendment of property deed placing restrictions on long-term use of the contaminated waste storage area.

The licensee stabilized the contaminated soil in place, posted area markers warning of the radioactive contamination, and placed restrictions in the deed rather than to excavate and dispose of the thorium-contaminated soil in the waste storage area and adjacent to the settling tank. A portion of the contaminated land extends beneath the floor of a machine shop. The licensee argued that removal of the contaminated tank and adjacent soils would have been nearly impossible and would have required the demolition of a load-bearing wall and foundation slab. Such demolition and associated waste disposal would have been prohibitively expensive for the licensee. In response to a technical assistance request from the State of New Hampshire, NRC reviewed the proposal to stabilize the soil *in situ*. Although NRC indicated that it would be more protective and, in the long run, more

economical to remove the contaminated soils during decommissioning, NRC indicated that *in situ* disposal of the thorium-contaminated soils would be acceptable under existing NRC guidance. NRC's 1981 Branch Technical Position (BTP) on *Disposal or Onsite Storage of Thorium or Uranium Wastes from Past Operations* (46 FR 52061; October 23, 1981) allowed disposal of contaminated soils under Option 4 up to 500 pCi/g for natural thorium with appropriate deed restrictions in areas zoned for industrial use only.

Consistent with Option 4 of the 1981 BTP, the licensee amended the deed to prohibit (1) excavation below 1 foot without prior approval and (2) construction or occupation of residential or industrial structures or for agricultural purposes. The restricted area has a surface area of approximately 1.3 million ft² and includes (1) contaminated subsurface soils outside the building in the waste storage area, (2) contaminated subsurface soils surrounding the buried settling tank, and (3) contaminated electrical cables and conduits in the buried electrical vault. The licensee estimated a worst case annual dose to an inadvertent intruder of about 770 millirem whole body dose above background in the event the person disregarded the area markers and deed restrictions and occupied the site of the contaminated soil for about 19 hours per day.

Current Status

- The State of New Hampshire terminated the license for the site on July 30, 1991

Lessons Learned¹

- Non-radiological hazards (high voltage) and excavation impacts sometimes may preclude decontamination efforts
- The decommissioning process was hampered by a lack of specific guidance and regulations for acceptable soil contamination limits
- Smaller Agreement State programs may not have sufficient technical expertise to regulate complicated decommissioning projects
- Use of surrogate radionuclide (²²⁸Ac for ²³²Th) in situations where secular equilibrium does not exist needs to be validated on a site-specific basis

¹Based on "Decontamination and Decommissioning of Thorium Dioxide Manufacturing Plant," Dennis P. O'Dowd, New Hampshire Department of Public Health Services, Presentation to the Conference of Radiation Control Program Directors Annual Conference, May 1988.

Radium Chemical Company⁶

Woodside, New York

Decommissioning Issues

- Radon exposures associated with residual radioactive material
- Disposal of low activity waste from decommissioning in sanitary landfills

Facility Description

The Radium Chemical Company site consists of a one-story brick building located in a light industrial section of Woodside, Queens County, New York. The Radium Chemical Company (RCC) produced luminous paint containing ^{226}Ra beginning in 1913 and later manufactured, leased, and sold ^{226}Ra sources to hospitals, medical centers, and research laboratories. The radium sources were stored on-site in lead containers in a poured concrete vault. Following closure of operations in 1983, RCC abandoned the building leaving behind radium sources, contaminated containers and labware, along with building and soil contamination. From 1988 to 1989, EPA undertook limited emergency removal actions under Superfund to secure the facility and remove radioactive sources.

The site was added to the National Priorities List for remediation under Superfund based on a health advisory issued by the Agency for Toxic Substances and Disease Registry in November 1989. The primary current radiological concern involves radium-contaminated building surfaces and components, hazardous wastes, and soil. Present and future potential exposures are primarily associated with direct gamma exposure and exposure via ingestion/inhalation within the facility.

Nature and Extent of Contamination

The one-acre site houses a one-story brick building with a floor area of 10,000 ft². RCC leased about 7220 ft² of the building. A detailed survey indicated 19 hotspots with elevated dose rate readings, including 15 hotspots in the source vault. A hotspot is defined in this project as an area that measures more than:

- (1) 10 millirem/hr at a distance of 1 cm from the surface,
- (2) 100,000 disintegrations per minute (dpm) per 100 cm² of removable alpha contamination, or
- (3) 250,000 dpm per 100 cm² removable beta contamination.

The highest hotspot inside the source vault measures 200 millirem/hr at 1 cm. The maximum surface contamination within the source vault was 847,000 dpm/100 cm² of removable beta contamination. The highest removable beta contamination outside the source vault was 483,000 dpm/100 cm².

Decommissioning Criteria

The objective of the remediation is to reduce contamination to a level that will permit release of the site for unrestricted use without generating an excessive amount of radium waste in the process. The criteria to be applied in this remediation include the following:

- (1) EPA's 5 pCi ^{226}Ra /g standard for contaminated soils and materials (based on EPA standards for uranium mill tailings cleanup in 40 CFR Part 192),
- (2) EPA's 4 pCi/l action level for ^{222}Rn in indoor air,
- (3) Gamma exposure rate no greater than 20 $\mu\text{R/hr}$ above background (based on 40 CFR Part 192 and EPA guidance), and
- (4) Acceptable surface contamination levels from NRC's Regulatory Guide 1.86 for removable, and maximum and average surface activity.

Decommissioning Approach

EPA considered 4 alternative remedies to cleanup the contamination at the RCC site, including: (1) no action, (2) total decontamination of the facility (e.g., building surfaces, underground piping, sewer lines, and soil) and disposal of radioactive waste offsite, (3) complete dismantling and removal of the contaminated material and its disposal at a radioactive waste disposal facility, and (4) partial decontamination and dismantling of the facility. EPA selected Alternative 4 with the objective of releasing the site for unrestricted use. This alternative provides the best balance of time for completion, volume of contaminated waste, risk to workers, state and public acceptance, and cost.

EPA conducted partial decontamination by first removing hot spots contaminated with ^{226}Ra to reduce worker exposure and the risk of spreading contamination during dismantling. Building masonry with ^{226}Ra concentrations less than 5 pCi/g was disposed of in a sanitary landfill to reduce the volume and cost of waste disposal in a radioactive waste disposal facility. Although the New York State Department of Labor prohibits disposal of wastes containing more than 0.1 pCi/g ^{226}Ra in a sanitary landfill or as *in situ* soil, the agency agreed to waive the requirement due to the technical difficulty in achieving this level because of background levels and the substantial increase in cost associated with disposal of such wastes at licensed disposal facilities.

EPA then dismantled and removed contaminated material, in sequence, from (1) the building interior; (2) roof, windows, and doors; and (3) residual masonry. Contaminated soil above the criteria was excavated and shipped to the Envirocare facility in Tooele County, Utah, or acceptable alternative facility. The projected cost to remediate the site was \$18,699,000 and required more than two years to complete.

Current Status of Site

Decontamination and dismantlement of the site is essentially complete. EPA is currently investigating contamination of a sewer line at the site and assessing the associated extent of contamination and risk. If the risk is excessive and removal can be justified, EPA may excavate the sewer line and any associated contamination soil and dispose of it consistent with the criteria used in the rest of the project. EPA may also consider applying supplemental standards in evaluating the contaminated sewer line.

Lessons Learned

- It was difficult to identify and select appropriate cleanup criteria for the site that satisfied all parties; the delays caused by this difficulty significantly complicated conduct of the remedial action
- Selection of cleanup criteria was complicated by the fact that the lifetime cancer risk from background radiation at the site (in excess of 10^{-5}) exceeded EPA's acceptable risk range in the Superfund Program (10^{-6} to 10^{-6} , with 10^{-6} as the point of departure)
- Selection of cleanup criteria was complicated because a suitable methodology did not exist for translating acceptable cleanup criteria for groundwater contamination to soil concentrations
- NRC Regulatory Guide 1.86 has only limited applicability in the remediation because it applies to surface contamination only and its values were not determined on a consistent dose or risk basis

BOMARC Missile Accident Site McQuire Air Force Base Ocean County, New Jersey

Decommissioning Issues

- Dependence of preferred remedial action on the availability of affordable waste disposal capacity
- Relationship between the volume of contamination and the cost of the decommissioning action
- Viability of long-term institutional controls to restrict access to contaminated materials

Facility Description

Boeing Michigan Aeronautical Research Center (BOMARC) Missile Site was an active defensive nuclear missile installation from 1958 until 1972. The facility housed missiles equipped with nuclear warheads on a 218 acre site in south-central New Jersey about 18 miles southeast of Trenton (see Figure 1). On June 7, 1960, a fire occurred in one of the onsite shelters housing a missile. The shelter, missile, missile launcher, and warhead were partially consumed by fire. Weapons grade plutonium (WGP) from the nuclear warhead was dispersed to soils and structures in the immediate vicinity of the missile shelter. The material was dispersed by the fire itself as well as the 30,000 gallons of water applied to control the fire for approximately 15 hours. The Air Force reports that no more than 300 grams of WGP was unaccounted for at the time of the accident. Soon after the accident the Air Force fixed the residual contamination in place by applying fixative paint, concrete, and asphalt over the contaminated areas, including the drainage ditch that conducted contaminated runoff during the accident.

The site is being cleaned up by the Air Force under the Installation Restoration Program Element of the Defense Environmental Restoration Program. The Environmental Protection Agency (EPA) is monitoring cleanup activities at the site in a manner similar to a Superfund site cleanup. The Air Force signed a Record of Decision selecting the preferred remedial action in November 1992.

Nature and Extent of Contamination

No concentrations of radionuclides attributable to the missile accident were detected in groundwater, surface water, or air at the site. The contaminants of concern (^{239}Pu and ^{241}Am) have been detected in numerous radiological surveys in site soils, sediments, missing missile launcher, and structural materials at the site. ^{240}Pu , ^{241}Pu , and ^{238}Pu will also be present, but at less significant concentrations. The contamination in the soil appears to be limited to the uppermost foot of soil and is concentrated in discrete "hot spots." The soil contamination does not appear to have migrated vertically

downward more than a few inches since the accident. Surface activity surveys of the missile shelter and utility bunkers indicated alpha surface activities up to 80,000 counts per minute per 100 cm². Cores through the concrete floor of the missile shelter indicate plutonium levels within the concrete as high as 65 μ Ci/sample. About 208,000 ft³ of contaminated soil and material is estimated to be above the applicable cleanup criteria, although additional material may be discovered during the course of excavation and remediation (see Figure 2). For example, the missing missile launcher and shelter doors may have been disposed of onsite and would likely be removed during remediation.

Decommissioning Criteria

The Air Force developed a site-specific cleanup standard for Pu in soil assuming that people may live on the site at some time in the future. The cleanup standard of 8 pCi/g of ²³⁹Pu was calculated using the computer code RESRAD based upon a lifetime risk objective of 10⁻⁴ cancer risk consistent with current EPA guidance for the Superfund program. The Air Force also proposes to apply the criteria for acceptable surface activity from NRC's Regulatory Guide 1.86 for remediation of the missile shelter, utility bunker, and other structures contaminated on their exterior surfaces. For alpha contamination, these criteria would be <20 dpm/100 cm² removable activity, <300 dpm/100 cm² maximum fixed activity, and <100 dpm/100 cm² average fixed activity.

Decommissioning Approach

The Air Force considered five alternative remedial actions for the contamination: (1) unrestricted access, (2) institutional control, (3) institutional control with removal of specific materials (e.g., missile launcher), (3) onsite treatment of soils and structures and disposed of contaminated material off site in a radioactive waste disposal facility, and (5) removal of all contaminated material above criteria for offsite disposal at a radioactive waste disposal facility. The Air Force selected Alternative #5 (Offsite disposal) because it was cost-effective, permanent, and environmentally preferred. This alternative includes

- Excavation of contaminated soils containing greater than 8 pCi/g of Pu
- Excavation and sectioning of contaminated portions of the concrete apron, utility bunkers, and missile shelter
- Excavation and removal (if found) of the missile launcher
- Containerization, transport, and disposal of contaminated materials in an off-site radioactive waste disposal facility operated by the Department of Energy (DOE)
- Restoration of the site by backfilling with clean fill, grading, and revegetation.

The cost of the preferred remedial action is \$7 million if disposal is allowed at a DOE disposal facility; commercial disposal would increase the cost to at least \$24 million.

The Air Force's selection of the preferred alternative is contingent on its cost-effectiveness. If it becomes no longer cost-effective, the Air Force proposes to retain institutional control over the contaminated area, thereby eliminating the only significant route of exposure. This alternative includes monitoring, maintenance, and access control actions currently being conducted at the site.

Current Status of Site

The Air Force is presently continuing to monitor the site and restrict access to contaminated portions awaiting resolution of the issues associated with waste disposal.

Lessons Learned

- Limited availability of disposal capacity for low-level radioactive waste after January 1, 1993 and lack of DOE consent to accept waste for disposal has delayed initiation of the remedial action
- Multiple regulatory reviews by government agencies and the public resulted in late-stage comments that could not reasonably be resolved without delaying the project
- Lack of acceptable cleanup criteria for plutonium delayed progress in remediation until the Air Force developed and negotiated a criterion with State and Federal agencies
- The State disagreed with the Federal agencies (Air Force and EPA) on acceptable risk basis for developing the cleanup criterion for Pu; the State preferred 10^{-6} , while the Federal agencies preferred a cleanup standard based on 10^{-4} lifetime risk. Another group, the Pinelands Commission, asserts that the cleanup criterion should be background, unless the Air Force can demonstrate no adverse impacts on surface water or groundwater quality

Source: Battelle, 1988.

Figure 1. Location of the BOMARC Missile Site (Reference: *Record of Decision: BOMARC Missile Accident Site, McGuire Air Force Base, New Jersey*, U.S. Air Force, November 1992, pg. 15)

Extent of Radiological Contamination at the BOMARC Site
 (Reference: Record of Decision: BOMARC Missile Accident Site,
 McQuire Air Force Base, New Jersey, U.S. Air Force, November 1992,
 pg. 32)

Figure 2.

INTERNATIONAL DECOMMISSIONING ACTIVITIES

Activities related to radiological criteria for decommissioning are occurring both in other countries and in international forums such as the International Atomic Energy Agency (IAEA). In general, the current practice is to derive decommissioning criteria on a case-by-case basis, usually using the guidance of the IAEA Safety Series No. 89, "Principles for the Exemption of Radiation Sources and Practices from Regulatory Control." The IAEA guidance is risk-based and uses exposure to natural background as a reference level. It concludes that the level of trivial individual effective dose equivalent would be on the order of some 10's of μSv [a few mrem] per year, however in consideration of multiple sources of exposure the recommendation is 10 μSv [1 mrem] in a year from each exempt practice. This assumes the practice selected is considered optimal i.e., As Low As is Reasonably Achievable (ALARA). A practice is assumed to be optimal if the estimated collective dose is less than 1 person-Sievert/y (100 person-rem/y). The IAEA's examples of practices did not include the unrestricted use of lands and structures after decommissioning but did include consumer products, waste, and recycle--reuse of materials.

During November 1990, the IAEA convened a group of consultants to develop a draft Technical Report entitled, "Criteria for Unrestricted Release of Facilities, sites or Materials from Decommissioning." That work is on hold pending the completion of the technical basis and methodology being developed for the publication of NUREG/CR-5512, "Residual Radioactive Contamination From Decommissioning: Technical Basis for Translating Contamination Levels to Annual Dose." Separate IAEA consultants and advisory group meetings in November 1991 and June 1992, and produced a draft document, "National Policies and Regulations for Decommissioning Nuclear Facilities." This latter document is still early in its development and will require further work before it is suitable for distribution as a draft. Another consultants meeting was held in Vienna, Austria in December 1992 to work on the draft.

In a related area, there has been a recent focus upon waste disposal and recycle at the IAEA. The criterion is typically set at 10 μSv [1 mrem] per year based on the IAEA Safety Series No. 89 guidance. This work relates to decommissioning criteria to the extent that materials left on site after decommissioning, at some subsequent time, may be freely disposed or recycled or reused without restriction. An IAEA advisory group, in which the NRC is participating, is currently developing a draft document, "Exemption From Regulatory Control Recommended Unconditional Exempt Levels For Solid Radioactive Materials." This document is also in an early stage of development and is not ripe for general distribution as a draft.

Residual contamination limits for decommissioning have been developed in several European countries based on the guidance in IAEA Safety Series No. 89. The most extensive information in the literature is on decommissioning in the Federal Republic of Germany (FRG) where residual contamination limits have

been incorporated into radiation protection ordinances. However, these ordinances are treated more as guidance to be applied, as appropriate, on a case-by-case basis rather than as regulations. In the FRG approximately 28% of the electrical power is generated by 20 operating nuclear power plants. Thirteen prototype nuclear power plants have been shut down and are in various stages of decommissioning. In addition several research reactors have been taken out of service. Estimates of total decommissioning wastes from all nuclear installations in FRG before unification range from 90,000 to 120,000 m³. However, by the year 2000 only about 10,000 m³ of decommissioning waste is expected to accumulate.¹

Decommissioning in the FRG is being carried out on a case-by-case basis using the following residual contamination guidelines. Surface contamination limits may not exceed 0.37 Bq/cm² (10 pCi/cm²) beta-gamma and 0.037 Bq/cm² (1 pCi/cm²) alpha, and specific activity limits may not exceed 3.7 Bq/g (100 pCi/g).^{2,3,4} Recycle of contaminated materials from nuclear installations is encouraged. The preferable option is to recycle this material within the nuclear industry. If this cannot be done for technical or economic reasons, recycle outside the nuclear industry is allowed if, in accordance with the principals in IAEA Safety Series No. 89, individual risks are sufficiently low as not to warrant regulatory concern.

In France most nuclear facilities are owned by the French government through various public companies and organizations. Currently 75% of the electric power is generated by 50 operating nuclear power plants. There are presently no specific regulatory criteria in place for decommissioning of nuclear facilities. However, in practice France has adopted an early CEC recommendation of 100 Bq/g (2700 pCi/g) as a residual contamination limit in cases where only small total quantities of radioactive material have been involved.⁵ [The French are developing recommended residual contaminated limits for CEC under contract] Case-by-case determinations are apparently

¹ G. Wolany, L. Weill, R. Gortz, "Regulatory aspects of Decommissioning in the Federal Republic of Germany", International Seminar on Decommissioning Policies, Paris, October 2-4, 1991.

² Meis, H.P., Stang, W., "Decommissioning of Nuclear Power Plant Gundremmingen Unit A," 1987 International Decommissioning Symposium, Pittsburgh, PA, October 1987.

³ Hoffman, R., Leidenberger, B., "Optimization of Measurement Techniques for very Low Level Radioactive Waste Material," 1989 International Conference on the Decommissioning of Nuclear Installations, Commission of the European Communities, Brussels, October 1989.

⁴ Hempelmann, W., "Treatment of Waste Metals from Decommissioning," Pittsburgh, PA, October 1987.

⁵ Chapuis, A.M., Guetat, P., Garbay, H., "Exemption limits for the Recycling of Materials from the Dismantling of Nuclear Installations," 1987 International Decommissioning Symposium, Pittsburgh, PA, October 1987.

made in situations where large total quantities of radioactive materials are involved.

In the United Kingdom residual radioactivity criteria for decommissioning is developed on a case-by-case basis using the general principals set out in IAEA Safety Series No. 89.

In Finland there is a federal guide for disposal or recycle of wastes from nuclear facilities.⁶ The guide adopts the dose guidelines from IAEA Safety Series No. 89 and applies the following activity constraints to unrestricted exemption: (a) Total activity concentration of 1 kBq/kg of beta or gamma activity or 100 Bq/kg of alpha activity averaged over a maximum of 1000 kg of waste, and (b) total non-fixed surface contamination (averaged over 0.1 m² for accessible surfaces) of 4 kBq/m² of beta or gamma activity or 400 Bq/m² of alpha activity. The guide does not specifically address whether the guidelines apply to lands and structures.

In general, disposal or recycle in European countries of materials (including lands and structures) containing residual radioactivity is carried out in accordance with the principals for limiting radiation dose to members of the public set out in IAEA Safety Series No. 89. However, specific national guidelines derived from these principles (and expressed in terms of residual radioactivity in materials to be released for unrestricted release) have so far been developed principally for recycle of materials from nuclear power plants. Current practice in most European countries is to derive residual radioactivity criteria for lands and structures on a case-by-case basis using the general principals set out in IAEA Safety Series No. 89.

The Commission of European Communities (CEC) has recommended clearance levels for mass and/or surface activity concentration for recycle of materials from dismantling of nuclear installations, based on generic assessment of individual and collective doses from recycle and use of the material.⁷ There are presently no CEC guidelines for unrestricted release of lands and structures. However, the CEC preparing guidelines which are expected to be in place in 1994. Individual member countries would then be expected to adopt these guidelines.

⁶ YVL-Guide 8.2 "Exemption from Regulatory Control of Nuclear Wastes," 2nd Revised Edition, January 5, 1992, Finnish Centre for Radiation and Nuclear Safety, Helsinki, Finland.

⁷ Radiation Protection No. 43 "Radiological Protection Criteria for the Recycling of Materials From Dismantling of Nuclear Installations," p 17, Commission of the European Communities", Luxembourg, November 1988.

APPENDIX C

COMMENTER LISTING

APPENDIX C - COMMENTER LISTING

The following commenters responded to the Federal Register Notice or made comments at the workshops; note that six letters are duplicates as indicated:

Docket/Workshop**Commenter**

1	Science Applications International Corp.
2	Margaret Gariota
3	Audubon Council of Texas
4	Adam H. Levin
5	Texas Nuclear Responsibility Network
6	Western States Legal Foundation
7	Mary Gerry White
8	Charlotte M. Sholeen, Ph.D.
9	Dade W. Moeller
10	Rowena S. Argall, CHP
11	Consumers Power
12	Broad Top Township Supervisors
13	Grace V. Palazzolo
14	Public Citizen
15	Duplicate of number 5
16	Thermal Analytical Inc., TMA
17	E. Wycliffe Orr
18	State of South Carolina, DHEC
19	Coalition on West Valley Nuclear Wastes
20	Catherine M. Jones, Ph.D.
21	Margaret J. Miller
22	Casper W. Hiatt, Ph.D.
23	ASPI
24	County Commission, Bedford, PA
25	Ted Lapis
26	U.S. Council for Energy Awareness
27	Duplicate of number 14
28	SIERRA CLUB, DALLAS GROUP
29	Fawn Shilling Law
30	Kennecott (Energy) Uranium Co.
31	Organization of Agreement States
32	American Nuclear Society
33	Assoc. of Solid Waste Mgmt. Officials
34	U.S. EPA
35	State of Michigan
36	Health Physics Society
37	Carol Cain
38	Duplicate of number 33
39	Jared Crawford
40	Ruth Black
41	Suzanne H. Williams
42	Betty S. Lee

Docket/Workshop

Commenter

43	GE Stockholders Alliance
44	Banute Forte
45	International Fellowship of Reconciliation
46	Priscilla Tomlinson
47	Mary P. Sinclair
48	David R. Brill
49	Beatrice Shneider
50	Tom Ferguson
51	California Integrated Waste Management Board
52	Nuclear Metals, Inc.
53	Public Citizen
54	NC Ground Zero
55	Georgians Against Nuclear Energy
56	Glenn Carroll
57	GREENPEACE-Atlanta
58	David Matthews
59	Joan O. King
60	Oregon Dept. of Human Resources
61	Cuyahoga County Dist. Board of Health
62	GE Nuclear Energy
63	8-Organization Group
64	New York State ERDA
65	Sierra Club
66	CRCPD
67	Dennis E. Gardiner
68	Florida Power Corp.
69	Rick Olen
70	American Mining Congress
71	GPU Nuclear
72	Georgians Against Nuclear Energy
73	OCRE
74	Winston & Strawn
75	Maggie Kennik
76	Carl Rupert
77	Katherine M. Shelly
78	Nuclear Information and Resource Service
79	Fuel Cycle Facilities Forum
80	Northeast Utilities
81	Yankee Atomic Electric Company
82	Public Service of Colorado
83	State of Wisconsin
84	Eric N. Johnson
85	Judith H. Johnsrud, Ph.D.
86	Boehringer Ingelheim Pharmaceuticals, Inc.
87	Duplicate of number 73
88	Helen B. Burgess
89	NUMARC

Docket/WorkshopCommenter

90	ACNP/SNM
91	Tennessee Dept. of Environment and Conservation
92	Siemens Power Corp.
93	Illinois Dept. of Nuclear Safety
94	New York Power Authority
95	CFUR
96	CECO
97	TFI
98	USCEA
99	Gina J. Holt
100	Duplicate of number 82
101	Duplicate of number 83
102	Elaine Ruane
103	Darrell B. Wells
104	Larry Crenshaw
105	Clark County, Nevada
106	US Dept. of Energy
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A	ED ARNOLD
A	DR. RICHARD W. BENJAMIN
A	DAVID R. BRILL, M.D.
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A	JACK KEIFER
A	CHONG FU LON
A	MICHAEL H. MOBLEY
A	KARL Z. MORGAN, PH.D.
A	BRUCE E. KNIGHT

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Chicago

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Commenter

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MILDRED McCLAIN, PH.D.

ROD McCOY

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WILLIAM PASSETTI

PATTY RICHARDSON

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JACK ZIMMERMAN

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ERV BALL

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MICHAEL J. SLOBODIEN
ROBERT STERN
CINDEE VIROSTEK
JUNE WING

Appendix C

Commenter

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DONALD ELLISBURG
KEVIN FRIEL
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APPENDIX D

COMMENT REFERENCES

APPENDIX D - COMMENT REFERENCES

This section is a reference which relates each comment to its origin. The listed information includes a comment number, the name of the commenter, the workshop at which the comment was made or the docket number of the letter containing the comment, and data for referencing a particular page, line or paragraph. Following is an explanation of the listed information.

The comment number is unique to a single comment made within an issue. If the same comment also applies to another issue code, another number is assigned for use within that other issue code.

The name of the commenter is listed as the last name or if an organization, the full or abbreviated name.

Comments from workshops are identified as C, S, B, D, P, A, and W which correspond to Chicago, San Francisco, Boston, Dallas, Philadelphia, and Washington, D.C.; respectively. If a workshop is identified the next section is a 0 (reserved for docket letters). The next group of numbers identifies the page of the manuscript of the workshop that the comment begins on. This page number is also followed by a 0 (reserved for docket letters). The next set of numbers gives the line number that the comment begins on. An illustrative example follows:

{Comment #}{Name}{ Workshop}{Reserved}{Page #}{Reserved}{ Line #}

1 ROYAL C 0 125 0 7

Identification of comments from docketed letters are similarly identified but begin at comment number 7,000 and the beginning paragraph number is listed instead of a line number. The last number in this series is always a 0 (reserved for future use). An illustrative example follows:

{ Comment #}{Name}{ Docket #}{Page #}{Paragraph #}{Reserved}

7659 R. Black 40 1 1 0

The following pages contain a column listing of Comment Number, Commenter's Name, Workshop and/or Docket Number, Page Number, Paragraph Number, or Line Number.

Comment References

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1 ROYAL C 0 125 0 7
 2 RESCEK C 0 136 0 5
 3 WILLIAMS C 0 140 0 4
 4 HONEY C 0 146 0 14
 5 ROYAL C 0 385 0 13
 6 TRUBATCH C 0 113 0 19
 7 BALL C 0 64 0 17
 8 WILLIAMS C 0 49 0 25
 10 RUSSELL C 0 167 0 24
 11 RUSSELL C 0 167 0 24
 12 CEMBER C 0 536 0 19
 13 CEMBER C 0 536 0 19
 14 WILLIAMS C 0 323 0 24
 15 SINCLAIR C 0 123 0 3
 16 KRAFT C 0 383 0 21
 17 WILLIAMS C 0 134 0 20
 18 MINNAR C 0 128 0 35
 20 RICHARDSON C 0 180 0 15
 22 KRAFT C 0 184 0 13
 24 WILLIAMS C 0 161 0 14
 26 RESCEK C 0 189 0 10
 27 RESCEK C 0 267 0 5
 28 DORUFF C 0 207 0 25
 29 RESCEK C 0 160 0 25
 30 CEMBER C 0 125 0 20
 31 RICHARDSON C 0 128 0 13
 32 RESCEK C 0 124 0 12
 33 RESCEK C 0 124 0 12
 35 WILLIAMS C 0 185 0 24
 37 THOMAS C 0 59 0 8
 38 CEMBER C 0 536 0 19
 41 WILLIAMS C 0 317 0 18
 42 CEMBER C 0 520 0 12
 43 MINNAR C 0 518 0 10
 45 WILLIAMS C 0 519 0 20
 47 OWEN C 0 261 0 21
 48 HIATT C 0 194 0 17
 49 WILLIAMS C 0 191 0 18
 51 RICHARDSON C 0 194 0 11
 52 RESCEK C 0 195 0 18
 53 KRAFT C 0 192 0 11
 54 CEMBER C 0 419 0 18
 55 RESCEK C 0 419 0 24
 60 OWEN C 0 196 0 23
 62 TREPAL C 0 170 0 15
 63 HIATT C 0 196 0 13
 64 MINNAR C 0 259 0 8
 65 TREPAL C 0 342 0 17
 66 OWEN C 0 335 0 8
 67 RESCEK C 0 205 0 18
 68 HONEY C 0 204 0 8
 69 RESCEK C 0 331 0 17
 70 KRAFT C 0 208 0 15
 71 DORUFF C 0 331 0 3
 73 HIATT C 0 383 0 4
 74 HIATT C 0 126 0 10
 75 SINCLAIR C 0 132 0 5
 76 KRAFT C 0 68 0 11
 77 CEMBER C 0 133 0 2
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 79 ROYAL C 0 127 0 12
 81 THOMAS C 0 59 0 8
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 84 TREPAL C 0 130 0 9
 85 ALLEN C 0 142 0 19
 86 CEMBER C 0 330 0 11
 87 WILLIAMS C 0 166 0 21
 88 ROYAL C 0 316 0 2
 89 RICHARDSON C 0 166 0 8
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 91 SINCLAIR C 0 172 0 23
 92 CEMBER C 0 407 0 25
 93 CEMBER C 0 175 0 7
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 95 CEMBER C 0 409 0 12
 96 ROYAL C 0 62 0 21
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 101 RICHARDSON C 0 128 0 13
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 106 RESCEK C 0 415 0 24
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 109 DORUFF C 0 162 0 14
 111 CEMBER C 0 164 0 18
 112 DORUFF C 0 66 0 1
 113 WILLIAMS C 0 413 0 21
 114 CEMBER C 0 216 0 1
 115 RICHARDSON C 0 400 0 3
 116 OWEN C 0 70 0 13
 117 OWEN C 0 70 0 13
 119 RAFFENSPERGER C 0 171 0 13
 120 DORUFF C 0 394 0 9
 121 RAFFENSPERGER C 0 52 0 5
 122 RAFFENSPERGER C 0 52 0 5
 123 TREPAL C 0 341 0 12
 124 HIATT C 0 159 0 16
 125 RICHARDSON C 0 406 0 14
 127 WILLIAMS C 0 317 0 18
 128 WHITE C 0 227 0 1
 129 HIATT C 0 67 0 15
 130 FOSTER C 0 55 0 17
 131 BALL C 0 64 0 17
 132 CEMBER C 0 48 0 13
 133 SHARKEY C 0 55 0 4
 134 JOHNSON C 0 43 0 5
 135 WILLIAMS C 0 134 0 20
 136 OWEN C 0 147 0 12
 137 OWEN C 0 147 0 12
 138 OWEN C 0 490 0 3
 139 BALOCCA C 0 53 0 19
 140 JOHNSON C 0 43 0 5
 141 TREPAL C 0 489 0 15
 142 WILLIAMS C 0 492 0 5
 143 OWEN C 0 70 0 13
 144 HIATT C 0 460 0 5
 145 KRAFT C 0 461 0 5
 146 WILLIAMS C 0 452 0 1
 148 OWEN C 0 465 0 10
 149 SINCLAIR C 0 470 0 2
 150 CEMBER C 0 476 0 15
 151 MINNAR C 0 56 0 18

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152 TREPAL C 0 61 0 6	229 WILLIAMS C 0 198 0 15
153 OWEN C 0 70 0 13	230 ROYAL C 0 177 0 24
154 MINNAR C 0 453 0 21	231 RICHARDSON C 0 337 0 13
155 MINNAR C 0 453 0 21	232 THOMAS C 0 59 0 8
156 RESCEK C 0 245 0 14	234 MINNAR C 0 525 0 14
157 THOMAS C 0 143 0 4	235 HONEY C 0 525 0 21
159 RAFFENSPERGER C 0 148 0 12	237 RESCEK C 0 314 0 14
160 BALL C 0 139 0 10	238 HIATT C 0 312 0 15
163 RESCEK C 0 365 0 9	239 RICHARDSON C 0 309 0 24
164 OWEN C 0 352 0 10	240 RICHARDSON C 0 187 0 1
165 BALOCCA C 0 349 0 2	241 MINNAR C 0 56 0 18
166 MINNAR C 0 343 0 1	242 HONEY C 0 58 0 7
167 ALLEN C 0 210 0 9	244 SHARKEY C 0 374 0 12
168 WILLIAMS C 0 359 0 24	245 ALLEN C 0 367 0 20
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170 TREPAL C 0 357 0 17	247 THOMAS C 0 143 0 4
171 MINNAR C 0 357 0 25	248 THOMAS C 0 143 0 4
172 WILLIAMS C 0 354 0 11	249 MINNAR C 0 56 0 18
173 MINNAR C 0 342 0 21	250 HOLDEN C 0 349 0 14
175 ALLEN C 0 271 0 22	253 RAFFENSPERGER C 0 356 0 13
176 OGLE C 0 113 0 9	254 ROYAL C 0 225 0 21
177 ROYAL C 0 513 0 21	255 RAFFENSPERGER C 0 265 0 2
179 RAFFENSPERGER C 0 515 0 3	256 WILLIAMS C 0 224 0 9
180 RESCEK C 0 478 0 3	257 RAFFENSPERGER C 0 223 0 3
181 KRAFT C 0 471 0 23	258 SINCLAIR C 0 223 0 17
182 MINNAR C 0 508 0 23	259 CEMBER C 0 222 0 7
183 BALOCCA C 0 512 0 10	260 KRAFT C 0 221 0 7
184 WILLIAMS C 0 512 0 24	261 SINCLAIR C 0 220 0 19
185 CEMBER C 0 505 0 23	262 DORUFF C 0 66 0 1
186 BALOCCA C 0 512 0 10	263 HONEY C 0 494 0 4
188 HONEY C 0 58 0 7	264 HIATT C 0 495 0 1
189 RAFFENSPERGER C 0 448 0 21	265 KRAFT C 0 202 0 16
190 HONEY C 0 270 0 14	266 WILLIAMS C 0 241 0 24
191 KRAFT C 0 269 0 8	267 MINNAR C 0 236 0 16
192 RAFFENSPERGER C 0 171 0 13	268 JOHNSON C 0 239 0 23
193 WILLIAMS C 0 488 0 6	269 THOMAS C 0 255 0 17
194 MINNAR C 0 493 0 8	270 OWEN C 0 254 0 21
195 RAFFENSPERGER C 0 423 0 5	273 JOHNSON C 0 199 0 2
197 CEMBER C 0 395 0 22	274 CEMBER C 0 338 0 3
198 RICHARDSON C 0 400 0 3	275 TREPAL C 0 267 0 25
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202 HIATT C 0 395 0 7	283 JOHNSON C 0 249 0 3
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210 HIATT C 0 429 0 14	287 HONEY C 0 58 0 7
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214 CEMBER C 0 205 0 2	292 JOHNSON C 0 482 0 2
215 WILLIAMS C 0 265 0 22	293 TREPAL C 0 478 0 15
216 WILLIAMS C 0 49 0 25	294 TREPAL C 0 351 0 18
217 DORUFF C 0 164 0 6	297 KELLEY S 0 23 0 10
218 ROYAL C 0 160 0 2	298 FASNACHT S 0 29 0 9
219 ROYAL C 0 263 0 6	299 FASNACHT S 0 29 0 11
220 ROYAL C 0 177 0 24	300 RUSSELL S 0 29 0 20
221 TREPAL C 0 61 0 6	301 JIM S 0 30 0 4
222 ROYAL C 0 62 0 21	302 DEBRULER S 0 30 0 19
223 ROYAL C 0 62 0 21	303 KNIGHT S 0 32 0 3
224 DORUFF C 0 66 0 1	304 KNIGHT S 0 32 0 10
226 ROYAL C 0 159 0 7	305 MEDLING S 0 33 0 5
227 CEMBER C 0 48 0 13	306 MEDLING S 0 33 0 18
228 CEMBER C 0 137 0 1	307 DUKE S 0 34 0 10

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 312 BAILEY S 0 36 0 1
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 323 BURKLIN S 0 40 0 20
 324 ADAMS S 0 41 0 3
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 623 FRASER S 0 193 0 2
 625 COOK S 0 194 0 5
 627 BRANIGAN S 0 196 0 2
 628 COSTELLO S 0 197 0 19
 629 COSTELLO S 0 198 0 9

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 636 DEPERRY S 0 200 0 8
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 654 COHEN S 0 126 0 1
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 665 GEORGE S 0 133 0 1
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 804 Unidentified Commenter S 0 406 0 20
 805 YOUNG S 0 407 0 23
 807 COOK S 0 410 0 12
 808 BRANIGAN S 0 413 0 4

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 1146 MELLOR B 0 260 0 5
 1148 SLESINGER B 0 260 0 25
 1150 BACKUS B 0 262 0 11
 1151 BACKUS B 0 262 0 18
 1153 DINGER B 0 339 0 3
 1154 FLEMING B 0 262 0 22
 1155 DINGER B 0 339 0 3
 1156 FLEMING B 0 262 0 22
 1157 SCOTNICKI B 0 340 0 7
 1158 PERKINS B 0 265 0 5
 1159 MYERS B 0 341 0 9
 1160 MYERS B 0 341 0 21
 1161 WATKINS B 0 266 0 17
 1163 DINGER B 0 349 0 9
 1165 DINGER B 0 350 0 5
 1166 DINGER B 0 267 0 8
 1169 WINTERS B 0 268 0 23
 1171 MANION B 0 269 0 17
 1172 MANION B 0 269 0 25
 1174 FLEMING B 0 274 0 5
 1176 BOYLE B 0 276 0 20
 1177 MOULTON B 0 293 0 4
 1178 MYERS B 0 293 0 16
 1179 MYERS B 0 294 0 1
 1180 SLESINGER B 0 294 0 12
 1181 PERKINS B 0 296 0 23
 1182 PERKINS B 0 296 0 23
 1183 PERKINS B 0 297 0 3
 1185 FLEMING B 0 297 0 14
 1186 FLEMING B 0 297 0 14
 1187 MCCARTHY B 0 298 0 13
 1188 MCCARTHY B 0 299 0 14

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1189 KELLY B 0 299 0 21
 1190 KELLY B 0 299 0 21
 1192 MCCARTHY B 0 299 0 14
 1193 MOULTON B 0 302 0 4
 1194 MOULTON B 0 302 0 4
 1195 MOULTON B 0 302 0 4
 1196 BOARDMAN B 0 304 0 5
 1197 SMITH B 0 305 0 12
 1198 SMITH B 0 305 0 12
 1199 MYERS B 0 306 0 16
 1200 MYERS B 0 306 0 12
 1201 KELLY B 0 366 0 11
 1202 KELLY B 0 366 0 11
 1203 MACLEOD B 0 306 0 21
 1204 KELLY B 0 368 0 1
 1205 MACLEOD B 0 308 0 5
 1206 DINGER B 0 350 0 13
 1207 DINGER B 0 351 0 10
 1208 DINGER B 0 370 0 14
 1210 BOYLE B 0 371 0 19
 1212 MACLEOD B 0 353 0 10
 1213 PERKINS B 0 372 0 18
 1214 DINGER B 0 354 0 18
 1215 PERKINS B 0 380 0 8
 1218 DINGER B 0 354 0 25
 1219 MACLEOD B 0 356 0 17
 1220 MYERS B 0 382 0 8
 1222 MACLEOD B 0 356 0 22
 1225 BOARDMAN B 0 357 0 11
 1226 KELLY B 0 385 0 20
 1227 KELLY B 0 385 0 20
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 1230 BOARDMAN B 0 386 0 21
 1231 BOARDMAN B 0 387 0 9
 1232 BOARDMAN B 0 387 0 13
 1233 BOARDMAN B 0 358 0 24
 1234 PERKINS B 0 388 0 4
 1235 BOARDMAN B 0 359 0 4
 1236 BOARDMAN B 0 359 0 11
 1237 MCCARTHY B 0 389 0 5
 1239 MCCARTHY B 0 389 0 17
 1240 MCCARTHY B 0 361 0 20
 1242 BACKUS B 0 394 0 15
 1244 MACLEOD B 0 361 0 25
 1247 TEFFT B 0 396 0 1
 1248 PERKINS B 0 362 0 12
 1249 MACLEOD B 0 396 0 15
 1251 BOARDMAN B 0 397 0 3
 1252 FLEMING B 0 398 0 4
 1253 MYERS B 0 399 0 22
 1254 FLEMING B 0 398 0 15
 1255 KELLY B 0 400 0 12
 1256 BULTER B 0 344 0 20
 1259 QUIGLEY B 0 138 0 18
 1260 QUIGLEY B 0 310 0 16
 1261 QUIGLEY B 0 310 0 16
 1262 QUIGLEY B 0 310 0 16
 1263 TREJO B 0 141 0 24
 1265 TUCKER B 0 141 0 19
 1266 BRODSKY B 0 143 0 2
 1267 BRODSKY B 0 144 0 10
 1269 BENNINGER B 0 392 0 23
 1270 BRODSKY B 0 142 0 13
 1272 ZIMMERMAN B 0 147 0 8

1274 BULTER B 0 391 0 17
 1275 TUCKER B 0 141 0 5
 1276 ENO B 0 144 0 17
 1277 ZIMMERMAN B 0 390 0 20
 1278 ZIMMERMAN B 0 277 0 16
 1279 ZIMMERMAN B 0 277 0 19
 1280 ZIMMERMAN B 0 277 0 21
 1281 ZIMMERMAN B 0 277 0 22
 1282 AUDET B 0 390 0 2
 1283 BAIMAN B 0 278 0 10
 1285 QUIGLEY B 0 385 0 5
 1286 BULTER B 0 279 0 2
 1287 CRAWFORD B 0 279 0 21
 1288 CRAWFORD B 0 280 0 3
 1289 QUIGLEY B 0 381 0 17
 1291 CRAWFORD B 0 281 0 13
 1292 QUIGLEY B 0 360 0 11
 1294 CRAWFORD B 0 281 0 20
 1296 CRAWFORD B 0 281 0 24
 1297 QUIGLEY B 0 365 0 18
 1298 AUDET B 0 375 0 2
 1299 CRAWFORD B 0 282 0 2
 1300 AUDET B 0 375 0 2
 1301 CRAWFORD B 0 282 0 7
 1302 CRAWFORD B 0 280 0 19
 1303 CRAWFORD B 0 280 0 21
 1304 TREJO B 0 282 0 25
 1305 TREJO B 0 283 0 2
 1306 TREJO B 0 283 0 10
 1307 RICARDSON B 0 301 0 5
 1308 RICARDSON B 0 70 0 13
 1310 RICARDSON B 0 70 0 13
 1311 BULTER B 0 401 0 4
 1313 ISELIN B 0 403 0 25
 1314 RICARDSON B 0 69 0 11
 1315 AUDET B 0 405 0 21
 1316 QUIGLEY B 0 127 0 13
 1318 QUIGLEY B 0 126 0 24
 1319 QUIGLEY B 0 126 0 24
 1320 ZIMMERMAN B 0 147 0 8
 1321 ZIMMERMAN B 0 147 0 8
 1322 ZIMMERMAN B 0 147 0 22
 1323 QUIGLEY B 0 65 0 20
 1324 QUIGLEY B 0 66 0 7
 1325 QUIGLEY B 0 65 0 7
 1326 TREJO B 0 142 0 6
 1327 QUIGLEY B 0 66 0 16
 1328 BENNINGER B 0 346 0 10
 1329 PRATT B 0 215 0 7
 1330 PRATT B 0 215 0 17
 1331 RICARDSON B 0 237 0 **
 1333 BAIMAN B 0 212 0 13
 1334 BAIMAN B 0 214 0 16
 1335 QUIGLEY B 0 203 0 4
 1336 QUIGLEY B 0 204 0 1
 1338 BENNINGER B 0 221 0 11
 1339 AUDET B 0 220 0 5
 1340 RICARDSON B 0 335 0 2
 1341 QUIGLEY B 0 223 0 13
 1342 Thompson D 0 39 0 1
 1343 Thompson D 0 39 0 10
 1345 Graves D 0 38 0 6
 1346 Still D 0 40 0 7
 1347 Still D 0 40 0 11

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1348 Still D 0 40 0 17	1425 Williams D 0 119 0 20
1349 Kirk D 0 41 0 22	1426 Crimi D 0 121 0 23
1350 Kirk D 0 42 0 13	1427 Crimi D 0 122 0 14
1353 McBurney D 0 43 0 2	1428 Still D 0 122 0 19
1354 McBurney D 0 43 0 9	1429 Still D 0 123 0 1
1355 McBurney D 0 43 0 16	1431 Dickerson D 0 123 0 7
1356 McBurney D 0 43 0 18	1432 Dickerson D 0 123 0 7
1357 Campbell D 0 44 0 1	1434 Brink D 0 123 0 22
1358 Campbell D 0 44 0 10	1435 BRINK D 0 124 0 8
1359 Williams D 0 46 0 14	1436 Brink D 0 124 0 8
1360 Williams D 0 47 0 4	1437 Crawford D 0 125 0 2
1362 Gordon D 0 48 0 19	1438 Crawford D 0 125 0 3
1363 Crimi D 0 50 0 10	1439 Beavers D 0 125 0 19
1364 Crimi D 0 50 0 21	1441 Beavers D 0 126 0 9
1366 Quillin D 0 51 0 11	1442 Hofstetter D 0 126 0 17
1367 Quillin D 0 51 0 20	1443 Hofstetter D 0 127 0 1
1368 Crawford D 0 53 0 9	1444 Hofstetter D 0 127 0 1
1370 Crawford D 0 54 0 10	1445 Quillin D 0 128 0 1
1372 Gardner D 0 56 0 1	1446 Quillin D 0 128 0 1
1373 Gardner D 0 56 0 6	1447 Belisle D 0 128 0 19
1374 Dicus D 0 57 0 15	1448 Belisle D 0 128 0 19
1375 Dicus D 0 58 0 6	1449 Belisle D 0 128 0 19
1376 Parsons D 0 59 0 9	1450 Podoloff, M.D. D 0 129 0 5
1377 Parsons D 0 59 0 17	1451 Podoloff, M.D. D 0 129 0 7
1378 Platerio D 0 60 0 1	1452 Bergendahl D 0 129 0 14
1380 Dickerson D 0 62 0 7	1453 Thompson D 0 129 0 24
1382 Hofstetter D 0 63 0 5	1455 Thompson D 0 131 0 7
1383 Hofstetter D 0 63 0 23	1456 Dickerson D 0 132 0 17
1385 rison D 0 65 0 1	1457 Parsons D 0 132 0 24
1386 Beavers D 0 67 0 6	1458 Russell D 0 135 0 5
1387 Beavers D 0 67 0 24	1459 MORRISON D 0 150 0 9
1389 Hughes D 0 68 0 23	1460 PALMER D 0 37 0 5
1390 Bergendahl D 0 69 0 20	1462 UNKNOWN OBSERVER D 0 135 0 25
1393 Bergendahl D 0 69 0 25	1463 BARFIELD D 0 135 0 15
1394 Brink D 0 71 0 3	1465 BARTON D 0 134 0 2
1395 Brink D 0 71 0 14	1466 BARTON D 0 134 0 14
1397 Podoloff D 0 72 0 7	1467 BARTON D 0 133 0 9
1398 Podoloff D 0 72 0 7	1468 PALMER D 0 121 0 17
1399 Dietrich D 0 72 0 15	1469 PALMER D 0 121 0 17
1400 Dietrich D 0 73 0 1	1470 BRINK D 0 131 0 23
1401 Belisle D 0 73 0 17	1471 BRINK D 0 132 0 23
1402 Belisle D 0 74 0 3	1472 OVERSTREET D 0 138 0 17
1403 Belisle D 0 74 0 14	1473 HILL D 0 139 0 12
1404 West D 0 76 0 1	1474 HILL D 0 139 0 20
1405 West D 0 76 0 21	1475 VERNUM D 0 140 0 1
1406 Bergendahl D 0 112 0 20	1476 VERNUM D 0 140 0 10
1407 Crawford D 0 113 0 11	1477 VERNUM D 0 140 0 11
1408 West D 0 114 0 6	1478 MILLER D 0 140 0 14
1409 Thompson D 0 114 0 18	1479 LEE D 0 140 0 22
1410 Thompson D 0 115 0 6	1480 LEE D 0 141 0 6
1411 Brink D 0 115 0 9	1481 BRAMELY D 0 141 0 8
1412 Brink D 0 115 0 12	1482 UNKNOWN OBSERVER D 0 141 0 21
1413 McBurney D 0 116 0 5	1483 HOLLAND D 0 142 0 10
1414 McBurney D 0 116 0 10	1484 HOLLAND D 0 142 0 22
1415 Dicus D 0 116 0 19	1485 ALLMUS D 0 143 0 10
1416 Dicus D 0 116 0 22	1486 CULL D 0 144 0 3
1417 Dicus D 0 117 0 1	1488 GARY D 0 144 0 7
1418 Dicus D 0 117 0 12	1489 GARY D 0 144 0 12
1419 Gordon D 0 117 0 21	1490 BURNAM D 0 145 0 11
1420 Gordon D 0 117 0 22	1491 BURNAM D 0 145 0 12
1421 Gordon D 0 118 0 1	1492 BURNAM D 0 145 0 18
1422 Gardner D 0 118 0 19	1493 YOTT D 0 146 0 17
1423 Gardner D 0 118 0 19	1494 UNKNOWN OBSERVER D 0 146 0 5
1424 Parsons D 0 119 0 3	1495 Schrader D 0 138 0 1

1497 CABASSO S 0 468 0 1	1589 BERGENDAHL D 0 233 0 12
1498 STILL D 0 153 0 9	1591 BRINK D 0 235 0 6
1499 STILL D 0 153 0 5	1593 BRINK D 0 236 0 10
1505 THOMPSON D 0 157 0 17	1594 PARSONS D 0 236 0 18
1507 READ D 0 161 0 16	1595 PARSONS D 0 237 0 5
1508 READ D 0 161 0 16	1596 PODOLOFF D 0 237 0 19
1511 HUGHES D 0 165 0 23	1598 PODOLOFF D 0 238 0 3
1512 HUGHES D 0 165 0 23	1599 MCBURNEY D 0 238 0 9
1513 DIETRICH D 0 166 0 2	1601 MCBURNEY D 0 238 0 9
1516 STILL D 0 166 0 13	1602 HUGHES D 0 239 0 11
1517 STILL D 0 166 0 13	1603 HUGHES D 0 240 0 3
1518 CAMPBELL D 0 170 0 8	1604 BELISLE D 0 248 0 4
1520 MCBURNEY D 0 171 0 15	1605 THOMPSON D 0 252 0 10
1522 BERGENDAHL D 0 173 0 11	1606 THOMPSON D 0 252 0 14
1523 BERGENDAHL D 0 174 0 2	1607 DICUS D 0 252 0 20
1524 HUGHES D 0 174 0 9	1609 DICUS D 0 254 0 15
1525 HUGHES D 0 174 0 21	1610 DICUS D 0 253 0 5
1527 HUGHES D 0 175 0 11	1611 MORRISON D 0 254 0 22
1529 PLATERIO D 0 176 0 7	1613 DIETRICH D 0 256 0 14
1530 PLATERIO D 0 176 0 7	1615 PARSONS D 0 258 0 7
1531 PLATERIO D 0 176 0 24	1616 WES D 0 259 0 15
1532 BERGENDAHL D 0 183 0 3	1619 WILLIAMS D 0 260 0 24
1533 BERGENDAHL D 0 183 0 16	1620 DICUS D 0 263 0 21
1534 WEST D 0 183 0 22	1622 GORDON D 0 264 0 5
1535 WEST D 0 185 0 1	1623 GORDON D 0 265 0 9
1536 WEST D 0 186 0 1	1624 GORDON D 0 265 0 9
1537 WILLIAMS D 0 186 0 14	1627 QUILLIN D 0 267 0 17
1540 BRINK D 0 189 0 5	1628 CRIMI D 0 267 0 24
1541 GRAVES D 0 241 0 2	1630 CRIMI D 0 268 0 5
1542 GRAVES D 0 241 0 2	1631 CAMPBELL D 0 270 0 7
1543 DIETRICH D 0 189 0 15	1632 HOFSTETTER D 0 272 0 11
1544 DIETRICH D 0 189 0 20	1633 UNKNOWN OBSERVER D 0 274 0 19
1545 DIETRICH D 0 190 0 16	1634 UNKNOWN OBSERVER D 0 274 0 22
1546 HOFSTETTER D 0 190 0 19	1635 UNKNOWN OBSERVER D 0 274 0 22
1547 HOFSTETTER D 0 190 0 19	1636 UNKNOWN OBSERVER D 0 274 0 19
1548 HOFSTETTER D 0 243 0 16	1637 BARTON D 0 275 0 2
1549 HOFSTETTER D 0 192 0 15	1639 BARTON D 0 277 0 13
1551 HOFSTETTER D 0 193 0 10	1640 UNKNOWN OBSERVER D 0 278 0 22
1552 PLATERIO D 0 247 0 18	1641 UNKNOWN OBSERVER D 0 279 0 5
1553 GORDON D 0 193 0 17	1642 TANO D 0 296 0 4
1554 PLATERIO D 0 247 0 22	1643 TANO D 0 296 0 16
1556 GORDON D 0 194 0 20	1646 RUSSELL D 0 301 0 20
1558 QUILLIN D 0 195 0 20	1647 WILLIAMS D 0 306 0 21
1560 CRAWFORD D 0 197 0 18	1649 MCBURNEY D 0 308 0 5
1561 CRAWFORD D 0 232 0 19	1650 HUGHES D 0 309 0 3
1562 CRAWFORD D 0 198 0 18	1651 HUGHES D 0 309 0 14
1563 BELISLE D 0 202 0 3	1652 BERGENDAHL D 0 312 0 16
1566 WILLIAMS D 0 203 0 8	1653 BERGENDAHL D 0 313 0 20
1568 HUGHES D 0 205 0 1	1654 DICUS D 0 314 0 7
1569 HUGHES D 0 205 0 1	1655 DICUS D 0 314 0 8
1570 WEST D 0 205 0 16	1658 DICUS D 0 314 0 5
1571 WEST D 0 206 0 19	1659 TANO D 0 316 0 4
1572 STILL D 0 207 0 18	1660 TANO D 0 316 0 14
1574 UNKNOWN OBSERVER D 0 210 0 15	1661 PODOLOFF D 0 316 0 24
1577 BARTON D 0 213 0 11	1662 PODOLOFF D 0 317 0 7
1579 UNKNOWN OBSERVER D 0 216 0 4	1663 THOMPSON D 0 317 0 21
1580 UNKNOWN OBSERVER D 0 216 0 6	1665 BARTON D 0 382 0 20
1581 BURNAM D 0 218 0 4	1666 BARTON D 0 383 0 7
1582 BURNAM D 0 218 0 4	1667 BARTON D 0 383 0 20
1583 UNKNOWN OBSERVER D 0 221 0 20	1668 BARTON D 0 384 0 12
1584 UNKNOWN OBSERVER D 0 222 0 19	1669 BARTON D 0 384 0 12
1585 MORRISON D 0 229 0 7	1670 UNKNOWN OBSERVER D 0 385 0 3
1586 CRAWFORD D 0 232 0 8	1671 UNKNOWN OBSERVER D 0 385 0 3
1587 BERGENDAHL D 0 233 0 12	1672 UNKNOWN OBSERVER D 0 385 0 10

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1673 UNKNOWN OBSERVER D 0 384 0 24
 1674 CABASSO S 0 275 0 8
 1676 GRAVES D 0 388 0 28
 1677 GRAVES D 0 389 0 3
 1678 KELLEY S 0 183 0 2
 1681 STRAUSS S 0 321 0 6
 1682 STRAUSS S 0 321 0 6
 1684 BARTON D 0 382 0 2
 1686 UNKNOWN OBSERVER D 0 379 0 16
 1687 UNKNOWN OBSERVER D 0 380 0 8
 1688 WILLIAMS D 0 321 0 2
 1690 HIATT C 0 194 0 17
 1691 WILLIAMS D 0 321 0 15
 1692 GRAVES D 0 323 0 17
 1693 DINGER B 0 115 0 24
 1694 GRAVES D 0 324 0 24
 1695 GRAVES D 0 325 0 15
 1696 RANKIN S 0 128 0 15
 1698 QUILLIN D 0 326 0 9
 1699 QUILLIN D 0 326 0 12
 1700 QUILLIN D 0 326 0 23
 1701 WEST D 0 327 0 20
 1702 BOYLE B 0 127 0 20
 1703 WEST D 0 328 0 5
 1704 WEST D 0 328 0 13
 1705 WES D 0 328 0 21
 1706 PACK S 0 323 0 4
 1707 GARDNER D 0 333 0 22
 1709 BRINK D 0 336 0 4
 1711 RUSSELL D 0 336 0 14
 1712 BRINK D 0 336 0 21
 1713 BRINK D 0 340 0 7
 1714 BRINK D 0 340 0 7
 1715 BRINK D 0 340 0 17
 1717 FLEMING B 0 49 0 19
 1718 BRACKIN D 0 343 0 10
 1720 BRACKIN D 0 344 0 7
 1721 PODOLOFF D 0 350 0 29
 1722 MYERS B 0 293 0 16
 1724 MYERS B 0 293 0 16
 1728 STILL D 0 352 0 3
 1729 STILL D 0 353 0 7
 1730 BALL C 0 64 0 17
 1733 CAMPBELL D 0 359 0 9
 1734 CAMPBELL D 0 358 0 6
 1736 GORDON D 0 362 0 7
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 1739 GORDON D 0 363 0 12
 1740 GORDON D 0 361 0 12
 1741 GORDON D 0 360 0 10
 1742 PODOLOFF D 0 364 0 2
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 1745 CRAWFORD D 0 366 0 7
 1746 CRAWFORD D 0 366 0 7
 1747 DIETRICH D 0 366 0 20
 1748 DIETRICH D 0 366 0 20
 1749 HOFSTETTER D 0 368 0 15
 1750 BRACKIN D 0 371 0 6
 1751 BRACKIN D 0 371 0 6
 1752 Unidentified Commenter San Francisco S 0 407 0 17
 1753 STOLLER S 0 411 0 22
 1755 KELLY B 0 170 0 17
 1761 MYERS B 0 306 0 12

1762 TREPAL C 0 61 0 6
 1763 PACK S 0 225 0 23
 1764 DUKE S 0 211 0 1
 1766 UNKNOWN OBSERVER D 0 221 0 20
 1767 BERGENDAHL D 0 341 0 11
 1768 BERGENDAHL D 0 391 0 11
 1769 BEAVERS D 0 392 0 11
 1770 HUGHES D 0 401 0 16
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 1773 WEST D 0 404 0 7
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 1777 MORRISON D 0 406 0 8
 1779 WILLIAMS D 0 407 0 14
 1782 GARDNER D 0 412 0 14
 1783 TANO D 0 410 0 12
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 1785 TANO D 0 411 0 12
 1786 TANO D 0 411 0 25
 1787 BELISLE D 0 414 0 21
 1789 EGBERT D 0 417 0 21
 1792 BRINK D 0 422 0 12
 1793 GORDON D 0 427 0 7
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 1800 CRAWFORD D 0 429 0 24
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 1804 CRIMI D 0 432 0 1
 1805 STILL D 0 425 0 6
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 1809 CRAWFORD D 0 436 0 14
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 1813 GRAVES D 0 437 0 16
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 1815 CRIMI D 0 447 0 11
 1816 SCHRADER D 0 446 0 3
 1817 SCHRADER D 0 445 0 1
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 1819 SANDERS D 0 446 0 15
 1820 BARTON D 0 444 0 18
 1821 HENDRICKS D 0 444 0 4
 1822 KAY D 0 442 0 20
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 1824 KAY D 0 443 0 8
 1827 O'DOUL D 0 448 0 22
 1828 SMITH D 0 449 0 7
 1829 DICUS D 0 459 0 22
 1831 MCBURNEY D 0 460 0 8
 1832 RICHARDSON D 0 463 0 4
 1834 QUILLIN D 0 464 0 7
 1835 WEST D 0 466 0 19
 1837 STILL D 0 467 0 12
 1838 STILL D 0 468 0 5
 1839 BRINK D 0 469 0 20
 1841 GORDON D 0 472 0 5
 1844 GORDON D 0 473 0 4
 1846 DICUS D 0 473 0 20
 1848 PARSONS D 0 474 0 19
 1849 PARSONS D 0 474 0 19
 1850 PARSONS D 0 474 0 19
 1852 STILL D 0 475 0 21

1854 THOMPSON D 0 476 0 7	1933 SMITH D 0 212 0 6
1855 THOMPSON D 0 476 0 17	1937 BRAMLETT D 0 215 0 15
1858 BRINK D 0 477 0 4	1938 GARFIELD D 0 216 0 21
1860 BRACKIN D 0 477 0 10	1939 GARFIELD D 0 217 0 18
1862 CRAWFORD D 0 479 0 5	1940 GARFIELD D 0 217 0 4
1863 HOFSTETTER D 0 481 0 16	1941 HENDRIX D 0 220 0 20
1864 BRINK D 0 482 0 9	1943 ALMAS D 0 220 0 11
1865 HUGHES D 0 483 0 1	1945 SCHRADER D 0 278 0 15
1866 HOFSTETTER D 0 483 0 24	1946 KAY D 0 280 0 3
1867 GORDON D 0 484 0 17	1947 KAY D 0 280 0 12
1869 PLATERIO D 0 485 0 18	1948 RUSSELL B 0 331 0 22
1870 EGBERT D 0 486 0 3	1951 FLETCHER P 0 41 0 23
1872 BERGENDAHL D 0 489 0 25	1952 FLETCHER P 0 41 0 16
1873 MORRISON D 0 490 0 16	1953 BROWN P 0 43 0 1
1875 CAMPBELL D 0 492 0 1	1954 BROWN P 0 43 0 13
1876 BRINK D 0 492 0 21	1955 JOHNSON P 0 44 0 4
1877 WILLIAMS D 0 493 0 11	1956 JOHNSON P 0 44 0 16
1878 BRACKIN D 0 499 0 24	1957 PORTER P 0 45 0 10
1879 QUILLIN D 0 500 0 25	1958 PORTER P 0 45 0 12
1881 THOMPSON D 0 504 0 17	1959 PORTER P 0 45 0 12
1882 THOMPSON D 0 504 0 17	1961 SGARLATA P 0 46 0 4
1883 CRAWFORD D 0 505 0 3	1962 SGARLATA P 0 46 0 6
1884 MORRISON D 0 505 0 24	1964 DUBIEL P 0 46 0 23
1885 CRAWFORD D 0 506 0 22	1965 DUBIEL P 0 47 0 4
1886 WILLIAMS D 0 507 0 7	1966 DUBIEL P 0 47 0 8
1887 WILLIAMS D 0 507 0 7	1967 VIROSTEK P 0 47 0 12
1888 BRAMLETT D 0 512 0 9	1968 VIROSTEK P 0 47 0 21
1891 SANDERS D 0 512 0 12	1969 VIROSTEK P 0 48 0 2
1892 SANDERS D 0 512 0 12	1971 KADLECEK, PH.D. P 0 48 0 15
1893 HUGHES D 0 400 0 23	1972 ROTH P 0 49 0 5
1894 ODEAR D 0 516 0 13	1973 ROTH P 0 49 0 5
1895 ODEAR D 0 516 0 18	1974 BRODIE P 0 50 0 6
1896 ODEAR D 0 516 0 25	1975 HIATT III P 0 51 0 1
1897 ODEAR D 0 517 0 4	1976 HIATT P 0 51 0 6
1898 ODEAR D 0 516 0 13	1977 SLOBODIEN P 0 51 0 22
1901 HOLMBECK D 0 518 0 1	1980 SLOBODIEN P 0 52 0 10
1903 GARFIELD D 0 519 0 12	1981 SLOBODIEN P 0 52 0 11
1904 GARFIELD D 0 519 0 17	1982 SLOBODIEN P 0 52 0 12
1905 HOFSTETTER D 0 521 0 5	1983 KOH P 0 52 0 21
1906 PODOLOFF D 0 521 0 15	1984 KOH P 0 52 0 23
1907 WES D 0 521 0 24	1985 GRIFFIN P 0 53 0 24
1908 GORDON D 0 524 0 4	1986 GRIFFIN P 0 54 0 1
1910 GORDON D 0 524 0 19	1987 COOMBS P 0 54 0 14
1911 MORRISON D 0 526 0 13	1988 COOMBS P 0 54 0 14
1912 MORRISON D 0 527 0 18	1989 COOMBS P 0 54 0 16
1913 DICKERSON D 0 529 0 5	1990 COOMBS P 0 54 0 19
1914 BRINK D 0 530 0 2	1991 FULLER P 0 55 0 9
1915 BRINK D 0 530 0 15	1992 FULLER P 0 55 0 11
1916 BRINK D 0 530 0 1	1993 FULLER P 0 55 0 19
1917 BELISLE D 0 531 0 5	1994 FULLER P 0 55 0 24
1918 EGBERT D 0 532 0 10	1995 JOHNSRUD P 0 57 0 1
1919 KIRK D 0 535 0 1	1996 JOHNSRUD P 0 57 0 13
1920 BRINK D 0 535 0 19	1997 JOHNSRUD P 0 57 0 18
1921 EGBERT D 0 535 0 22	1998 NARDI P 0 58 0 19
1922 CAMPBELL D 0 536 0 2	1999 NARDI P 0 59 0 4
1923 SANDERS D 0 377 0 3	2000 NARDI P 0 59 0 11
1924 SANDERS D 0 377 0 3	2001 NARDI P 0 59 0 14
1925 PLATERIO D 0 320 0 6	2003 DORNSIFE P 0 60 0 19
1926 PLATERIO D 0 320 0 14	2004 DORNSIFE P 0 60 0 19
1927 BRAMLETT D 0 377 0 12	2006 DORNSIFE P 0 61 0 5
1928 BRAMLETT D 0 377 0 22	2007 DORNSIFE P 0 61 0 19
1929 BRAMLETT D 0 379 0 7	2008 DORNSIFE P 0 61 0 19
1930 SMITH D 0 211 0 21	2009 DORNSIFE P 0 62 0 6
1932 SMITH D 0 212 0 1	2010 DORNSIFE P 0 60 0 2

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2012 SCHUTZ P 0 63 0 24	2079 GRIFFIN P 0 128 0 21
2013 SCHUTZ P 0 63 0 8	2080 GRIFFIN P 0 128 0 24
2014 PINKARD P 0 66 0 8	2082 COOMBS P 0 155 0 9
2015 STERN P 0 66 0 23	2083 COOMBS P 0 130 0 15
2016 STERN P 0 66 0 2	2084 JOHNSRUD, PH.D. P 0 132 0 5
2017 JOHNSRUD P 0 69 0 9	2085 JOHNSRUD P 0 132 0 5
2018 JOHNSRUD P 0 69 0 19	2086 NARDI P 0 132 0 25
2019 JOHNSRUD P 0 109 0 1	2087 NARDI P 0 133 0 3
2020 DORNSIFE P 0 110 0 5	2088 NARDI P 0 133 0 13
2021 COOMBS P 0 113 0 12	2089 NARDI P 0 133 0 19
2022 COOMBS P 0 113 0 12	2090 DORNSIFE P 0 135 0 22
2023 COOMBS P 0 113 0 12	2091 DORNSIFE P 0 135 0 22
2024 SLOBODIEN P 0 113 0 20	2092 COOMBS P 0 137 0 5
2025 SLOBODIEN P 0 114 0 8	2093 FULLER P 0 138 0 5
2026 SLOBODIEN P 0 114 0 9	2094 FULLER P 0 138 0 5
2027 SLOBODIEN P 0 114 0 10	2095 FULLER P 0 138 0 20
2028 SLOBODIEN P 0 114 0 8	2096 JOHNSON P 0 138 0 25
2029 SLOBODIEN P 0 115 0 1	2098 JOHNSON P 0 139 0 4
2030 SLOBODIEN P 0 115 0 3	2099 PINKARD P 0 139 0 13
2031 SLOBODIEN P 0 115 0 6	2100 PINKARD P 0 139 0 13
2032 BRODIE P 0 115 0 17	2102 FRACKE P 0 140 0 22
2033 BRODIE P 0 115 0 19	2103 FRACKE P 0 140 0 25
2034 BRODIE P 0 115 0 22	2104 FRACKE P 0 142 0 23
2035 JOHNSON P 0 116 0 9	2105 SZALINSKY P 0 143 0 3
2036 JOHNSON P 0 116 0 11	2106 SZALINSKY P 0 143 0 3
2037 JOHNSON P 0 116 0 17	2107 SCHUTZ P 0 147 0 19
2038 JOHNSON P 0 116 0 20	2108 SCHUTZ P 0 147 0 23
2039 JOHNSON P 0 116 0 22	2110 DORNSIFE P 0 150 0 5
2040 STERN P 0 117 0 16	2111 JOHNSRUD P 0 151 0 17
2041 STERN P 0 118 0 2	2113 JOHNSRUD P 0 152 0 9
2042 STERN P 0 118 0 22	2114 JOHNSRUD P 0 152 0 11
2043 KOH P 0 120 0 10	2115 JOHNSRUD, PH.D. P 0 152 0 14
2044 FULLER P 0 121 0 3	2121 MINNAR C 0 128 0 35
2045 FULLER P 0 121 0 3	2122 CEMBER C 0 520 0 12
2046 FULLER P 0 121 0 7	2127 DURMAN S 0 291 0 14
2047 FULLER P 0 120 0 20	2129 DINGER B 0 156 0 12
2048 FULLER P 0 120 0 20	2131 DINGER B 0 156 0 12
2049 BROWN P 0 121 0 14	2132 DINGER B 0 156 0 12
2050 DORNSIFE P 0 122 0 15	2134 DINGER B 0 162 0 1
2051 DORNSIFE P 0 122 0 17	2136 CARDITO B 0 236 0 18
2052 DORNSIFE P 0 122 0 25	2138 SCOTNICKI B 0 136 0 10
2054 JOHNSRUD P 0 123 0 17	2145 DICUS D 0 314 0 8
2055 JOHNSRUD P 0 123 0 17	2146 DICUS D 0 314 0 8
2056 JOHNSRUD P 0 123 0 17	2150 GRAVES D 0 389 0 7
2057 JOHNSRUD P 0 123 0 22	2152 MYERS B 0 293 0 16
2058 COOMBS P 0 124 0 16	2157 KAY D 0 442 0 25
2060 COOMBS P 0 124 0 21	2158 KAY D 0 442 0 25
2061 COOMBS P 0 125 0 8	2162 KELLEY S 0 218 0 9
2062 SCHUTZ P 0 125 0 12	2166 DUMAS B 0 38 0 10
2063 SCHUTZ P 0 125 0 16	2168 TREPAL C 0 61 0 6
2064 SCHUTZ P 0 125 0 17	2170 MINNAR C 0 259 0 8
2065 NARDI P 0 125 0 23	2175 DUKE S 0 161 0 13
2067 NARDI P 0 126 0 9	2177 DUKE S 0 161 0 13
2068 NARDI P 0 126 0 11	2178 DUKE S 0 161 0 13
2069 NARDI P 0 125 0 23	2179 PACK S 0 167 0 16
2070 JOHNSON P 0 126 0 18	2180 PACK S 0 167 0 16
2071 JOHNSON P 0 126 0 18	2181 DEBRULER S 0 169 0 7
2072 COOMBS P 0 127 0 9	2183 DAVIS S 0 270 0 17
2073 COOMBS P 0 127 0 19	2184 STRAUSS S 0 273 0 8
2074 COOMBS P 0 127 0 19	2185 CABASSO S 0 275 0 8
2075 SLOBODIEN P 0 127 0 23	2189 DUKE S 0 252 0 2
2076 DUBIEL P 0 128 0 4	2190 DUKE S 0 252 0 2
2077 DUBIEL P 0 128 0 4	2191 DEPERRY S 0 200 0 15
2078 DUBIEL P 0 128 0 4	2192 HUBBARD S 0 120 0 20

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2193 HUGHES S 0 122 0 22	2307 COOMBS P 0 227 0 8
2195 Unidentified Commenter San Francisco S 0 191 0 23	2308 FULLER P 0 158 0 12
2197 WATKINS B 0 51 0 22	2309 FULLER P 0 158 0 19
2198 PERKINS B 0 59 0 15	2310 FULLER P 0 228 0 15
2200 CARDITO B 0 68 0 14	2311 BRODIE P 0 229 0 6
2201 MANION B 0 113 0 21	2313 BROWN P 0 159 0 4
2203 SMITH B 0 119 0 3	2315 BRODIE P 0 229 0 6
2204 SMITH B 0 45 0 15	2316 BROWN P 0 160 0 2
2207 MACLEOD B 0 173 0 16	2317 DORNSIFE P 0 229 0 20
2208 BOARDMAN B 0 183 0 6	2318 DORNSIFE P 0 229 0 20
2210 BOARDMAN B 0 183 0 6	2319 DORNSIFE P 0 230 0 13
2213 GRAVES D 0 324 0 24	2320 JOHNSON P 0 231 0 11
2216 BRINK D 0 530 0 1	2321 KADLECEK P 0 160 0 9
2217 BRAMLETT D 0 215 0 1	2323 JOHNSON P 0 231 0 11
2220 BRAMLETT D 0 215 0 1	2324 KADLECEK P 0 160 0 17
2222 DEBRULER S 0 172 0 16	2325 JOHNSON P 0 231 0 11
2223 DAVIS S 0 347 0 7	2326 JOHNSRUD P 0 234 0 3
2227 GORDON D 0 361 0 12	2328 DORNSIFE P 0 160 0 21
2230 GARFIELD D 0 217 0 4	2329 DORNSIFE P 0 161 0 12
2233 DEBRULER S 0 240 0 16	2332 PINKARD P 0 235 0 20
2235 MANION B 0 241 0 2	2333 PINKARD P 0 235 0 20
2237 PERKINS B 0 247 0 24	2334 DORNSIFE P 0 161 0 12
2241 UNKNOWN OBSERVER D 0 385 0 3	2335 PINKARD P 0 236 0 22
2243 BERGENDAHL D 0 391 0 11	2336 KOH P 0 237 0 17
2245 HOLMBECK D 0 517 0 21	2337 KOH P 0 161 0 23
2248 HONEY C 0 168 0 16	2338 SGARLATA P 0 238 0 6
2250 STRAUSS S 0 117 0 1	2340 HIATT III P 0 162 0 11
2251 BURKLIN S 0 219 0 19	2342 FULLER P 0 238 0 21
2253 KELLEY S 0 318 0 10	2343 JOHNSON P 0 163 0 8
2255 STRONG S 0 464 0 1	2344 NARDI P 0 239 0 23
2257 TEFFT B 0 58 0 17	2346 NARDI P 0 239 0 23
2258 TEFFT B 0 58 0 17	2347 NARDI P 0 239 0 23
2260 DINGER B 0 209 0 21	2348 NARDI P 0 239 0 23
2261 BACKUS B 0 337 0 8	2349 DORNSIFE P 0 241 0 9
2262 STILL D 0 153 0 5	2350 DORNSIFE P 0 242 0 4
2264 THOMPSON D 0 157 0 17	2351 NARDI P 0 244 0 7
2266 BERGENDAHL D 0 173 0 11	2352 NARDI P 0 244 0 7
2267 HUGHES D 0 174 0 9	2353 BROWN P 0 244 0 14
2268 WILLIAMS D 0 186 0 14	2354 KOH, P 0 248 0 1
2269 WILLIAMS D 0 186 0 14	2355 KOH, P 0 248 0 1
2271 DIETRICH D 0 189 0 15	2357 JOHNSRUD P 0 249 0 12
2273 WEST D 0 402 0 23	2358 NARDI P 0 250 0 23
2274 BRAMLETT D 0 215 0 10	2359 SLOBODIEN P 0 253 0 2
2275 BRAMLETT D 0 215 0 10	2360 SLOBODIEN P 0 254 0 2
2277 SMITH D 0 211 0 21	2363 SCHUTZ P 0 254 0 10
2280 GORDON D 0 473 0 4	2364 SCHUTZ P 0 254 0 10
2285 SLOBODIEN P 0 114 0 8	2365 SCHUTZ P 0 254 0 10
2286 COOMBS P 0 153 0 1	2367 JOHNSON P 0 256 0 15
2287 SLOBODIEN P 0 154 0 2	2368 JOHNSON P 0 256 0 15
2289 SLOBODIEN P 0 154 0 2	2369 KOH, P 0 257 0 25
2290 PORTER P 0 155 0 24	2370 KOH, P 0 257 0 25
2291 SCHUTZ P 0 219 0 17	2371 STERN P 0 258 0 15
2292 PORTER, JR. P 0 155 0 24	2372 STERN P 0 258 0 15
2295 SCHUTZ P 0 220 0 1	2374 PINKARD P 0 236 0 22
2296 SCHUTZ P 0 221 0 8	2375 DORNSIFE P 0 259 0 18
2297 SCHUTZ P 0 222 0 15	2376 DORNSIFE P 0 260 0 2
2298 GRIFFIN P 0 223 0 25	2377 COOMBS P 0 164 0 19
2299 FLETCHER P 0 225 0 8	2378 GRIFFIN P 0 260 0 11
2300 FLETCHER P 0 225 0 8	2379 GRIFFIN P 0 260 0 15
2301 COOMBS P 0 226 0 11	2380 GRIFFIN P 0 260 0 11
2303 COOMBS P 0 227 0 3	2381 COOMBS P 0 261 0 1
2304 COOMBS P 0 227 0 8	2382 COOMBS P 0 261 0 1
2305 COOMBS P 0 227 0 8	2383 JOHNSRUD P 0 262 0 11
2306 FULLER P 0 157 0 18	2385 GRIFFIN P 0 165 0 18

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2387 DORNSIFE P 0 265 0 10	2470 COOK S 0 410 0 12
2388 DORNSIFE P 0 265 0 10	2471 BROWN P 0 217 0 19
2389 PINKARD P 0 167 0 5	2473 COOMBS P 0 287 0 18
2390 FULLER P 0 265 0 22	2476 JOHNSRUD P 0 308 0 10
2391 KOH, P 0 266 0 16	2477 JOHNSRUD P 0 308 0 10
2392 FLETCHER P 0 167 0 19	2478 JOHNSRUD P 0 308 0 10
2393 BROWN P 0 267 0 12	2479 GRIFFIN P 0 310 0 13
2394 BROWN P 0 267 0 12	2480 GRIFFIN P 0 310 0 13
2395 PORTER, JR. P 0 168 0 19	2481 GRIFFIN P 0 310 0 13
2396 PORTER, JR. P 0 168 0 22	2482 GRIFFIN P 0 310 0 15
2397 SKOSKI P 0 274 0 6	2483 GRIFFIN P 0 310 0 15
2398 PORTER P 0 169 0 2	2484 GRIFFIN P 0 310 0 15
2399 FRACKE P 0 275 0 20	2485 PINKARD P 0 311 0 15
2400 PORTER P 0 169 0 8	2486 PINKARD P 0 311 0 15
2401 SZALINSKY P 0 278 0 20	2487 PINKARD P 0 311 0 15
2402 SZALINSKY P 0 279 0 3	2489 COOMBS P 0 312 0 23
2403 BILHORN P 0 281 0 1	2490 COOMBS P 0 313 0 11
2405 FRACKE P 0 282 0 5	2491 COOMBS P 0 313 0 16
2407 STERN P 0 171 0 22	2492 COOMBS P 0 314 0 52
2408 STERN P 0 172 0 12	2494 BURKLIN S 0 152 0 22
2409 SCHMIDT P 0 284 0 14	2495 SLOBODIEN P 0 315 0 1
2410 STERN P 0 172 0 18	2496 SLOBODIEN P 0 315 0 2
2411 SCHMIDT P 0 284 0 3	2497 SLOBODIEN P 0 315 0 4
2412 SCHMIDT P 0 245 0 4	2498 SLOBODIEN P 0 315 0 4
2413 WING P 0 286 0 2	2500 SLOBODIEN P 0 315 0 11
2415 JOHNSRUD P 0 173 0 9	2501 SLOBODIEN P 0 315 0 19
2417 JOHNSRUD P 0 173 0 9	2502 SLOBODIEN P 0 315 0 20
2418 JOHNSRUD P 0 173 0 9	2503 SLOBODIEN P 0 315 0 21
2419 FULLER P 0 175 0 11	2504 SLOBODIEN P 0 315 0 21
2420 FULLER P 0 175 0 11	2505 SLOBODIEN P 0 315 0 21
2421 FULLER P 0 175 0 25	2506 SLOBODIEN P 0 316 0 16
2422 FULLER P 0 176 0 10	2507 VIROSTEK P 0 319 0 17
2424 SCHUTZ P 0 181 0 6	2508 VIROSTEK P 0 320 0 4
2425 SCHUTZ P 0 181 0 18	2509 VIROSTEK P 0 320 0 22
2427 NARDI P 0 182 0 3	2510 FLETCHER P 0 321 0 2
2428 DORNSIFE P 0 183 0 17	2511 FLETCHER P 0 321 0 24
2430 COOMBS P 0 184 0 21	2512 JOHNSON P 0 322 0 12
2431 KELLY B 0 63 0 4	2513 JOHNSON P 0 322 0 21
2432 JOHNSRUD P 0 185 0 18	2515 JOHNSON P 0 322 0 23
2433 NARDI P 0 188 0 3	2516 JOHNSON P 0 323 0 24
2434 NARDI P 0 188 0 3	2517 FULLER P 0 324 0 24
2435 SCOTNICKI B 0 63 0 18	2518 FULLER P 0 326 0 2
2437 DUBIEL P 0 192 0 13	2519 FULLER P 0 326 0 2
2438 DUBIEL P 0 193 0 11	2520 FULLER P 0 326 0 2
2439 WATKINS B 0 181 0 12	2521 FULLER P 0 326 0 7
2440 DUBIEL P 0 193 0 4	2522 FULLER P 0 326 0 17
2441 KELLY B 0 182 0 14	2523 FULLER P 0 326 0 2
2442 TEFFT B 0 190 0 1	2524 BROWN P 0 327 0 15
2444 PINKARD P 0 194 0 1	2525 BROWN P 0 327 0 15
2445 PINKARD P 0 194 0 21	2526 BROWN P 0 327 0 15
2447 GRIFFIN P 0 194 0 24	2527 BROWN P 0 327 0 15
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2451 GRIFFIN P 0 195 0 21	2529 BROWN P 0 329 0 18
2454 JOHNSRUD P 0 196 0 3	2530 BRODIE P 0 329 0 25
2455 MANION B 0 131 0 13	2531 BRODIE P 0 330 0 9
2457 SLOBODIEN P 0 198 0 1	2532 BRODIE P 0 330 0 12
2458 RUSSELL P 0 202 0 10	2533 BRODIE P 0 331 0 4
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2462 KAY D 0 443 0 8	2535 BRODIE P 0 331 0 14
2463 SHELLY P 0 208 0 15	2536 BRODIE P 0 332 0 15
2466 JOHNSRUD P 0 211 0 22	2537 SCHUTZ P 0 334 0 11
2467 JOHNSRUD P 0 212 0 14	2538 SCHUTZ P 0 334 0 11
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 2551 DUBIEL P 0 345 0 15
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 2553 PORTER, JR. P 0 348 0 2
 2554 PORTER P 0 349 0 13
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 2560 GRIFFIN P 0 352 0 13
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 2562 JOHNSRUD, PH.D. P 0 354 0 9
 2563 JOHNSRUD P 0 354 0 9
 2564 JOHNSRUD, PH.D. P 0 355 0 2
 2565 JOHNSRUD P 0 355 0 5
 2566 JOHNSRUD, PH.D. P 0 355 0 14
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 2613 KOH P 0 394 0 17

2615 JOHNSON P 0 397 0 17
 2616 JOHNSRUD P 0 401 0 18
 2617 JOHNSRUD P 0 401 0 21
 2618 PINKARD P 0 404 0 7
 2619 PINKARD P 0 404 0 7
 2620 JOHNSRUD P 0 405 0 18
 2621 JOHNSRUD P 0 405 0 18
 2622 JOHNSRUD P 0 406 0 1
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 2630 FULLER P 0 408 0 22
 2631 SLOBODIEN P 0 411 0 25
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 2642 SCHUTZ P 0 415 0 1
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 2647 COOMBS P 0 419 0 14
 2648 SCHUTZ P 0 421 0 23
 2649 SCHUTZ P 0 421 0 23
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 2651 DUBIEL P 0 423 0 16
 2652 DUBIEL P 0 423 0 15
 2653 JOHNSON P 0 425 0 2
 2654 JOHNSON P 0 425 0 2
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 2656 JOHNSON P 0 425 0 2
 2657 FRACKE P 0 432 0 13
 2658 PORTER P 0 443 0 4
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 2660 STERN P 0 444 0 14
 2661 PINKARD P 0 444 0 23
 2663 SCHUTZ P 0 447 0 1
 2665 SCHUTZ P 0 447 0 1
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 2667 BROWN P 0 448 0 12
 2668 JOHNSRUD P 0 450 0 8
 2670 JOHNSRUD P 0 450 0 8
 2671 FLETCHER P 0 450 0 23
 2673 FLETCHER P 0 450 0 23
 2674 JOHNSON, P 0 451 0 9
 2676 SLOBODIEN P 0 454 0 7
 2677 JOHNSON P 0 455 0 16
 2678 JOHNSON P 0 455 0 16
 2679 JOHNSON P 0 455 0 16
 2680 GRIFFIN P 0 456 0 12
 2681 GRIFFIN P 0 456 0 12
 2683 SCHUTZ P 0 457 0 7
 2684 SCHUTZ P 0 457 0 19
 2685 SCHUTZ P 0 457 0 7
 2686 FULLER P 0 459 0 7

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2687 STERN P 0 462 0 1
 2688 STERN P 0 462 0 1
 2689 SLOBODIEN P 0 464 0 1
 2690 SLOBODIEN P 0 464 0 1
 2692 COOMBS P 0 464 0 7
 2693 COOMBS P 0 464 0 7
 2696 LaGUARDIA P 0 370 0 6
 2698 REILLY P 0 376 0 9
 2699 LaGUARDIA P 0 372 0 8
 2700 LaGUARDIA P 0 372 0 2
 2701 LaGUARDIA P 0 3 0 11
 2702 RIEMAN P 0 426 0 14
 2703 RIEMAN P 0 426 0 14
 2704 HENDRICKS P 0 428 0 23
 2705 HENDRICKS P 0 428 0 23
 2706 RIEMAN P 0 358 0 6
 2708 LaGUARDIA P 0 371 0 16
 2709 BARKER P 0 373 0 16
 2710 BARKER P 0 373 0 16
 2711 JOHNSRUD P 0 465 0 21
 2712 JOHNSRUD P 0 466 0 8
 2713 SCHUTZ P 0 467 0 9
 2714 SCHUTZ P 0 468 0 11
 2715 SLOBODIEN P 0 468 0 5
 2716 SLOBODIEN P 0 468 0 5
 2717 COOMBS P 0 469 0 6
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 2719 RICHARDSON P 0 469 0 18
 2720 JOHNSRUD P 0 470 0 6
 2721 BROWN P 0 473 0 9
 2722 GRIFFIN P 0 475 0 9
 2723 GRIFFIN P 0 475 0 9
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 2729 STERN P 0 479 0 16
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 2732 FULLER P 0 481 0 4
 2733 FULLER P 0 482 0 11
 2734 COOMBS P 0 482 0 17
 2735 COOMBS P 0 483 0 1
 2736 FLETCHER P 0 484 0 1
 2737 KOH, P 0 485 0 21
 2738 JOHNSRUD, PH.D. P 0 486 0 8
 2739 PINKARD P 0 489 0 3
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 2748 SHELLY P 0 502 0 5
 2749 SHELLY P 0 502 0 5
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 2756 PINKARD P 0 505 0 8
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 2758 PINKARD P 0 506 0 2

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 2769 Strong S 0 46 0 6
 2770 BESSERMIN S 0 299 0 5
 2771 CABASSO S 0 310 0 19
 2773 WATKINS B 0 267 0 2
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 2777 BERGENDAHL D 0 351 0 5
 2778 BERGENDAHL D 0 351 0 5
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 2780 SMITH B 0 45 0 23
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 2783 MACLEOD B 0 310 0 3
 2784 UNKNOWN OBSERVER D 0 216 0 6
 2786 FASNACHT S 0 29 0 9
 2790 WOLBARST S 0 50 0 17
 2792 MANION B 0 130 0 13
 2793 PARSONS D 0 428 0 23
 2794 CRIMI D 0 431 0 7
 2795 STILL D 0 434 0 15
 2796 CRAWFORD D 0 436 0 14
 2797 O'DOUL D 0 448 0 22
 2798 SHOCKLEY S 0 434 0 5
 2799 MACLEOD B 0 172 0 3
 2803 MINNAR C 0 236 0 16
 2804 RICHARDSON C 0 369 0 13
 2805 RAFFENSPERGER C 0 248 0 8
 2806 WILLIAMS C 0 252 0 8
 2807 RAFFENSPERGER C 0 248 0 6
 2808 JOHNSON C 0 249 0 3
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 2810 RESCEK C 0 368 0 4
 2811 RESCEK C 0 368 0 4
 2813 BURKLIN S 0 40 0 18
 2814 KNIGHT S 0 447 0 8
 2815 CEHN S 0 449 0 11
 2817 FASNACHT S 0 421 0 19
 2818 FASNACHT S 0 425 0 20
 2819 MELLOR B 0 55 0 14
 2820 PERKINS B 0 60 0 9
 2821 DINGER B 0 160 0 11
 2823 DINGER B 0 132 0 18
 2824 BEAVERS D 0 275 0 2
 2825 BEAVERS D 0 275 0 2
 2826 GRAVES D 0 388 0 28
 2827 BARTON D 0 382 0 2
 2828 TANO D 0 410 0 1
 2829 GARDNER D 0 412 0 14
 2837 BRINK D 0 477 0 4
 2839 BRACKIN D 0 477 0 10
 2840 CRAWFORD D 0 479 0 5
 2842 FULLER P 0 158 0 22
 2844 JOHNSRUD P 0 234 0 3
 2846 BRACKIN D 0 180 0 20
 2847 BRACKIN D 0 181 0 6
 2848 BRACKIN D 0 181 0 6

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2849 THOMPSON D 0 181 0 13	2931 TREPAL C 0 373 0 5
2850 MOBLEY A 0 45 0 17	2932 HOLDEN C 0 437 0 3
2851 MOBLEY A 0 45 0 18	2933 DAVIS S 0 39 0 25
2852 MOBLEY A 0 45 0 19	2934 KELLEY S 0 42 0 21
2853 MOBLEY A 0 45 0 22	2935 STRAUSS S 0 49 0 9
2854 MOBLEY A 0 46 0 6	2936 KELLEY S 0 110 0 21
2855 CARROLL A 0 46 0 13	2937 DEBRULER S 0 175 0 1
2856 CARROLL A 0 46 0 15	2938 CABASSO S 0 186 0 21
2857 FUENTE A 0 47 0 7	2939 CABASSO S 0 217 0 24
2858 FUENTE A 0 47 0 11	2941 KELLEY S 0 286 0 22
2859 KEARFOTT A 0 47 0 22	2944 BAILEY S 0 220 0 6
2860 KEARFOTT A 0 48 0 10	2945 CABASSO S 0 220 0 15
2861 KNIGHT A 0 49 0 1	2947 CABASSO S 0 220 0 15
2862 KNIGHT A 0 49 0 9	2949 PACK S 0 226 0 17
2864 de VENTE A 0 49 0 21	2950 KASE S 0 227 0 2
2865 de VENTE A 0 49 0 21	2951 KNIGHT S 0 290 0 7
2866 de VENTE A 0 49 0 23	2953 PACK S 0 325 0 2
2867 GARRY A 0 50 0 6	2954 BAILEY S 0 327 0 19
2868 GARRY A 0 50 0 15	2955 ADAMS S 0 242 0 21
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2872 COSTNER A 0 51 0 16	2964 Unidentified Commenter San Francisco S 0 144 0 7
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2930 GORDON D 0 524 0 4	3020 MURRAY A 0 114 0 16

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3242 MURRAY A 0 303 0 16	3317 HOLLAND A 0 419 0 10

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 3607 ADRIAN W 0 58 0 9

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3651 WALLO W 0 111 0 19	3720 MAGAVERN W 0 135 0 17
3653 GILFAND W 0 112 0 5	3721 SKOSKI W 0 137 0 22
3654 VOTH W 0 112 0 19	3722 SKOSKI W 0 137 0 22
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3656 VOTH W 0 112 0 24	3724 CLEMONS W 0 138 0 17
3657 VOTH W 0 112 0 25	3725 CLEMONS W 0 139 0 4
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3659 DORNSIFE W 0 113 0 8	3727 RANSOHOFF W 0 139 0 10
3660 DORNSIFE W 0 113 0 8	3728 RANSOHOFF W 0 139 0 19
3661 DORNSIFE W 0 113 0 8	3729 RANSOHOFF W 0 139 0 22
3662 DORNSIFE W 0 113 0 10	3730 DONNAY W 0 140 0 10
3663 DORNSIFE W 0 114 0 4	3731 SCOTNIKI W 0 141 0 16
3664 DORNSIFE W 0 114 0 4	3732 SCOTNIKI W 0 141 0 16
3665 OLSON W 0 114 0 16	3733 RILEY W 0 146 0 10
3666 OLSON W 0 114 0 19	3734 RILEY W 0 146 0 13
3667 OLSON W 0 115 0 3	3735 SCHIAGER W 0 147 0 4
3668 OLSON W 0 114 0 25	3736 SCHIAGER W 0 147 0 7
3669 DAVENPORT W 0 115 0 18	3737 SCHIAGER W 0 147 0 10
3670 FULLER W 0 117 0 11	3738 SCHIAGER W 0 147 0 4
3671 FULLER W 0 117 0 23	3739 OLSON W 0 147 0 17
3672 FULLER W 0 118 0 2	3741 HANSON W 0 149 0 15
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 3934 SCHMITT W 0 215 0 3
 3935 MORTON W 0 216 0 11
 3936 CAMPBELL D 0 358 0 6
 3937 MORTON W 0 216 0 25

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 4009 STRAUSS S 0 321 0 6
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 4040 Unidentified Commenter San Francisco S 0 328 0 23
 4042 KNIGHT S 0 476 0 8
 4043 FORTUN B 0 38 0 21
 4045 MACLEOD B 0 207 0 5
 4055 DICUS D 0 501 0 3
 4056 SCOTNICKI B 0 64 0 1
 4057 BOARDMAN B 0 183 0 6
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 4083 DAM W 0 246 0 6

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 4154 RANSOHOFF W 0 294 0 14
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 4156 MORRIS W 0 296 0 18
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 4158 SEIKEN W 0 297 0 7
 4159 SEIKEN W 0 297 0 12

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 4302 HOLDEN W 0 375 0 3
 4303 SCOTNIKI W 0 375 0 23

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8528 CECO	96 1 2 0	8599 CECO	96 13 6 0

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APPENDIX E

APPENDIX E

Summary of Comments Received from Generic Environmental Impact Statement (GEIS) Scoping Meetings on Radiological Criteria for Decommissioning

As part of the effort to codify radiological criteria for decommissioning to determine the extent to which radioactive contamination must be removed or reduced in lands and structures before a nuclear facility can be released and its license terminated, the NRC held public meetings on the scope of the GEIS during July 1993 in Washington, D.C., San Francisco, CA, Oklahoma City, OK, and Cleveland, OH. Interested parties were invited to provide early and comprehensive input before the NRC staff develops the GEIS. A notice in the Federal Register, June 18, 1993, also invited comments.

This Appendix summarizes 642 comments from records of the meetings and an additional 954 comments from 63 letters¹ received by the NRC from individuals and organizations. The summaries were organized to the following issues and sub-issues. A unique comment number was assigned to each comment and therefore the source of each comment can be identified as to origin, commenter, beginning page number, and line number (for meetings only). Comments received during the meetings are numbered under 700 while docketed letter comments are numbered greater than 700. A listing of commenters follows the summaries.

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¹This also includes a letter from the US Department of Energy which was received but it was not docketed at manuscript completion.

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E.1 GENERAL

E.1.1 Need For Criteria

Most commenters supported the NRC's efforts to establish codification of radiological criteria for decommissioning and expressed a need for uniformity, definition, and clarity (1, 53, 57, 152, 231, 327, 973, 982, 1223, 1601, 1617). Two commenters expressed a need for criteria that would ensure full decontamination (711, 827). One commenter urged that previously decommissioned sites not be exempted from further consideration (1137) while another commenter requested exemption for uranium mill and ISL facilities (1056). One commenter thought it was impossible or inappropriate to attempt remediation with current technology or any foreseen technology (880). One State related experience with workable approaches to site cleanup (1601).

E.1.2 General Form Of Rule

Two commenters expressed that the proposed action should be defined as "codification of radiological criteria for decommissioning and decontamination of lands and structures" versus just decommissioning (716, 770). Another commenter suggested the use of "Existing Radiological Guidance..." in lieu of "Existing Radiological Criteria ..." as codified decommissioning criteria does not now exist (1614). Two commenters wanted definite criteria that will not be open to interpretation by an industry which might be confused by complex rules or overall policy (153, 241). One commenter did not believe that protection of human beings and the environment can be ensured (245); another commenter desired the nuclear power industry to be banned (1597).

One commenter expressed a concern that non-standard reporting of radionuclide concentrations by industry and federal agencies would increase the likelihood of "misleading independent oversight and the general public"(700).

Two commenters expressed concern regarding the impact of easy standards:

An easy standard ensures that it will be easy for the nuclear industry to expand in the future (89).

"Lesser standards shift risks to those least in a position to accept them." These groups include Native Americans, downwinders, and workers in nuclear field center, etc. (414).

Two commenters identified specific problems and presented specific requests:

One commenter wanted the regulatory concern to be how to contain and isolate with zero release the radioactivity that has been generated, no matter where it is physically located. The commenter stated that a generic rule should contain the requirement for a site-specific decommissioning plan that is approved not only by the regulator, but the affected communities. The plan should be based upon a site-specific environmental impact statement that is also generically required (1267).

We recommend "independent" epidemiological studies of people living near facilities and ecosystems monitoring with full public disclosure of shipping manifests, reports, accidents, and releases (604).

One commenter made detailed statements regarding the approaches to the GEIS:

The final standards need to be flexible enough to address concerns noted in all four approaches discussed in the issue paper as well as reduce problems caused by the individual approaches (8868).

The procedural requirements and the basic structure of the standard must be codified. This includes the "risk limit", the process for multi-attribute analyses to determine how far below the risk limit is achievable, and the requirements for dealing with situations that cannot achieve the "risk limit" requirements (1596, 8895).

At a minimum, the "risk goals" concept and how it fits within the overall standard must be codified. The actual concentration screening goals, if developed, need not be codified. However, they should be issued for public comment and undergo detailed peer review. The regulation need not be overly prescriptive but at the least, recommended measurement techniques and compliance requirements (e.g., acceptable models, guidance on parameter determination, and guidance on procedures for multi-attribute analyses or other alternative approaches) should be included in a regulatory guide and provided in draft for public comment. The final guidance documents should be placed or their availability announced in the Federal Register to ensure that there is a complete understanding of how compliance should be demonstrated (8899).

One commenter preferred expressing the criteria in terms of dose rather than in terms of extrapolated cancer risks because the latter emphasizes acceptable risk which is loosely based on very soft numbers and introduces issues which are not resolvable (1604).

E.1.3 Procedural Aspects

Many commenters expressed the need for the GEIS as a tool to focus and evaluate the approaches to establish practical criteria for decommissioning (1107, 1155, 1234, 1236). Others felt that remediation at this time is inappropriate and insufficient with present knowledge (653, 882), and two expressed concerns for the future (893, 909). Short term economic benefit enjoyed as a result of compromising the public's health will create a future burden and should not be adopted (1017).

Decommissioning of non-disposable toxicants must be forever open to new information, new technology, and new evaluation with the bottom line always the most advanced scientific facts from all credible sources (935). In light of technology, more scoping meetings were also recommended to discuss what can be done with land which can not be remediated (1413). Another commenter stated that restricted use should be evaluated as an option for any limit or criteria established and be analyzed in GEIS (990).

Two commenters expressed concern that the GEIS would not cover issues which were covered by prior environmental review (1171, 1615); others wanted comments from the decommissioning workshops considered as part of the scoping process (931, 952, 1140); and another considered that a complete GEIS is required by law (1181). There was also concern about generic analyses versus a need for site specific analyses (1246). Some commenters questioned how the NRC could identify environmental review or consultation prior to receiving public comments and whether the scoping meetings were a meaningless exercise (438, 513, 1180). Another commenter proposed a Manhattan II Project to solve the entire process (937).

One commenter was pleased that the NRC will continue inspection and enforcement (191); while another proclaimed the real problem was weak NRC staff oversight (797). Others desired to seize the assets of nuclear power utilities and to halt production of nuclear waste (390, 728), and viewed the scoping process as a way to deregulate radioactive waste, extend the BRC policy (151, 467), and contaminate the environment (940).

One commenter expressed a relationship between the decommissioning criteria and the siting of waste disposal facilities: as the volumes of waste increase, the potential location for sites decrease. The commenter indicated hope that the NRC's rules would preclude his state from selection as a disposal site (465).

Several commenters requested an extension of the comment period for various reasons such as misunderstanding, too short a comment period, and not enough or no notice (38, 92, 107, 260, 303, 701, 764, 873).

Many commenters expressed the need for the NRC to develop public trust through reasonable and responsible efforts (145, 148, 151, 234, 246, 438, 467, 513, 885, 917, 923, 928, 929, 931, 1180). One commenter felt that no government agency "...is truly sincere in wanting to protect the general public from causes of injury..." (279). The following comments are provided for examples of other areas of concern:

GEIS and rule proceeding concurrently (438).

Attempting to hurry the rulemaking process to expedite licensees' avoidance of the liability problem (885)

Desired full hearing with sworn testimony (928).

One commenter considered the scoping meetings as subsidizing the nuclear power industry (225); however, most wanted more meetings or suggested ways to improve attendance through various advertising (147, 265, 276, 204, 1593). One commenter suggested an easier to read document - not written as if by a lawyer - as an aid to the public (263).

Several commenters stated the implications (costs, potential overlapping, or uncertainties) of the NRC rulemaking and interaction with other federal and state agencies and hoped for consistency and agreement (187, 321, 408, 446, 1048, 1052, 1099, 1287, 8893). The GEIS should consider the different kinds of facilities to be decommissioned and the likelihood that the NRC's rule might be adopted by other agencies (429).

Some specific comments regarding interaction between the NRC and local or state governments were made:

NRC must listen to the communities which are most affected and the communities which, because of economic and discriminatory factors, are the most unable to deal with problems (188).

The commenter would not want to see state requirements that were less restrictive than federal requirements (189)

Provide citizens' groups with a simplified written explanation that shows how to register a complaint or concern to the NRC (192).

If the NRC's determination that a site should be decommissioned is based on the finding that there is no risk to the safety of persons and the environment from radioactive materials at the site, then there would clearly be no basis to continue to assert federal jurisdiction over the site, and the state would be free to impose such other restrictions as it desired. The NRC should not suppose that it could both terminate its jurisdictional interest and maintain federal preemption of state law (748).

The NRC should have a consistent approach to radiological and chemical risks, building consistency for future compliance with state laws for post-decommissioning owners of the property (347).

The NRC may want to work towards consistent approaches for risks from radionuclides and chemicals so that anyone taking over the decommissioned property will already comply with state laws. Property that has been maintained in compliance with such laws would be much more attractive to prospective buyers (950).

In the opinion of several commenters, peer review and formal consensus by scientists is required for the rule making and the GEIS (227, 259, 8899). One commenter recommends consulting physicians as part of the GEIS (226). One commenter expressed concern about the general public's knowledge of nuclear plants and noted how long it took the public to be informed that smoking causes cancer (288).

One commenter was "frightened" at the manner in which governmental regulatory bodies pander to radical environmental organizations and believes they should instead be listening to scientific fact and make judgments based on actual risk assessments rather than on far-fetched scenarios from the "uninformed hysteria of a radical few" (297).

One commenter recommended that the final guidance documents should be placed, or their availability announced, in the Federal Register to ensure that there is a complete understanding of how compliance should be demonstrated (8899)

E.2 ALTERNATIVES

E.2.1 Abandonment Of Facilities

Some commenters said that a decommissioning alternative of the abandonment of facilities should be considered in the GEIS (252, 492, 718). One commenter said that abandonment with no remediation should be considered (252); another said that whether to remediate rather than abandon should be considered (492); and one would reject an abandonment alternative, but believes it should be considered in the GEIS (718).

E.2.2 No Regulatory Change

Several commenters opposed an alternative of no regulatory change (210, 1147, 1281, 1426) as allowing "industry" undue influence (210), as insufficiently protective of biota (1081), or as perpetuating an unacceptable status quo (1426). One commenter favored a no-regulatory-change alternative "because the present system has worked well to date" (807).

E.2.3 Risk Limit/Risk Goal

E.2.3.1 General

Some commenters advocated a lifetime or 100-year risk limit (1335, 1463). One said that the limit should be based on a collective 100-year dose less than that which would result in one cancer fatality (1335). Another suggested radiological limiting criteria similar to those for exposure to chemicals and linked to lifetime (rather than annual) cancer risks to the public of 10^{-5} to 10^{-6} , and suggested that these risks be discussed in section 5 of the GEIS (1463). One commenter noted that a "dose constraint" of about 30 millirem/year is consistent with the EPA's individual 10^{-4} risk constraint (8880).

Some commenters said that a risk goals "concept" or procedures for risk limit, ALARA analysis, and situations where risk limits cannot be achieved must be "codified" (1299, 8896). Actual concentration screening goals need not be codified (1299), and ALARA analysis might not be required if goals are used, but there should be a "general assessment" to ensure that the application of goals will not be detrimental, and the added analytic burden is justified for "large" complex actions (8905).

There were various comments on the application of the ALARA principle (1335, 8896, 8899, 8902, 8905). A commenter said that the ALARA principle should be applied, using not more than \$10,000 per person-rem, only in cases where the 100-year dose exceeds that which would cause one cancer fatality (1335). Another said that procedures for ALARA should be "codified" (8896), while another said that such procedures should be provided in a regulatory guide (8899). Others said that ALARA analysis allows consideration of practicality and a balancing of all pertinent risks and benefits (8902) or should be made on a site-specific basis when risk limits are used (8905).

A commenter distinguished between risks accepted voluntarily, and with informed consent, and those imposed involuntarily (424).

One commenter expressed no confidence in the NRC's application of ALARA because of the way it was thought to have been misapplied in a particular case (1220).

One commenter asked about the basis for the announced limits of 0.03 to 60 millirem/year to be considered in the GEIS (65). [The 0.03 value is equivalent to the EPA criterion of 10^{-6} lifetime risk, and the 60 millirem/year value was chosen as applicable to any one source rather than the 10 CFR Part 20 value of 100 millirem/year which applies to all sources.]

E.2.3.2 Agrees/Disagrees with Risk Limit/Goal Approach

Many commenters agreed with a risk limit or risk goal approach (3, 24, 26, 30, 114, 118, 119, 127, 132, 134, 238, 239, 325, 330, 344, 500, 789, 790, 810, 830, 973, 987, 988, 1027, 1033, 1224, 1229, 1248, 1337, 1359, 1362, 1365, 1595, 8861, 8863, 8870, 8875, 8882, 8886). Other commenters did not support such an approach (178, 256, 312, 413, 475, 537, 813, 889, 964, 1148, 1182, 1187, 1297, 1329, 1605).

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Reasons, conditions or considerations for agreement with risk limits or risk goals included:

Following international, national, or scientific- professional recommendations on radiation exposures, such as 100 millirem per year to individuals, the general public, or critical groups (3, 24, 26, 68, 114, 118, 119, 127, 330, 377, 830, 1033, 1229, 1358, 1608, 8857).

The ALARA principle should be applied along with risk limits or risk goals to reduce radiation doses (3, 68, 132, 330, 789, 790, 810, 973, 988, 1027, 1365, 8861, 8863, 8882, 8886).

The dose range considered by the NRC should be from the lowest reasonably measurable to a limit of 100 millirem/year (24, 26, 1248); we question the stated range to be considered of 0.03 to 100 millirem/year (24, 1602); it is unreasonable to include 0.03 millirem/year as there is no way to measure compliance (1248).

The NRC should not consider dose values for standards below which accurate and reliable data are available at reasonable cost (30); remediation to background levels might be set as a goal but not as a limit for a standard that might require remediation, disproportionate to risk, with no incremental benefit and the likelihood of increasing other risks. Health risks are the appropriate starting points for such standards (8870).

Setting too low a dose limit would require slight soil contamination, generated in compliance with regulations, to be included as radioactive waste (31).

The commenter notes that 100 millirem/year is about the range of natural background radiation in the United States (68).

Some comments suggested screening radiation levels of 25 millirem/year (114) or a dose constraint of 30 millirem/year (25 rounded to one significant figure) (1359, 8875). One commenter recommended the use of 10 mrem/y for site-specific contamination to satisfy ALARA considerations for both cleanup workers and members of the general public (1607).

Contrary to some erroneous inferences national, international, and governmental standards for protection against radiation have not changed significantly through reassessments over the past 30 years and remain at 500 millirem/year for members of the general public, as modified by the ICRP/NCRP to 100 millirem per year for continuous averaged exposures with infrequent 5-year total exposures of 500 millirem (119).

Site-specific appropriate ALARA considerations should be secondary to dose limits and not drive them (132).

Protection criteria should be based on real rather than hypothetical risks. Too stringent limits would be unsound policy (134). Guidance is needed for making ALARA determinations (973, 8882); without guidance ALARA is an enigma (132).

Set risk levels erring on the low side because accidents will occur and there might be "unassessed"

long-term effects (207).

The language of the regulation should be clear and concrete about risk limits and not leave interpretation to licensees (239, 500).

On risk limits or dose limits we take the stance of zero tolerance, no exposure to residual radiation at decommissioned sites (325).

Consider basing radiological criteria on risk determinations similar to those for chemical exposures, e.g., 10^{-5} or 10^{-6} lifetime cancer risk (344).

The collective 100-year dose that could result in one cancer fatality should be the limit below which no further remediation is required. For greater doses apply ALARA at no more than \$10,000 per person-rem (789).

Use 10,000 person-rem as a threshold below which, at low doses and dose rates, there is no cancer risk, and apply ALARA at no more than \$10,000 per person-rem only for greater collective doses (790, 1362, 1365).

A risk limit approach with ALARA applied allows flexibility and maintains doses low; this system is used now and works effectively (810). There should be enough site-specific flexibility in applying ALARA (1027); there is no evidence of a need for change from established regulatory practice (1033).

The ANS supports "tiered" regulatory limits for decommissioning to both restricted and unrestricted use, with specific criteria to limit the choice of restricted use (987).

Procedures for "risk limit," ALARA, and situations where a limit cannot be met must be "codified" (988). Set an overall limit of 100 millirem/year total effective dose equivalent above background to any member of the public, regardless of exposure pathway, from all man-made sources (1033).

Ensure that all risks are realistically characterized in ALARA assessments (8861). Allow the use of either risk-based approach or specific standards (1595).

For "small" decontamination actions costly ALARA analysis might not be warranted, and it might be appropriate to establish activity per unit mass or area screening levels to establish practicable compliance below risk limits (8886).

Reasons, conditions, or considerations in disagreeing with risk limits or risk goals included:

Risk based criteria assumes everyone has a similar response to radiation doses, "and we should assume otherwise" (178).

One commenter said that risk limits or goals are "a defective methodology" because they cause controversy over measurements and demonstrating compliance (312).

Some commenters do not favor an ALARA approach and believe it emphasizes short-term costs over long-term health impacts or that costs should not be a controlling factor in radiation protection regulation (377, 964, 1187, 1297).

Some commenters favored other approaches such as return-to background over risk limits or goals (413, 537, 1182).

Avoid setting risk goals or limits because "reductions put forward in annual limits" ... "cause grief to persons in industry" (475).

Commenter does not support risk goals because unreasonable goals might be set to attempt to achieve zero risk and require remediation to unattainable levels (613).

The commenter believes risk goals and limits imply a "hedonic calculus," raise questions of acceptability of risk, and "might put God out of business" (889).

A dose limit of 100 millirem/year would be the same as if the facility were never closed (1329).

One commenter preferred expressing the criteria in terms of dose rather than in terms of extrapolated cancer risks because the latter emphasizes acceptable risk which is loosely based on very soft numbers and introduces issues which are not resolvable (1605).

E.2.4 Return To Background

E.2.4.1 General

A number of commenters dealt with determining, measuring, defining, or otherwise assessing natural background radiation (34, 368, 431, 761, 1087, 1192). Some advocated that the NRC carry out studies, surveys, or monitoring to gather and publish "comprehensive" information on background radiation and the practicality of its measurement locally and nationally on which to base regulatory decisions (34, 368, 761, 1087, 1192). One commenter advocated additional studies by local "independent scientists" (431). Some recommended "codifying" specific levels [*sic*] of single radionuclides and location-specific radiation levels (368, 761).

Some comments said that "background" means "pre-existing naturally-occurring background" (58, 1192).

Some comments noted that a return-to-background criterion is impractical owing to the variability of background radiation (1233, 1481), would result in "different standards nationwide" and significantly increased quantities of waste, raises unresolved technical questions of definition and measurement, and should never be defined as a single number (1481).

One commenter noted that the "public and affected community" would have to be involved in determining background at a particular facility (421).

E.2.4.2 Agrees/Disagrees with Return-To-Background Alternative

Several commenters supported a return-to-background approach (47, 60, 94, 155, 183, 203, 213, 236, 242, 248, 282, 366, 399, 411, 417, 432, 457, 466, 502, 552, 719, 721, 762, 777, 780, 828, 835, 875, 892, 941, 953, 960, 1011, 1024, 1059, 1068, 1131, 1138, 1219, 1227, 1272, 1336, 1480, 1487, 1598) with most asserting a preference for return to "pre-existing," "naturally-occurring," "natural," "pristine," "original," "pre-licensure," or "zero exposure above naturally-occurring" conditions, without particular explanation for the preference.

Some commenters emphasized completeness of cleanup (248, 399, 466, 725, 752, 762, 828, 835, 875, 953, 960).

Several commenters would require return to background as a condition for release to unrestricted use (155, 366, 457, 725, 752, 875, 892, 1011, 1024, 1131).

Some commenters said that not requiring a return-to-background approach would be a "subsidy" or "welfare" to industry (411, 1272); others felt that licensees should continue to be held responsible for costs and controls at sites not returned to background (502, 1131).

One commenter said that NRC dose limits are fairly responsible, but would "call for exposure to the public indistinguishable from background" (236).

Some commenters advocated return to background on the basis of personally propounded hypotheses about radiation effects (183) or personal interpretation of technical data (457); two commenters advocated a return-to-background approach until "no hazard to human health" is demonstrated (242, 892).

One commenter proposed that local councils of "citizens" should make technical and procedural determinations about background radiation (282).

Several commenters disagreed with a return-to-background approach (9, 34, 73, 88, 136, 314, 334, 476, 533, 612, 816, 904, 979, 1051, 1393, 1547, 1572, 8869) mostly for reasons such as technical impracticality, infeasibility, lack of scientific justification, or the variability of background and the difficulty of its definition and measurement.

Some commenters noted that a return-to-background approach would result in differing and inequitable standards nationwide (9, 334, 612, 979).

Commenters noted that "there is no special merit in distinguishing between man-made and natural sources" (73), that background is a quantity, not zero, and is time and site specific (816).

Some commenters said that a return-to-background requirement would result in extreme expenses without commensurate benefit to health or to society, might even increase risks or impacts to people or the environment (816, 1393, 8869), and could be "unwise," "unsound," and "foolish" policy (136, 904).

Some commenters said that a return-to-background standard would increase waste disposal problems by generating more waste (9, 334, 979).

One commenter stated that the concept has little applicability since it can only be defined for species not found in nature. Adoption of a dose limit from residual contamination makes this alternative extraneous and it should not be considered as the preferred alternative (1613).

E.2.5 Best Technology

Most of those commenting on the best available technology approach opposed it as, e.g., "insufficient," "not appropriate," a "defective" methodology (313, 376, 412, 781, 814, 866, 1149, 1464, 8874).

One commenter said that the term "best available technology" requires better definition before it can be considered as an alternative (173), while another said that best effort is too subject to interpretation and regulatory language should be clear and not allow for interpretation (240).

Two commenters said that they favored the alternative approach of return-to-background over a best effort approach (412, 781).

Two commenters said that a best effort approach would be a "subsidy to industry" (412), or would potentially allow licensees to leave sites with high levels of residual radioactivity (814).

Three commenters said that a best technology approach would put economic considerations ahead of concern for public health and safety (376, 866, 1464).

Two commenters noted that, as "best effort" will change with advances in technology, facility closures would, potentially, never be final (814), or periodic re-evaluation would be required, and technology-based standards should be used only when risk-based standards cannot be applied in a timely manner (8874).

Three commenters said that the GEIS should consider a best available technology approach (478, 1105, 1478) and should specify the time period in which best available technology will be "determined" (405) or how best effort will be evaluated to determine whether it protects public health and promotes the development of new technology (1478).

E.2.6 Restricted Use

E.2.6.1 Agrees/Disagrees With Restricted-Use Alternative

[NOTE: Different commenters apparently used the notion of restriction on use in different ways. Some meant that there should be no decommissioning unless no further restriction on use is required; others meant that facilities could be decommissioned with some restrictions imposed on subsequent use. The former are noted here as disagreeing with a restricted-use alternative; the latter are noted as agreeing with a restricted-use alternative.]

Many commenters agreed that a decommissioning-to-restricted-use alternative should be considered (8, 20, 83, 96, 137, 154, 158, 164, 185, 193, 199, 208, 215, 243, 257, 284, 292, 304, 308, 310, 317, 319, 323, 324, 333, 375, 400, 437, 461, 501, 612, 615, 618, 712, 720, 732, 734, 891, 989, 1139, 1091, 1152, 1189, 1273, 1288, 1290, 1482, 1562, 1565, 1609, 8891); several others opposed such an alternative (358, 367, 386, 753, 585, 805, 847, 1201, 1277, 1424, 1561).

One commenter stated that agencies requiring only unrestricted use limits did not impose any significant benefit; rather it resulted in wasted resources and contributed to filling limited disposal volumes with slightly contaminated material without significantly enhancing possible uses of contaminated sites (1611).

Some commenters said that restricted use should be an option adjunctive to other alternatives rather than a separate alternative (20, 333, 1189, 1562, 1565, 1612, 1619).

Some commenters suggested imposing restrictions through limitations on land use through deeds, covenants, or restrictive easements (8, 333, 732, 1189, 1565, 1609), or by a "trusteeship alternative" devolving continued responsibility upon each successive owner of the property (319, 734). Three commenters felt that restrictions such as land-use limitations could not be assured after decommissioning or into a distant future (386, 605, 1561).

Several commenters linked a restricted-use alternative to some aspect of radioactive-waste management or to continued on-site waste storage or entombment (83, 154, 164, 199, 243, 304, 310, 324, 375, 387, 437, 646, 759, 1288).

A number of commenters, both of those who opposed and of those who favored a restricted-use alternative, noted a need to maintain clear responsibility for costs and controls for required radiation safety measures (193, 215, 308, 501, 529, 720, 734, 799, 1152, 1162, 1189, 1273, 1290, 1424, 1482).

Some commenters alluded to or specifically suggested a "seventh alternative" of indefinite extension of "licenses and liabilities" (367, 783, 799).

Some commenters said that they do not believe that nuclear power plant sites can be decommissioned to unrestricted use (284, 292, 317).

One commenter suggested successive decommissionings to a series of different restricted uses (308)

E.2.6.2 Concerns/Questions About This Alternative

Two commenters expressed concern about the ability to assure institutional controls, security measures, or financial responsibilities over potentially long time periods (109, 479, 966); one said that past and present institutional controls should be reviewed (966).

Two commenters were concerned about how to enforce, or demonstrate compliance with, restrictions on use (1406, 1566); one said that guidance documents must be available on how to demonstrate compliance with restrictions on use (1566).

Two commenters said that restrictions on use should be evaluated as an option under other alternatives (990, 996); another said that the incremental costs between cleanup to restricted use and other alternatives should be analyzed and include the "full costs and benefits of restricted use" (405).

One commenter said that land-use options should be considered as an independent alternative and cleanup impacts should be evaluated for various land-use "scenarios" (996); another said that the GEIS should consider the various kinds of restricted use and the various associated levels of cleanup required (401).

A commenter questioned the technical ability to remediate sites for public use because problems of radioactive waste disposal remain unresolved (883).

Concerns that licensees might "preferentially choose" a restricted-use alternative can be addressed by providing specific criteria for limiting its application (989). Another commenter believed this alternative was a cheap out and would not protect the public (1600).

One commenter said that regulatory control and "licensee liability" must be maintained until the site is returned to "natural, preexisting background levels and zero release of radioactivity that has been 'cleaned up'"[sic] (1569).

One commenter said that a restricted-use alternative "sentences sites" to continued hazardous uses and creates "sacrifice zones" (1570).

E.2.6.3 Procedural Aspects of Restricted Use

A commenter said that "scoping hearings and rulemakings" should be held on what to do with lands that can not be remediated for release to public use (883).

A commenter said that the standard should include a process to establish restricted use as a control measure for the achievement of risk limits (982); another said that restrictions on use should be realistic as to actual public risk and that the criteria should consider reusability of sites for other industries or for expansion of existing industries (906).

Some commenters said that land-use restrictions should be considered in implementing restricted use (610, 990, 1610) or that the existence of a mechanism for land-use restrictions should be acknowledged but not considered in detail in the GEIS (1202). One commenter favored a "regulatory easement" that would allow the NRC to "come in at any later date and assert its regulatory interest" (318).

Some commenters advocated that restricted use be considered as adjunctive to other alternatives rather than as a separate alternative (611, 614, 990, 1285).

Several commenters noted procedural aspects covered in Sections E.2.6.1 or E.2.6.2 above, *q. v.* (320, 966, 987, 1152, 1406).

E.2.7 Other Comments

Three commenters linked restricted use to some aspect of waste handling or disposal (425, 934, 1567). Two emphasized a need for long-term control of "radioactivity" or "radioactive waste/ contamination" (425, 934). One said that "clean-up" should not be limited to current knowledge or techniques (934). One said that the GEIS should address improbable "scenarios" such as the NRC's allowing decommissioning with the licensee turning responsibility for on-site spent fuel over to the Department of Energy (1576).

One commenter said to add an alternative of combining a generic, health-based federal standard with site-specific standards and to discuss in the GEIS the relative merits of having federal, state, or local site-specific standards (1103). Another commenter said that the GEIS should use specific facilities as examples in discussing the environmental implications of decommissioning (1291).

A commenter said to expand the scope of the GEIS to include lessons learned from past experience and a "broader list of alternatives" (1291).

One commenter noted that the current definition of decommissioning doesn't technically incorporate the alternative of restricted use (499).

E.3 METHOD OF APPROACH

NRC should use realistic cost estimates for waste disposal based on projects of the compacts developing waste disposal sites. If the evaluation of some alternatives indicates waste volumes that are factors of 2-3 times larger than what was generally anticipated for LLW disposal sites, NRC should factor in the impacts associated with the potential need to site additional disposal facilities. In addition, the need to comply with waste form

requirements of various disposal sites should be included in the impact analysis for the evaluation of alternatives (1019).

E.3.1 Facilities Covered

Six commenters advocated that the GEIS consider a more comprehensive range of facilities, materials, impacts, or regulations to be applied (41, 1053, 1142, 1169, 1296, 1383). Some said that both radiological and non-radiological impacts should be covered (41, 1053). Some said that the GEIS should consider all nuclear-related facilities whether or not regulated by the NRC (41, 1142, 1169, 1296, 1383). One commenter said that the GEIS should "cover the worst possible case" (262); another was concerned that the GEIS might not "cover a site that was extremely contaminated" (269).

Several commenters objected to, questioned, or said there should be some rationale presented for not considering in the GEIS those facilities previously decommissioned or currently proceeding with decommissioning (122, 251, 773, 959, 1435). One commenter said the GEIS should consider alternatives for applying different decommissioning standards to existing (licensed) facilities and to proposed (not yet licensed) facilities (1069). One commenter said that, for SDMP sites, the GEIS should evaluate the differences between the risks incurred due to the final rule and the current criteria for SDMP sites (1093).

Some commenters recommended that the GEIS discuss specific sites as exemplars (190, 1117, 1128, 1174, 1292). One commenter said to select a few sites "from one extreme of contamination to the other" and go through a complete process from GEIS to decommissioning (190). One commenter emphasized full-scale characterization of representative sites using the same methodologies to be implemented (1117, 1128, 1174).

Several commenters recommended that the GEIS or the standard to be developed consider various types of facilities or deal differently with different facilities (298, 430, 448, 809, 945, 1075, 1078, 1215). Some commenters said that decommissioning criteria for fuel-cycle facilities should be different from those for non-fuel-cycle facilities (298, 448, 945, 1215). One said that there should be different GEIS analyses for groups of facilities, and suggested specific groupings (1078). Two commenters urged that uranium mills and tailings, or ISL facilities, be excluded from the scope of the GEIS or from the decommissioning criteria because they are already separately regulated (809, 1056). One commenter recommended that the NRC include uranium enrichment plants in the scope of the GEIS and consider gaseous diffusion, and gas centrifuge and atomic vapor laser isotope separation technologies generically (575).

The extent of variation to be expected in the decommissioning impact and costs per unit of capacity within each group of facilities should also be explicitly considered. For example, the cost of decommissioning nuclear power plants may not depend linearly on size, and the nature of this dependence should be analyzed (1080).

E.3.2 Affected Environment

One commenter said that the GEIS "inappropriately excluded the issue of groundwater and surface water contamination" and that the GEIS should include clean-up of water bodies (1072). Another commenter said that the proposed scope of the GEIS is "deficient" in omitting clean-up of water bodies (1579).

A commenter said that the NRC should not limit the EIS or GEIS to a specific site but should include the "totality of impact" on "all affected areas and environments" from all licensed and unlicensed activities that "comprise the nuclear industry" (1143).

One commenter said that the GEIS should be an efficient evaluation limited to reasonable, generally-applicable alternatives appropriately analyzed in general categories (1443). Two commenters suggested four sub-categories

to consider for land use of: residential, agricultural, recreational, and commercial/industrial (1443, 1488).

One commenter cited three areas of deficiency in the scope of the GEIS as: not evaluating risks from both radioactive and non-radioactive materials, not addressing risks from waste disposal, and omitting clean-up of water bodies (1579).

One commenter cited a need to recognize that efforts to remediate risks from radioactive materials can cause non-health-related secondary ecological or social impacts, and said that the criteria selected must be balanced to protect all "these resources" (8859).

E.3.3 Technical Approach

Some commenters emphasized the need to assess "all" impacts of various kinds (15, 17, 22, 40, 72, 340, 702, 583, 973, 1005, 1109, 1195, 1382, 8861, 8866). Of these, some said to consider individual or collective impacts on workers or the public, or impacts on the environment (15, 22, 583, 973, 1005, 8866). Others said to consider both radiological and non-radiological impacts or synergistic impacts (40, 72, 340, 502, 583, 1037), or to consider both long-term and short-term impacts from both NRC-regulated and non-NRC-regulated facilities (40, 1382).

Some commenters said that assessments should be based on realistic, or accurate and reliable, data and assumptions, and on comparable methodologies (17, 29, 33, 793, 821, 836, 899, 1187, 1242, 1243, 1247, 1471, 1505, 1537, 8861).

Some commenters said to avoid overestimating benefits of remediation, biasing data, wasting resources to remediate trivial risks, or doing more harm than good (22, 72, 296, 793, 997, 1005, 1125, 1195, 1243, 1490, 8860, 8886, 8906).

A number of commenters said that costs or incremental costs should be considered in analyses (15, 29, 33, 222, 340, 404, 583, 946, 1002, 1158, 1195, 1490, 8863, 8902), and one commenter found any consideration of costs to licensees "offensive" (851), while another said that analysis of costs and benefits "should not be part of the NRC's primary area of responsibility" (255).

Commenters offered a variety of suggestions for the bases of analytic methodologies to use in assessing individual or collective doses or risks (351, 791, 803, 915, 956, 1000, 1158, 1176, 1245, 1250, 1328, 1332, 1333, 1339, 1360, 1367, 1374, 8876). [See also Section E.2.6 for summaries of specific numerical recommendations.]

One commenter suspected that current technology is not capable of remediation of sites for safe release to public use (1324).

One commenter recommended that the NRC consider recycle/reuse standards, criteria, or protocols in the decommissioning standards process (8950).

E.4 IMPACTS/COSTS/WASTES**E.4.1 Radiological Impacts****E.4.1.1 Health Impacts**

Some commenters questioned the accuracy of dose or health risk estimates or of the reliability of their source (75, 79, 184, 220, 233, 267, 415, 1433).

Current radiological protection recommendations or standards have not changed significantly over many years and are sufficient to protect public health or the environment (120, 549, 831, 1340, 8877). One commenter said that the NRC rule should be consistent with established standards (8893).

Some commenters said that estimated risk factors have increased (124, 1338, 1370, 1492).

The GEIS should address uncertainties in radiological health estimates (126, 180, 887, 1006, 1009, 1095).

Some commenters said that health criteria should be scientifically based and related to real, not hypothetical, risks (138, 608, 915, 1123, 1258).

Some commenters said that no exposure to radiation is safe and exposures should be minimized (159, 182, 427, 472, 926, 1013, 1599); but another said that the concept that any amount of radiation is harmful "ignores reality" (1013), while another said that unreliable speculation of incremental impacts at lower doses based on existing higher-dose data must be avoided (1123).

One commenter said that health effects on special groups such as elderly people or children should be considered (202).

Some commenters said to conduct epidemiologic studies in conjunction with decommissioning (271, 378, 383), or to gather information for establishing criteria (374).

One commenter said that health effects are "deleterious," "horrifying," and "long-term" (450).

Some commenters offered personal interpretations of health effects of radiation exposure (458, 468).

One commenter said to consider synergistic effects (703).

One commenter said to consider 10,000 person-rem collective dose in 100-year increments to be a level below which no cancer is produced (786, 787).

One commenter said that the health risks from radiation should be treated differently from those from chemical carcinogens (1054).

E.4.1.2 General Impacts

One commenter recommended to consider the total cancer risks, radiological and chemical, associated with decommissioning, and to consider some community "right-to-know" actions if decommissioned facilities pose a lifetime cancer risk greater than 10 to the minus five -- similar to the manner in which California state laws have risk-based "triggers" that require public notice (527).

E.4.1.3 Radiological Impacts to Workers/Public

A number of commenters said to apply ICRP/NCRP or federally-adopted criteria for limiting doses to the public or to apply ALARA for additional dose reduction (6, 71, 117, 128, 541, 545, 550, 557, 599, 988, 991, 994, 1248, 1249, 1254, 1357, 1437, 1459, 1467, 1475, 1476).

Several commenters emphasized not wasting resources nor introducing error by considering hypothetical costs and impacts of complying with values below those that can be reasonably measured or evaluated and practically used; use realistic bases for assessment of real risks to those who are affected (28, 35, 77, 541, 560, 1014, 1082, 1188, 1241, 1249, 1254, 1256, 1305, 1386, 1472, 8890).

Some commenters said that the dose range to be evaluated should begin at zero above background (60, 1153). Others said to use 10 millirem per year as a de facto threshold below which no cancer is produced regardless of collective dose (594) and to use collective dose over time rather than annual dose rates to measure risk (595), or to establish a dose-based criterion with the lowest dose rates reasonably determined by pathway analysis after decommissioning to "coincide" with an average yearly individual total effective dose equivalent of 25 millirem (1082).

One commenter noted that changing from a contamination-limit system to a dose-limit system will require "adjustments" to account for "differences in radionuclides" (33).

Several commenters said to consider the total, cumulative, radiation exposures from all sources or total impacts from both radiological and non-radiological risks (87, 566, 575, 579, 948, 1055, 1096, 1151, 1463, 1525, 1550).

One commenter said that internal radiation dose is "more biologically damaging" than external radiation dose (162).

One commenter said to consider "non-fatal as well as fatal cancers" (300).

Some commenters expressed "concerns" about, or urged consideration of, particular groups such as workers, elderly people, children, and gardeners (201, 216, 361, 403).

Some commenters said to consider EPA standards in performing pathway analyses for biological exposures or to specify the considerations for performing pathway analyses (370, 717, 776, 1082).

One commenter said that radiation risk models overestimate doses and risks by factors of 10 to a thousand (562).

Some commenters expressed concern about the health impacts of radioactive waste handling or disposal (634, 639, 1583).

One commenter said to update the information for, rather than eliminate from consideration, those items previously considered as announced in the *Federal Register* notice (971).

Some commenters said to consider in assessments four sub-alternatives of land use as: residential, agricultural, recreational, and commercial/industrial (1134, 1188, 1241).

One commenter stated that use of 10 mrem/y for site-specific contamination would satisfy ALARA considerations for both cleanup workers and members of the general public (1606).

Comments not otherwise summarized here, or repeating information summarized elsewhere in subsections of E.2, E.3, or E.4 of this document, *q.v.* (1373, 1378, 1491, 1493, 1494, 1506, 1550, 1576, 8866, 8876, 8878, 8880).

E.4.2 Non-radiological impacts

E.4.2.1 Human Health Impacts; Synergism With Chemical Wastes; Construction and Transportation Accidents

It is important to consider non-radiological impacts to the public, workers, or the environment, *inter alia*, to avoid overestimating benefits of radiological risks averted or to avoid doing more harm than good (22, 567, 580, 1003, 1004, 1046, 1098, 1196, 1212, 1513, 1519, 1524, 1528, 1531, 1589).

Some commenters said to consider various aspects of potential hazards, radiological and non-radiological, from transportation accidents in the GEIS (194, 197, 633, 638, 1060, 1239, 1532, 1589), and one said to include risks of low-probability-high-impact events (581).

One commenter said to consider the "measurable perception of risk in various communities" (316); another said to discuss untested assumptions that are used in risk calculations (551).

Several commenters want to include various aspects of waste disposal or waste management as a GEIS issue (581, 638, 852, 1060, 1115), and one said to include requirements that wastes be handled within RCRA Subtitle C (657).

Two commenters said to consider issues of workers' health (582, 587).

One commenter distinguished informed risks with consent as different from other risks (597).

Some commenters said that the GEIS should address synergistic effects (506, 774, 1115).

Comments repeating information summarized elsewhere in subsections of E.2, E.3, or E.4 of this document, *q.v.* (345, 704, 755, 1578).

E.4.2.2 Biota

Some commenters said to consider migration pathways or bio-concentration of radionuclides (84, 384, 393); others said to consider the EPA's health standard for groundwater and air in analyzing pathways for human and biota exposures (558, 1315).

Some commenters said to consider the impact of waste storage or disposal on ecosystems (393, 1420).

Some commenters said to conduct epidemiological studies and monitor ecosystems near facilities (603, 869).

Several commenters said to consider non-radiological impacts, e.g., to avoid erroneous evaluation of overall impacts (576, 657, 1533, 8858).

Comments not otherwise summarized here or summarized in other subsections of E.2, E.3, or E.4 of this document, *q.v.* (660, 661).

E.4.2.3 Economic/Land Use

One commenter said to consider non-health impacts (419).

A commenter said that cleaning to an ALARA standard will alter future site use (420).

One commenter said that decommissioned facilities should be put to new commercial uses to avoid adverse economic or social impacts (907).

Some commenters said to account for land use as part of dose assessment methodology (1001, 1193, 1244, 1603).

Some commenters said to base criteria on probable risks to those affected economically in the nearby community (1421, 1422, 1508).

E.4.2.4 Societal

Several commenters said that assessments should be balanced to be protective of cultural resources, Native American sites of special significance, or other potentially affected groups (200, 272, 596, 656, 8858); while one said to consider the effects of exported nuclear technology on countries with little environmental protection regulation (443).

One commenter said to compare how different approaches might affect problems of undue influence of "industry" or licensees over the public (1073); another said to consider voluntary vs. involuntary risk (1088).

One commenter said to evaluate variables such as "community concerns" (1509).

Comments not otherwise summarized here or summarized in other subsections of E.2, E.3, or E.4 of this document, *q.v.* (571, 659).

E.4.3 Transfer of Risk

A number of commenters noted that aspects of the transfer of risk involved the moving radioactive waste off site (83, 285, 293, 612, 625, 631, 635, 640, 641, 648, 1402, 1522, 1563, 1580, 1586).

One commenter raised a question of to whom the term "acceptable risk" applies (385).

One commenter said that economic costs should not be transferred to the public (1190).

E.4.4 Costs; Measurements Capability

Many commenters gave expectations of the scope of the GEIS to include generic waste disposal costs with categorization for each alternative (404, 559, 592, 1217, 1510, 1546, 1581), associated timing (14, 1000), and consideration of different waste management technologies (37, 372). Similarly, impacts from on-site disposal of wastes were recommended to be explicitly included (339, 1581). Specific cost analyses which were recommended were: health care and relocation expenses (381, 871); independent monitoring (381, 554, 637, 1311); regulatory costs to state and local governments (509, 1100); costs of contamination of land and groundwater at the facilities (1100) or disposal sites (758); costs of not implementing alternatives (888); all non-monied costs (897) and industrial risks (1261, 1520); potential need of more disposal sites (1022, 1210); the variation of decommissioning costs per size of facility (1499); and transportation, and radiological and

non-radiological risks to the public and workers during all phases of waste disposal (341, 343, 1581).

Several commenters stated that the full cost of "complete decontamination" must be borne by the generator along with all liability for personal and property damage to locations where the licensee sends radioactive materials or wastes for treatment, storage, or disposal (63, 435, 723, 1384). [See also section E.5.1, Funding/Planning of Decommissioning.]

One commenter recommended that theoretical measurement of radiological criteria risk-based determinations parallel those used for chemical exposures such as lifetime cancer risk of 10^{-5} or 10^{-6} (343). Others believed the licensee must also have a reasonable opportunity to demonstrate compliance with the release criteria developed (1502, 1618) but that it will not be feasible or practical to assess contamination levels or to demonstrate compliance to cleanup values below several mrems per year (1007, 1016, 1023, 1231, 1502, 1541). Continuing, the NRC should not waste resources or introduce error by considering hypothetical costs and impacts of complying with values that cannot, in practice, be used (590). Carefully documenting practical limits of measurability and compliance demonstration in the GEIS will be important for gaining public acceptance of realistic protective site cleanup standards (1473). The NRC should establish a dose-based site cleanup criterion, where compliance is demonstrated based upon pathways dose assessment methodologies such as those found in NUREG/CR-5512 (1501).

E.4.5 Wastes

One commenter stated that the GEIS should not cover issues that have been previously covered or are not significant (616), but the EIS should consider when and where to dispose of wastes and the costs and risks of disposal (616, 1414, 1419, 1577). One commenter stated that the GEIS should include the combined total and short and long-lived, long-term effects and health and safety impacts of decommissioning and decontamination activities for all nuclear facilities; as well as, both radiological and non-radiological impacts from all other nuclear facilities that are not regulated by the NRC (620). Another commenter stated that the dire seriousness of the issue should preclude limiting clean-up to present day technologies (981). Another commenter stated that a generic rule to regulate the siting of nuclear waste would be both highly inappropriate and insufficient with the present knowledge (454).

Other commenters expressed a need for full evaluation of waste generation associated with each alternative (112, 149, 598, 613, 628, 726, 968, 1000, 1582). This should include hazards of transportation (149, 174, 632, 637, 1238), and radiological and non-radiological risks at intermediate sites for storage, handling, and packaging and at final disposal sites (1582). Similarly, impacts from on-site disposal or burial of wastes should be explicitly included (839, 1582). Dispersal by means of industrial furnace was not acceptable (161, 647). One commenter recommended research to neutralize radioactivity (278). Two commenters stated that nobody wants the wastes in their backyard, and that creates problems that should have further consideration (289, 637). Two commenters were alarmed about the possible extension of the BRC policy, and not requiring monitoring of all nuclear waste (627, 1263).

One commenter suggested that in the disposal of very long-lived radioactive materials, we might not be able to take account of the changed conditions tens of thousands of years hence (86) while others desired that containment be held to zero release levels forever (100, 110, 1400). Another stated that decommissioning of a contaminated site does not eliminate the radioactive and chemical wastes, but rather repackages and reconfigures them on-site, or moves them to another location (1582). One stated that it was foolish to contaminate new sites (637) and another desired on-site storage (629, 632) or entombment (1585). Other commenters remarked that decommissioning of a power plant may produce enormous volumes of radioactive wastes (150, 1203, 1527, 1534), yet we do not know how to deal with the waste (250, 884). Other commenters were concerned with the required number, size, and safety of storage sites (449, 469, 617, 618,

642, 652, 654, 1191, 1197, 1262, 1620).

Several commenters suggested that reclassification and segregation of radioactive waste on the basis of half-life (long or short), toxicity (based on half-life level > 100 years), or source would provide more disposition options (364, 380, 397, 439, 746, 550, 586, 865, 1588). Others stated that the problem of where or when to store spent fuel is a decommissioning issue and should be regarded as such (307, 739, 1135).

E.4.6 Comparison of Impacts and Costs

Many commenters discussed the use of the "as low as reasonably achievable" (ALARA) process as an appropriate method for considering the total detriment and benefit associated with remedial alternatives in the decommissioning process. They noted that for such a process to result in good risk management decisions, all attributes (detriments or benefits) need to be compared from an equal base (570, 573, 973, 994, 997, 1000, 1002, 1543, 8861, 8863). One also noted that comparison of very conservative public health impacts to realistic or best-estimate worker or ecological impacts will bias decisions (8861). It should include both radiological and non-radiological impacts from licensed facilities (574, 585) and all other nuclear facilities that are not regulated by the NRC (483). The costs must be considered for all analyses as well as "total and real" impacts to the public and to workers (559, 1002, 1423, 1518, 1521). Certain specific recommendations and comments included:

One commenter stated that the NRC should not waste resources considering hypothetical costs or impacts of complying with criteria that cannot be met in a practical sense (1012). One commenter recommended the lowest reasonable measurable dose be determined (1436) and that the NRC should not consider establishing dose values for site cleanup standards below values where accurate and reliable data is available or obtainable at reasonable costs (1515).

One commenter recommended the development of both population risk and individual risk in analyses (8867).

One commenter recommended that a term such as "years of life lost" be developed and used to express the potential health impact of a given action or decision (565). Another recommended measurement tool was "one excess cancer per million exposed people" (848). Other commenters described the use of "significant threat to public health and safety" and "significant" as inadequate (920, 1390). One commenter used a value for lifetime cancer risk as greater than 10^{-5} (585).

One commenter desired an evaluation and analysis of the incremental costs as between cleanup to restricted use and the other alternatives for setting the radiological criteria for decommissioning, including the full costs and benefits of restricted use (572).

One commenter stated that it would be appropriate to use general categories for the analyses. For example, land uses should be limited to four types: commercial/ industrial, agricultural, residential, and recreational (1553). Cost and benefits should only be calculated generically for each alternative in order to compare the totals which could be expected to result from applying the generic criteria to all affected sites. Site specific details are not appropriate for such a generic analysis and should be considered in separate, site specific environmental analyses and not in this GEIS (1554).

One commenter recommended the evaluation of past and present uses of institutional controls, as well as discuss how the financial and other responsibilities of licensees will be maintained (964).

One commenter requested that the GEIS relate risk, uncertainty, and radioactivity in real world terms (141).

Regarding cost specifically, one commenter stated that the most expensive solution is not the safest or the best, but frequently misguided (593) while another stated the only consideration is to ensure maximum protection of human health and the environment, without regard to cost (1067). Several commenters objected to trying to balance cost against cleanup and dangers to human life (456, 1157, 1385, 1465) while another commenter objected to changing from a process that was safe and predictable to a process that considers cost-benefit ratios (591). One commenter stated that a cost analysis and benefits should not be part of the NRC's primary area of "responsibility" (255). One stated that decontamination can not be bottom-lined, least cost (1161); another urged the NRC to reject a "reasonable cost" concept (1214).

Conversely, one commenter cautioned that the financial impacts of changing decommissioning standards should be carefully considered. The creation of more restrictive decommissioning standards will dramatically increase operating costs for NRC licensees without commensurate benefits to the public health. Licensees should not be forced to shoulder these costs. Changes in decommissioning standards that increase decommissioning costs, such as a return to background standard, may force licensees to cancel new projects because the eventual cost of decommissioning will be prohibitive (819).

One commenter offered the following ALARA determination techniques:

If the collective dose is above 10,000 person-rem, the ALARA principle should be used to determine whether or not to decontaminate further. A value of not more than \$10,000 per person-rem for collective doses above 10,000 person-rem in today's dollars should be used in that ALARA calculation (1366).

If the collective 100-year dose is less than that which will result in one cancer fatality (based on the best current cancer risk/dose model), that should be the limit below which no further decontamination is required. The ALARA principle (using not more than \$10,000 per person-rem) should be used in cases where the 100-year dose is greater than that which will result in one cancer fatality (1368).

The Commission should set the value at 10,000 person-rem below which, for purposes of regulation, no cancer would be produced (1375).

One commenter recommended that the NRC consider disposal of material removed - quantities, disposition, and time frame - as part of the GEIS. This issue is of concern to the industry and to the public for cost, environmental, and public health risk reasons. The availability (or unavailability) of effective treatment and land disposal will significantly impact the required cost analyses for all the GEIS alternatives (1573).

E.5 AREAS INSIDE/OUTSIDE GEIS SCOPE

E.5.1 Funding/Planning of Decommissioning

Many commenters agreed that the NRC should not cover issues that have been previously covered or are not significant (13, 19, 338, 997, 1166, 1226, 1284). Many other commenters did not agree with the indicated omissions (406, 1198, 1200, 1439, 1455) and one desired an update from the previously used 1988 data (1427).

One commenter stated that the GEIS should evaluate costs and impacts of various regulatory approaches from the lowest reasonably measurable dose up to 100 mrem per year, i.e., the dose limit recommended for members of the public by national and international radiation protection experts, NCRP and ICRP (1165).

Commenters called for thorough planning for decommissioning and requested public involvement. Topics for planning included: economic analysis, management and disposition of nonhazardous solid waste (mostly construction and demolition wastes), and any mixed hazardous wastes. The recommended planning included both off-site and on-site waste management considerations (853, 859, 870).

One commenter wanted wastes to be stored on-site at the point of generation in above-ground, monitored, retrievable storage facilities until a permanent solution is found (896).

Many commenters were concerned if the licensees (including the utilities) had adequate funds to perform decommissioning and wanted this topic to be in the GEIS (291, 389, 396, 407, 434, 503, 1020, 1026, 1303, 1410). Other comments regarding funds and their use included:

Two commenters called for seizing the assets of utilities to pay for decommissioning (507, 1584) and converting the resources of national laboratories to the cleanup effort (507).

Two other commenters stated that citizens committees and state and local environmental agencies should be given funds and invited to participate in all monitoring of the facility to be decommissioned (637, 1303).

One commenter felt that the availability of funding for restricted use should be reviewed (407).

Another commenter wanted provisions for health care costs and relocation expenses for those affected by radioactive contamination, and provisions for funds for independent monitoring of decommissioning (498).

E.5.2 Timing/Timeliness Considerations

Several commenters supported the NRC's elimination of the subject of timeliness of decommissioning from study under the GEIS because they have been previously considered and would merely dilute the effort at hand to evaluate the comparative impacts of alternatives for setting radiological criteria (481, 482, 490, 1284, 1438, 1440, 1442). However, other commenters opposed the elimination (491, 493, 1084, 1177, 1428) for reasons which included a potential for substantial environmental and cost penalties incurred by delays.

Two commenters stated that there is no need to rush decommissioning (322, 741).

One commenter recommended that the NRC reconsider its preferred choice of decommissioning options, e.g., DECON, SAFSTOR, and ENTOMB which have different timing impacts and costs (730).

E.5.3 Continued Liability for Facilities

Commenters urged the NRC to consider liability in the GEIS and stated that liability should remain with generators of wastes for as long as they need to be managed, i.e., over the lifetime of the waste regardless of where the material is located (99, 287, 301, 359, 398, 495, 594, 595, 936, 1066, 1355, 1404, 1405, 1452, 1453, 1486, 1535). Clarifying comments included:

Consider non-fatal as well as fatal cancers among the risks to be considered, and consider who will be liable for costs of "future damages or illness or whatever" (301).

The generic standard needs to allow for site-specific considerations, including financial compensation by the industry to the community (488).

The GEIS should consider ways to hold the licensee responsible for the costs of the waste and contamination as a part of the licensing process (495).

Liability should extend to locations where the licensee sends radioactive waste material for treatment, storage, or disposal (594).

Alternatives should include the indefinite extension of licenses and liabilities. Sites would be decommissioned, but licensees would continue to hold a possession-only type license and continue to be held financially liable for damages. This alternative would be close to the present regulatory approach for toxic chemicals. All parties responsible for toxic waste disposal, that is, present and past landowners, operators and waste generators, continue to be responsible for clean-up, as if all these parties were licensed (1355).

E.5.4 Recycle

Several commenters want the GEIS to cover the recycle of wastes and contaminated material, i.e., criteria for release of contaminated equipment, components, piping, and other similar materials (167, 494, 860, 862, 1064, 1295, 1441). A recommendation was made to include a regulatory requirement for the licensee to state clearly how it proposed to safely dispose of all contaminated waste streams (1062). Another commenter recommended a review of impacts of deliberate intrusion into waste storage facilities for raw material (355). One commenter implied that short-lived wastes could be held on site and handled separately (1411).

E.5.5 Accidents

One commenter urged the NRC to set an overall limit of 100 mrem/yr total effective dose equivalent (TEDE) to any member of the public regardless of the pathway of exposure for above background levels from all man-made sources (1034). Another commenter addressed the need for training of medical and other personnel for adequate response to radiological accidents (625).

E.5.6 Monitoring

One commenter stated that it is imperative that before any monitoring begins, citizens groups and the NRC analyze all possible pathways for radiation to have escaped over the life of the facility (638). Another recommended that the NRC ensure adequate monitoring before, during, and after decommissioning (843). One commenter recommended occasional spot monitoring even after clean up to make sure that nothing has been missed or brought back onto the property. There should be a period of years between the end of clean up and any new use of the property in order that post-clean-up monitoring can occur (1594).

One commenter recommended independent epidemiological studies of people living near facilities and ecosystems (605). Another commenter wanted monitoring for radon in wells before starting decommissioning (273).

E.5.7 Hazardous Wastes, Mixed Wastes, Other Agency Regs., Radium

One commenter stated that the GEIS as presently scoped erroneously omits consideration of non-radioactive hazardous pollutants, and is thus not capable of providing an accurate or meaningful evaluation of the costs and benefits of decommissioning (1529). The presence of nonradioactive chemical contaminants at NRC-licensed facilities may exacerbate the risks posed by radioactive contaminants. Non-radioactive chemical contaminants also sometimes involve non-cancer risks, which need to be taken into account (1044). One commenter stated that it is very important for the NRC and the EPA to coordinate their regulatory requirements for mixed wastes;

it is critical for this proposal (1616). Another commenter wanted planning for decommissioning to include the management and disposition of the very substantial amounts of nonhazardous solid waste (mostly construction and demolition wastes), and any mixed hazardous wastes resulting from the dismantling of NRC-licensed facilities. This planning should cover both off-site and on-site waste management and disposal considerations, to include technical capability and capacity (1412). Other related comments were:

Because of the clear application of state and local law after a site is released from NRC regulatory control, each of the alternatives discussed in the GEIS should be evaluated to prevent the creation of impediments to the application and enforcement of state and local regulation (1318).

Once nonhazardous solid waste materials pass out of the Commission's nuclear regulatory management, they will be managed under the Resource Conservation and Recovery Act (RCRA) and applicable State solid waste laws and regulations, to include any special management requirements considered appropriate due to their former or current radiological content (854).

The combined hazardous and nuclear mixed wastes which will result from decommissioning must be handled within the national hazardous waste management system (i.e., RCRA Subtitle C), and this rulemaking should make that restriction absolutely clear (856).

One commenter encouraged including in the GEIS discussion of the establishment of separate radiological criteria for radon and radium as important to the soil contamination issue for fuel-cycle facilities (133). Another commenter recommended that the GEIS distinguish between man-made radionuclides and naturally occurring radionuclides (1045).

E.6 GEIS VERSUS SITE SPECIFIC EIS; SITE-SPECIFIC FLEXIBILITY

Most commenters indicated a need for a generic EIS (2, 462, 513, 515, 607) but they wanted a process to determine site specific criteria (7, 90, 130, 139, 166, 169, 211, 217, 254, 441, 462, 874, 900, 1032, 1041, 1092, 1118, 1444, 1469, 8905); or they wanted requirements for licensees to perform a site specific EIS (43, 45, 48, 50, 172, 306, 348, 705, 707, 771, 903, 1116, 1124, 1126, 1129, 1222, 1275, 1278, 1293, 1444, 1549, 1555).

One commenter stated that just the larger facilities should require a separate EIS for each major decommissioning project (306).

Two commenters stated that the site-specific EIS should allow for the application of clean-up requirements which may be more restrictive than those that might be in the GEIS (45, 1118).

Two commenters disagreed with the NRC's intent to use the GEIS in order to eliminate from consideration in the site-specific decommissioning EIS those issues that have been addressed in the GEIS (48, 54). Another commenter disagreed with them but added that the purpose of the GEIS is to assess the overall total impacts of decommissioning all nuclear facilities; while the purpose of the site-specific EIS is to address impacts associated with a single site and those at other affected locations and times (709). Another commenter stated that none of the issues proposed to be eliminated due to prior analysis should be omitted from the GEIS, nor from subsequent licensee-specific EIS (1167).

Two commenters stated that the concept of a GEIS was unacceptable, unscientific, defeating the function of an EIS, or threatening to the public health and safety (972, 1062). One commenter felt it inappropriate to exclude issues in site-specific proceedings because they were deemed "resolved" by a GEIS (1264). Another

stated that because each plant decommissioning is unique in its nuclear process, geographical location, and the degree of contamination, it seems apparent that all decommissioning regulations must be set up on a case by case basis (903).

One commenter stated that mechanisms for ensuring compliance with land use restrictions need not be considered in detail in the GEIS because many of them would not be applicable to specific sites (1206).

One commenter recommended that the GEIS should discuss how the National Environmental Policy Act will be applied to individual decommissioning actions if the proposed rule is adopted (1429).

E.7 CITIZEN PARTICIPATION

Several commenters noted that interactive public participation is important to the process of NRC rule making and that the GEIS should consider involving local citizens in approving licensing and decommissioning plans (101, 177, 218, 326, 363, 365, 409, 477, 521, 531, 749, 829, 846, 901, 1029, 1265, 8856).

Commenters further noted that risks are different at each site (524), and that the GEIS should have a mechanism for local public involvement in risk assessments (958, 1449). Two commenters stated that local communities should have the power and authority to decide how a site and facility are dealt with (779, 1445, 1447), while another desired that only local citizens who live near the site be afforded this participation and exclude outsiders (911). The various comments made regarding local concerns also included:

The rule should require that all communities along transportation routes for radioactive materials be informed of the potential hazards and emergency procedures (196, 224).

Consider total cancer risks, radiological and chemical, associated with decommissioning, and consider some community "right-to-know" actions if decommissioned facilities pose a lifetime cancer risk greater than 10 to the minus five -- similar to the manner in which California state laws have risk-based "triggers" that require public notice (346, 949).

Workers and families of workers involved in decommissioning of a facility should be informed of the long-term health effects of radiation (198).

There were several comments made encouraging the involvement of local public groups participating in establishing site specific background criteria (171, 280, 352, 423, 433), although two commenters wanted to pursue the use of scientific experts in this matter (350, 433). Another commenter stated that the GEIS should include consulting with physicians (530).

Other commenters also stated that too much attention is given to people with little or no scientific background (280, 295). Another desired that scientists review the GEIS for lay people who may not understand all of the considerations (512, 529). One questioned if it is reasonable to ask citizens to discuss highly technical things (617). A different view point was made in suggesting that provisions for continual public reviews of scientific literature should be part of the new rules (551).

Several commenters stated that the GEIS should provide a mechanism for funding of local citizen groups for evaluating plans and monitoring of decommissioning (101, 845, 1029, 1076, 1304). Another commenter supported the need for funding in that local groups must hire their own technical experts (637).

One commenter requested provisions for citizen groups to register a complaint or concern to the NRC (522).

Several commenters stated that citizen participation would be facilitated through better education of the public (179, 228, 395).

Two commenters requested that the NRC provide for full opportunity for public comment and hearings (1225, 1327, 1448). Others advocated that more efforts should be made to get more involved and questioned if there were enough meetings (186, 471, 930). More advertising through television was recommended (523). Three commenters requested the comment period be extended (511, 525, 1323).

Comments were made which implied that public trust and less misunderstanding must be developed by the NRC:

One commenter considered the meetings a sham and inappropriate (518).

Other commenters implied that potential attendees are concerned about the value of the meetings and if their attendance would be productive (218, 206, 249).

Another wanted the meetings in the vicinity of each facility (520).

One commenter desired a clearer presentation of issues (more readable by the general public (526).

Another commenter was suspicious that the previously held workshops are not part of the scoping process and stated that the enhanced participatory rulemaking is another manipulation of public trust (932). One commenter asked and received confirmation that both the scoping materials and the results of the workshops will be part of the NRC's decision record for the rulemaking. Commenter then requested that her oral comments at the Philadelphia workshop and her subsequent written comments be incorporated into the scoping process (44).

One commenter stated that carefully documenting practical limits of measurability and compliance demonstration in the GEIS will be important for gaining public acceptance of realistic protective site cleanup standards (1175).

A question was raised as to how the GEIS should discuss the National Environmental Policy Act and how it will be applied to individual decommissioning actions if the proposed rule is adopted (975). Other commenters questioned how the GEIS will interact with EPA requirements (444) and if requirements for local groups would parallel EPA models (270, 277, 302).

E.8 WASTE MINIMIZATION

Many commenters recommended that the NRC should discourage or stop those nuclear operations which generate nuclear wastes (98, 205, 223, 247, 275, 286, 294, 394, 470, 529, 766, 785, 872, 938, 978, 1058, 1170, 1216, 1283, 1454).

One commenter hoped that the NRC would require complete decontamination and minimization of wastes that are generated in the clean-up (1205). Another cautioned that decommissioning of a power plant will produce four times more radioactive wastes than the entire operating years, yet we don't know how to deal with the waste (626).

Two commenters expressed concern regarding the lack of permanent sites for storing radioactive wastes (294, 833). Commenters suggested: nobody wants the wastes in their backyard (636) and that it is foolish to contaminate new sites with waste (294).

The GEIS must include restrictions on licensing new facilities or extending licenses on existing facilities that cannot comply with the decommissioning criteria to be established (1216). A commenter stated that utilities that built nuclear power plants should have already had the means of taking care of the waste before they were allowed to build the plant (636).

One commenter recommended that the NRC should ensure adequate monitoring before, during, and after decommissioning and ensure that wastes removed from the site are taken to approved facilities, and that during clean up the guidelines of "zero release of radiation" is followed (844). Another cautioned that transportation will lead to accidents and highway contamination (294).

Specific recommendations were made by one commenter. Reclassify low-level radioactive waste on the strict basis of half-life, and deal separately with long-lived and short-lived radionuclides in minimizing and disposing of waste. Alternative waste minimization solutions such as on-site storage for decay should be used by medical institutions and others using short-lived materials (645).

One commenter questioned the NRC's policy of not requiring the licensee to conduct additional cleanup in response to NRC criteria or standards established after NRC approved of the (new) plan, and to remove hazards to human health unless the NRC decides they are "significant" (1371).

COMMENT REFERENCES

This section is a reference which relates each comment to its origin. The listed information includes a comment number, the name of the commenter, the meeting at which the comment was made or the docket number of the letter containing the comment, and data for referencing a particular page, line or paragraph. Following is an explanation of the listed information.

The comment number is unique to a single comment made within an issue. If the same comment also applies to another issue code, another number is assigned for use within that other issue code.

The name of the commenter is listed as the last name or if an organization, the full or abbreviated name.

Comments from meetings are identified as DC1 or 2, CA1 or 2, OK1 or 2, and OH1 or 2 which correspond to Washington, D.C., San Francisco, CA, Oklahoma City, OK, and Cleveland, OH.; respectively. The number 1 or 2 refer to a day time or evening meeting. The next group of numbers identifies the page of the manuscript of the workshop that the comment begins on. The next set of numbers gives the line number that the comment begins on. An illustrative example follows:

{Comment #}	{Name}	{ Meeting}	{Page #}	{ Line #}
1	ROYAL	OK2	125	7

Identification of comments from docketed letters² are similarly identified but begin at comment number 700 and the beginning paragraph number is listed instead of a line number. An illustrative example follows:

{ Comment #}	{Name}	{ Docket #}	{Page #}	{Paragraph #}
7659	BLACK	40	1	1

The following pages contain a column listing of Comment Number, Commenter's Name, Workshop and/or Docket Number, Page Number, Paragraph Number, or Line Number.

²The letter received from the US Department of Energy was assigned number 99 as it was not formally docketed at manuscript completion.

Appendix E

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1	DAM	DC1	31	3
2	DAM	DC1	31	4
3	DAM	DC1	31	6
4	DAM	DC1	31	6
5	DAM	DC1	31	7
6	DAM	DC1	31	10
7	DAM	DC1	31	13
8	DAM	DC1	31	17
9	DAM	DC1	32	2
10	DAM	DC1	32	3
11	DAM	DC1	32	4
12	DAM	DC1	32	7
13	DAM	DC1	32	17
14	DAM	DC1	32	19
15	DAM	DC1	33	3
17	HENDRICKS	DC1	34	4
18	HENDRICKS	DC1	34	5
19	HENDRICKS	DC1	34	17
20	HENDRICKS	DC1	35	5
21	HENDRICKS	DC1	35	14
22	HENDRICKS	DC1	35	19
23	HENDRICKS	DC1	35	19
24	HENDRICKS	DC1	36	5
25	HENDRICKS	DC1	36	11
26	HENDRICKS	DC1	37	2
28	HENDRICKS	DC1	36	20
29	HENDRICKS	DC1	37	8
30	HENDRICKS	DC1	37	8
31	HENDRICKS	DC1	37	22
32	HENDRICKS	DC1	37	22
33	HENDRICKS	DC1	38	16
34	HENDRICKS	DC1	39	6
35	HENDRICKS	DC1	39	11
36	HENDRICKS	DC1	39	13
37	HENDRICKS	DC1	39	16
38	JOHNSRUD	DC1	40	23
39	JOHNSRUD	DC1	41	5
40	JOHNSRUD	DC1	42	3
41	JOHNSRUD	DC1	42	11
42	JOHNSRUD	DC1	42	23
43	JOHNSRUD	DC1	43	9
44	JOHNSRUD	DC1	44	10
45	JOHNSRUD	DC1	44	14
46	JOHNSRUD	DC1	44	14
47	JOHNSRUD	DC1	44	21
48	JOHNSRUD	DC1	45	12
49	JOHNSRUD	DC1	45	12
50	JOHNSRUD	DC1	46	14
51	JOHNSRUD	DC1	46	14
52	JOHNSRUD	DC1	46	14
53	JOHNSRUD	DC1	47	9
54	JOHNSRUD	DC1	47	17
55	JOHNSRUD	DC1	47	17
56	JOHNSRUD	DC1	48	2
57	JOHNSRUD	DC1	48	15
58	JOHNSRUD	DC1	49	6
59	JOHNSRUD	DC1	49	6
60	JOHNSRUD	DC1	49	6
61	JOHNSRUD	DC1	49	6
62	JOHNSRUD	DC1	50	10

63	JOHNSRUD	DC1	50	14
64	HENDRICKS	DC1	51	10
65	LITTLEFIELD	DC1	54	7
66	LITTLEFIELD	DC1	54	7
67	JOHNSRUD	DC1	55	2
68	JOHNSON	DC2	25	10
69	JOHNSON	DC2	25	14
70	JOHNSON	DC2	25	18
71	JOHNSON	DC2	26	1
72	JOHNSON	DC2	26	6
73	JOHNSON	DC2	26	11
74	JOHNSON	DC2	26	11
75	JOHNSON	DC2	27	19
76	JOHNSON	DC2	27	19
77	JOHNSON	DC2	28	3
78	JOHNSON	DC2	28	3
79	NELSON	DC2	28	19
80	NELSON	DC2	29	1
81	NELSON	DC2	29	7
82	NELSON	DC2	29	10
83	NELSON	DC2	29	18
84	NELSON	DC2	30	5
85	NELSON	DC2	30	5
86	NELSON	DC2	30	20
87	NELSON	DC2	31	6
88	NELSON	DC2	31	13
89	LATSON	DC2	34	9
90	D'ARRIGO	DC2	34	23
91	D'ARRIGO	DC2	34	23
92	D'ARRIGO	DC2	35	4
93	D'ARRIGO	DC2	35	7
94	D'ARRIGO	DC2	35	14
95	D'ARRIGO	DC2	35	14
96	D'ARRIGO	DC2	35	24
98	D'ARRIGO	DC2	37	2
99	D'ARRIGO	DC2	37	18
100	D'ARRIGO	DC2	38	6
101	D'ARRIGO	DC2	38	13
102	D'ARRIGO	DC2	38	20
103	D'ARRIGO	DC2	38	13
104	D'ARRIGO	DC2	38	18
105	NELSON	DC2	40	18
106	NELSON	DC2	41	20
107	OLSON	DC2	42	6
109	OLSON	DC2	42	22
110	OLSON	DC2	43	21
111	OLSON	DC2	44	3
112	OLSON	DC2	44	3
114	MCLAIN	OK1	23	6
115	MCLAIN	OK1	23	7
116	MCLAIN	OK1	23	7
117	STILL	OK1	25	15
118	STILL	OK1	25	15
119	STILL	OK1	24	20
120	STILL	OK1	25	2
122	STILL	OK1	27	7
123	STILL	OK1	27	7
124	STILL	OK1	28	1
125	STILL	OK1	28	10
126	STILL	OK1	29	2

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127	STILL	OK1	30	12
128	STILL	OK1	30	13
129	STILL	OK1	30	15
130	STILL	OK1	30	17
132	STILL	OK1	30	18
133	STILL	OK1	30	25
134	STILL	OK1	31	4
136	STILL	OK1	31	10
137	STILL	OK1	31	11
138	STILL	OK1	31	7
139	CUDDY	OK1	32	2
141	CUDDY	OK1	33	6
142	CUDDY	OK1	33	6
145	CUDDY	OK1	34	3
147	GARDNER	OK1	35	9
148	MEDLEY	OK2	25	23
149	MEDLEY	OK2	32	16
150	GARDNER	OK1	38	21
151	MEDLEY	OK2	42	3
152	SINCLAIR	OK2	43	23
153	SINCLAIR	OK2	43	23
154	SINCLAIR	OK2	43	20
155	GARDNER	OK1	40	4
156	SINCLAIR	OK2	43	21
157	SINCLAIR	OK2	43	22
158	GARDNER	OK1	40	7
159	GARDNER	OK1	40	11
161	SINCLAIR	OK2	46	5
162	GARDNER	OK1	40	19
164	BARFIELD	OK2	47	18
165	BARFIELD	OK2	47	18
166	GARDNER	OK1	41	18
167	SINCLAIR	OK2	46	12
168	SINCLAIR	OK2	46	12
169	GARDNER	OK1	41	21
170	GARDNER	OK1	41	21
171	CUDDY	OK2	49	16
172	CUDDY	OK2	49	16
173	CUDDY	OK2	50	3
174	CUDDY	OK2	50	16
175	BELISLE	OK1	42	17
176	CUDDY	OK2	50	25
177	CUDDY	OK2	52	10
178	BELISLE	OK1	43	3
179	CUDDY	OK2	52	20
180	CUDDY	OK2	54	10
181	CUDDY	OK2	54	10
182	BELISLE	OK1	43	3
183	BELISLE	OK1	43	15
184	BELISLE	OK2	55	18
185	BELISLE	OK1	43	20
186	BARFIELD	OK1	44	14
187	BARTON	OK2	58	22
188	BARFIELD	OK1	45	9
189	BARTON	OK2	61	3
190	BARTON	OK2	62	18
191	BARTON	OK2	65	5
192	BARTON	OK2	68	12
193	BARFIELD	OK1	45	14
194	BARTON	OK2	73	24

195	BARFIELD	OK1	45	16
196	BARTON	OK2	72	19
197	BARTON	OK2	72	19
198	BARTON	OK2	74	23
199	BARFIELD	OK1	46	1
200	BARFIELD	OK1	46	10
201	BARTON	OK2	78	14
202	BARTON	OK2	78	4
203	BARFIELD	OK1	46	24
204	BARTON	OK2	80	19
205	BARFIELD	OK1	47	6
206	NEUMANN	OK2	81	23
207	NEUMANN	OK2	82	18
208	NEWMANN	OK1	47	16
209	NEWMANN	OK1	47	6
210	GEARY	OK2	84	5
211	NEWMANN	OK1	48	9
212	NEWMANN	OK1	48	19
213	GEARY	OK2	84	8
214	GEARY	OK2	84	8
215	GEARY	OK2	84	16
216	NEWMANN	OK1	48	24
217	GEARY	OK2	86	7
218	GEARY	OK2	86	15
220	NEWMANN	OK1	49	7
221	NEWMANN	OK1	49	9
222	GEARY	OK2	88	23
223	GEARY	OK2	90	5
224	NEWMANN	OK1	49	12
225	DICKERSON	OK2	91	12
226	CARPENTER	OK2	103	22
227	BARTON	OK1	50	21
228	LORZ	OH2	21	2
229	LORZ	OH2	21	2
230	LORZ	OH2	21	2
231	LORZ	OH2	21	24
232	LORZ	OH2	24	10
233	LORZ	OH2	23	1
234	LORZ	OH2	22	14
235	LORZ	OH2	23	7
236	LORZ	OH2	23	24
237	LORZ	OH2	24	5
238	LORZ	OH2	24	5
239	LORZ	OH2	24	14
240	LORZ	OH2	24	14
241	LORZ	OH2	25	4
242	LORZ	OH2	25	8
243	LORZ	OH2	25	19
244	LORZ	OH2	25	19
245	LORZ	OH2	26	4
246	LORZ	OH2	26	10
247	LORZ	OH2	27	14
248	LORZ	OH2	27	21
249	DAVIS	OH2	28	8
250	ELLISON	OH2	30	25
251	ELLISON	OH2	31	17
252	ELLISON	OH2	33	1
253	ELLISON	OH2	33	1
254	ELLISON	OH2	33	8
255	DAVIS	OH2	34	4

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256	DAVIS	OH2	34	10	319	DAVENPORT	CA1	32	13
257	DAVIS	OH2	34	13	320	DAVENPORT	CA1	32	13
258	DAVIS	OH2	34	13	321	DAVENPORT	CA1	33	24
259	DAVIS	OH2	34	21	322	DAVENPORT	CA1	35	1
260	AVENI	OH2	36	15	323	LUCHION	CA1	37	3
262	HANNAH	OH2	40	8	324	LUCHION	CA1	37	8
263	HANNAH	OH2	40	21	325	LUCHION	CA1	37	10
264	HANNAH	OH2	40	21	326	LUCHION	CA1	37	22
265	LORZ	OH2	41	22	327	FULLER	CA1	39	18
266	NELSON	DC2	30	1	328	FULLER	CA1	39	20
267	NELSON	DC2	30	1	329	FULLER	CA1	39	20
268	BARTON	OK1	51	6	330	FULLER	CA1	39	23
269	BARTON	OK1	51	6	331	FULLER	CA1	40	1
270	BARTON	OK1	52	10	332	FULLER	CA1	40	5
271	BARTON	OK1	54	14	333	FULLER	CA1	40	12
272	BARTON	OK1	56	14	334	FULLER	CA1	40	22
273	BARTON	OK1	56	22	335	FULLER	CA1	40	24
274	BARTON	OK1	57	1	336	FULLER	CA1	40	24
275	BARTON	OK1	57	20	337	FULLER	CA1	41	2
276	BARTON	OK1	60	7	338	FULLER	CA1	41	9
277	BARTON	OK1	60	10	339	FULLER	CA1	41	13
278	NIPPER	OK1	63	17	340	FULLER	CA1	41	19
279	NIPPER	OK1	64	10	341	FULLER	CA1	41	20
280	GEARY	OK1	65	14	342	FULLER	CA1	41	22
281	GEARY	OK1	65	17	343	McLAY	CA1	42	17
282	GEARY	OK1	65	21	344	McLAY	CA1	42	22
283	GEARY	OK1	65	23	345	McLAY	CA1	43	1
284	GEARY	OK1	66	7	346	McLAY	CA1	43	4
285	GEARY	OK1	66	18	347	McLAY	CA1	43	19
286	GEARY	OK1	66	21	348	YOUNG	CA1	45	3
287	GEARY	OK1	67	3	349	YOUNG	CA1	45	5
288	GEARY	OK1	68	10	350	YOUNG	CA1	45	9
289	DICKERSON	OK1	70	1	351	YOUNG	CA1	45	13
291	DICKERSON	OK1	70	18	352	YOUNG	CA1	45	20
292	DICKERSON	OK1	71	2	353	YOUNG	CA1	45	22
293	DICKERSON	OK1	71	20	354	YOUNG	CA1	45	23
294	DICKERSON	OK1	72	12	355	YOUNG	CA1	45	24
295	ELLIS	OK1	74	25	356	YOUNG	CA1	46	2
296	ELLIS	OK1	76	2	357	YOUNG	CA1	45	24
297	ELLIS	OK1	76	19	358	YOUNG	CA1	46	6
298	GOLTEIN	CA1	20	11	359	YOUNG	CA1	46	15
299	GOLTEIN	CA1	20	17	360	YOUNG	CA1	46	15
300	GOLTEIN	CA1	21	9	361	YOUNG	CA1	46	21
301	GOLTEIN	CA1	21	14	362	YOUNG	CA1	46	21
302	GOLTEIN	CA1	21	18	363	HITZ	CA1	48	19
303	GOLTEIN	CA1	22	18	364	HITZ	CA1	49	11
304	GOLTEIN	CA1	23	4	365	HITZ	CA1	49	21
305	GOLTEIN	CA1	23	4	366	HITZ	CA1	49	25
306	GOLTEIN	CA1	23	10	367	HITZ	CA1	50	3
307	DAVENPORT	CA1	25	13	368	HITZ	CA1	50	8
308	DAVENPORT	CA1	26	5	369	HITZ	CA1	50	8
310	DAVENPORT	CA1	27	14	370	HITZ	CA1	50	13
311	DAVENPORT	CA1	27	15	371	HITZ	CA1	50	19
312	DAVENPORT	CA1	27	22	372	HITZ	CA1	50	22
313	DAVENPORT	CA1	27	22	373	HITZ	CA1	50	19
314	DAVENPORT	CA1	27	22	374	HITZ	CA1	51	7
315	DAVENPORT	CA1	28	3	375	KLASKY	CA1	52	8
316	DAVENPORT	CA1	28	12	376	KLASKY	CA1	52	24
317	DAVENPORT	CA1	29	14	377	KLASKY	CA1	52	25
318	DAVENPORT	CA1	30	4	378	KLASKY	CA1	53	4

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379	KLASKY	CA1	53	4	440	KELLEY	CA2	35	14	
380	KLASKY	CA1	53	14	441	KELLEY	CA2	35	18	
381	KLASKY	CA1	53	18	442	KELLEY	CA2	36	13	
382	KLASKY	CA1	53	20	443	EICHELBERGER	CA2	38	21	
383	KLASKY	CA1	53	23	444	EICHELBERGER	CA2	39	16	
384	KLASKY	CA1	54	9	445	EICHELBERGER	CA2	39	20	
385	KLASKY	CA1	57	1	446	EICHELBERGER	CA2	39	23	
386	KLASKY	CA1	58	2	447	KELLEY	CA2	40	8	
387	KLASKY	CA1	58	21	448	WARREN	OH1	23	24	
388	KLASKY	CA1	59	4	449	WARREN	OH1	24	11	
389	KLASKY	CA1	59	5	450	WARREN	OH1	24	18	
390	KLASKY	CA1	59	8	451	WARREN	OH1	24	18	
391	KLASKY	CA1	59	10	452	WARREN	OH1	24	18	
393	KLASKY	CA1	60	1	453	WARREN	OH1	25	6	
394	KLASKY	CA1	60	3	454	WARREN	OH1	25	6	
395	KLASKY	CA1	60	9	455	WARREN	OH1	25	6	
396	KLASKY	CA1	61	22	456	WARREN	OH1	25	11	
397	DAKE	CA1	63	11	457	BLOCK	OH1	28	25	
398	DAKE	CA1	63	17	458	BLOCK	OH1	28	5	
399	DAKE	CA1	63	24	459	BLOCK	OH1	27	14	
400	STRAUSS	CA2	14	17	460	BLOCK	OH1	28	15	
401	STRAUSS	CA2	14	22	461	BLOCK	OH1	27	4	
402	STRAUSS	CA2	14	22	462	BLOCK	OH1	29	8	
403	STRAUSS	CA2	15	7	463	BLOCK	OH1	29	8	
404	STRAUSS	CA2	15	9	464	WEATHERINGTON-RICE	OH1	30	14	
405	STRAUSS	CA2	15	10	465	WEATHERINGTON-RICE	OH1	30	3	
406	STRAUSS	CA2	15	23	466	GANIS	OH1	31	19	
407	STRAUSS	CA2	17	6	467	GANIS	OH1	32	21	
408	CABASSO	CA2	18	13	468	GANIS	OH1	38	16	
409	CABASSO	CA2	18	22	469	PERERA	OH1	44	10	
410	CABASSO	CA2	18	22	470	PERERA	OH1	45	2	
411	CABASSO	CA2	20	21	471	PERERA	OH1	45	3	
412	CABASSO	CA2	21	5	472	COOK	OH1	45	23	
413	CABASSO	CA2	21	7	473	COOK	OH1	48	3	
414	CABASSO	CA2	21	9	474	COOK	OH1	48	5	
415	CABASSO	CA2	21	18	475	McKENNA	OH1	49	9	
416	CABASSO	CA2	21	24	476	McKENNA	OH1	49	18	
417	CABASSO	CA2	22	20	477	McKENNA	OH1	50	2	
418	CABASSO	CA2	22	25	478	McKENNA	OH1	50	7	
419	CABASSO	CA2	23	2	479	McKENNA	OH1	50	9	
420	CABASSO	CA2	23	2	480	ENERGY RESEARCH		1	0	
421	CABASSO	CA2	23	17	481	DAM	DC1	32	17	
422	CABASSO	CA2	23	18	482	HENDRICKS	DC1	34	17	
423	CABASSO	CA2	23	14	483	JOHNSRUD	DC1	42	3	
424	CABASSO	CA2	23	21	484	OLSON	DC2	42	12	
425	CABASSO	CA2	25	5	485	GRESALFI	DC2	44	15	
426	CABASSO	CA2	25	13	486	SINCLAIR	OK2	46	5	
427	CABASSO	CA2	27	6	487	BARFIELD	OK2	47	18	
428	CABASSO	CA2	28	11	488	GEARY	OK2	86	7	
429	KELLEY	CA2	30	17	489	BARTON	OK1	51	6	
430	KELLEY	CA2	30	19	490	FULLER	CA1	41	9	
431	KELLEY	CA2	30	24	491	STRAUSS	CA2	15	23	
432	KELLEY	CA2	31	1	492	STRAUSS	CA2	15	23	
433	KELLEY	CA2	31	3	493	CABASSO	CA2	25	13	
434	KELLEY	CA2	31	6	494	CABASSO	CA2	25	13	
435	KELLEY	CA2	31	17	495	KELLEY	CA2	31	25	
436	KELLEY	CA2	31	25	496	GOLTEIN	CA1	21	14	
437	KELLEY	CA2	32	4	497	YOUNG	CA1	45	3	
438	KELLEY	CA2	33	3	498	KLASKY	CA1	53	20	
439	KELLEY	CA2	34	6	499	D'ARRIGO	DC2	36	18	

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500	LORZ	OH2	25	4	560	HENDRICKS	DC1	37	8
501	GEARY	OK1	67	3	561	HENDRICKS	DC1	38	16
502	GEARY	OK1	67	3	562	JOHNSON	DC2	27	19
503	GEARY	OK1	67	3	563	CUDDY	OK2	54	10
504	GEARY	OK1	67	3	564	DAVIS	OH2	34	4
505	DAVENPORT	CA1	26	5	565	NELSON	DC2	30	1
506	KLASKY	CA1	53	18	566	FULLER	CA1	41	19
507	KLASKY	CA1	59	8	567	FULLER	CA1	41	19
508	KELLEY	CA2	30	17	568	FULLER	CA1	41	19
509	DAVENPORT	CA1	33	24	569	KLASKY	CA1	57	1
510	KELLEY	CA2	30	19	570	KLASKY	CA1	57	1
511	D'ARRIGO	DC2	35	4	571	STRAUSS	CA2	15	9
512	BARTON	OK1	50	21	572	STRAUSS	CA2	15	9
513	BARTON	OK1	60	7	573	HENDRICKS	DC1	34	5
514	JOHNSRUD	DC1	41	5	574	HENDRICKS	DC1	35	19
515	JOHNSRUD	DC1	44	10	575	HENDRICKS	DC1	35	19
516	D'ARRIGO	DC2	35	7	576	HENDRICKS	DC1	35	19
517	CUDDY	OK1	34	3	577	JOHNSRUD	DC1	42	11
518	GARDNER	OK1	35	9	578	JOHNSON	DC2	26	6
519	BELISLE	OK1	42	17	579	JOHNSON	DC2	26	6
520	BARFIELD	OK1	44	14	580	JOHNSON	DC2	26	6
521	BARFIELD	OK1	45	9	581	CUDDY	OK2	50	25
522	BARTON	OK2	68	12	582	NEWMANN	OK1	48	24
523	BARTON	OK2	80	19	583	FULLER	CA1	41	22
524	NEWMANN	OK1	48	19	584	McLAY	CA1	43	1
525	AVENI	OH2	36	15	585	McLAY	CA1	43	1
526	HANNAH	OH2	40	21	586	HITZ	CA1	50	22
527	McLAY	CA1	43	4	587	STRAUSS	CA2	15	17
528	McLAY	CA1	43	4	588	CABASSO	CA2	21	7
529	ELLIS	OK1	76	19	589	CABASSO	CA2	21	7
530	CARPENTER	OK2	103	22	590	HENDRICKS	DC1	36	20
531	DAVIS	OH2	34	21	591	GEARY	OK2	88	23
532	LORZ	OH2	24	14	592	ELLIS	OK1	76	2
533	DAVENPORT	CA1	27	22	593	ELLIS	OK1	76	2
534	DAVENPORT	CA1	27	22	594	JOHNSRUD	DC1	50	10
535	DAVENPORT	CA1	27	22	595	BARFIELD	OK1	45	16
536	HITZ	CA1	49	25	596	CABASSO	CA2	21	9
537	CABASSO	CA2	20	21	597	CABASSO	CA2	23	21
538	KELLEY	CA2	30	24	598	KELLEY	CA2	31	17
539	BLOCK	OH1	28	25	599	STILL	OK1	30	13
540	DAM	DC1	31	6	600	GEARY	OK1	65	23
541	HENDRICKS	DC1	36	11	601	DAVENPORT	CA1	28	3
542	JOHNSRUD	DC1	49	6	602	DAVENPORT	CA1	28	3
543	JOHNSON	DC2	25	14	603	KLASKY	CA1	53	4
544	MCLAIN	OK1	23	6	604	KLASKY	CA1	53	4
545	STILL	OK1	25	15	605	KLASKY	CA1	53	4
546	STILL	OK1	30	15	606	CUDDY	OK2	49	16
547	STILL	OK1	31	4	607	HANNAH	OH2	40	8
548	STILL	OK1	31	4	608	FULLER	CA1	39	20
549	FULLER	CA1	39	23	609	YOUNG	CA1	45	5
550	FULLER	CA1	39	23	610	CABASSO	CA2	23	18
551	CUDDY	OK2	54	10	611	HENDRICKS	DC1	35	5
552	HENDRICKS	DC1	39	6	612	NELSON	DC2	29	10
553	JOHNSRUD	DC1	49	6	613	SINCLAIR	OK2	43	20
554	D'ARRIGO	DC2	38	18	614	FULLER	CA1	40	12
555	CABASSO	CA2	23	17	615	COOK	OH1	48	5
556	DAM	DC1	31	7	616	DAM	DC1	32	19
557	MCLAIN	OK1	23	7	617	HENDRICKS	DC1	37	22
558	HITZ	CA1	50	13	618	HENDRICKS	DC1	39	16
559	DAM	DC1	33	3	619	JOHNSRUD	DC1	42	23

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620	JOHNSRUD	DC1	42	23	718	JOHNSRUD	2	5	0	
621	JOHNSRUD	DC1	50	14	719	JOHNSRUD	2	5	0	
622	JOHNSRUD	DC1	50	14	720	JOHNSRUD	2	6	0	
623	D'ARRIGO	DC2	38	6	721	JOHNSRUD	2	6	0	
624	OLSON	DC2	44	3	722	JOHNSRUD	2	6	0	
625	MEDLEY	OK2	32	16	723	JOHNSRUD	2	6	0	
626	GARDNER	OK1	38	21	724	JOHNSRUD	2	6	0	
627	MEDLEY	OK2	42	3	725	JOHNSRUD	2	6	0	
628	SINCLAIR	OK2	43	22	726	JOHNSRUD	2	6	0	
629	BARFIELD	OK2	47	18	727	JOHNSRUD	2	6	0	
630	CUDDY	OK2	50	16	728	JOHNSRUD	2	6	0	
631	BARFIELD	OK1	46	1	729	JOHNSRUD	2	6	0	
632	BARFIELD	OK1	46	1	730	STATE OF NEVADA	3	5	0	
633	NEWMANN	OK1	49	12	731	STATE OF NEVADA	3	5	0	
634	NEWMANN	OK1	49	12	732	STATE OF NEVADA	3	5	0	
635	NEWMANN	OK1	49	12	734	STATE OF NEVADA	3	8	0	
636	DICKERSON	OK1	70	1	735	STATE OF NEVADA	3	8	0	
637	DICKERSON	OK1	71	20	736	STATE OF NEVADA	3	8	0	
638	DICKERSON	OK1	71	20	739	STATE OF NEVADA	3	8	0	
639	DICKERSON	OK1	71	20	741	STATE OF NEVADA	3	7	0	
640	DAVENPORT	CA1	27	14	743	STATE OF NEVADA	3	9	0	
641	LUCHION	CA1	37	8	744	STATE OF NEVADA	3	9	0	
642	FULLER	CA1	41	13	745	STATE OF NEVADA	3	10	0	
643	FULLER	CA1	41	20	746	STATE OF NEVADA	3	10	0	
644	FULLER	CA1	41	20	747	STATE OF NEVADA	3	10	0	
645	HITZ	CA1	49	11	748	STATE OF NEVADA	3	10	0	
646	HITZ	CA1	50	19	749	HITZ	4	1	0	
647	KLASKY	CA1	52	8	750	HITZ	4	1	0	
648	KLASKY	CA1	52	8	751	HITZ	4	1	0	
649	KLASKY	CA1	59	4	752	HITZ	4	1	0	
650	KLASKY	CA1	59	10	753	HITZ	4	1	0	
651	KELLEY	CA2	31	6	755	HITZ	4	1	0	
652	KELLEY	CA2	40	8	756	HITZ	4	2	0	
653	WARREN	OH1	25	6	757	HITZ	4	2	0	
654	WEATHERINGTON-RICE	OH1	30	3	758	HITZ	4	2	0	
655	PERERA	OH1	44	10	759	HITZ	4	2	0	
656	BARFIELD	OK2	47	18	760	HITZ	4	2	0	
657	CABASSO	CA2	23	2	761	HITZ	4	2	0	
658	CABASSO	CA2	23	2	762	BIZZARRO	5	1	0	
659	CABASSO	CA2	23	2	763	BIZZARRO	5	1	0	
660	WARREN	OH1	24	18	764	KLINE	6	1	0	
661	BLOCK	OH1	27	14	765	KLINE	6	1	0	
700	CHEROKEE NATION		1	1	0	766	KLINE	6	1	0
701	JOHNSRUD		2	1	0	767	KLINE	6	1	0
702	JOHNSRUD		2	2	0	768	KLINE	6	1	0
703	JOHNSRUD		2	2	0	769	KLINE	6	1	0
704	JOHNSRUD		2	2	0	770	KLINE	6	2	0
705	JOHNSRUD		2	2	0	771	KLINE	6	2	0
706	JOHNSRUD		2	2	0	772	KLINE	6	2	0
707	JOHNSRUD		2	3	0	773	KLINE	6	2	0
708	JOHNSRUD		2	3	0	774	KLINE	6	2	0
709	JOHNSRUD		2	3	0	775	KLINE	6	2	0
710	JOHNSRUD		2	3	0	776	KLINE	6	2	0
711	JOHNSRUD		2	4	0	777	KLINE	6	2	0
712	JOHNSRUD		2	4	0	778	KLINE	6	2	0
713	JOHNSRUD		2	4	0	779	KLINE	6	3	0
714	JOHNSRUD		2	4	0	780	KLINE	6	2	0
715	JOHNSRUD		2	5	0	781	KLINE	6	2	0
716	JOHNSRUD		2	5	0	782	KLINE	6	2	0
717	JOHNSRUD		2	5	0	783	KLINE	6	2	0

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1054	AMERICAN MINING CONGRESS	34	9	0
1055	AMERICAN MINING CONGRESS	34	9	0
1056	AMERICAN MINING CONGRESS	34	9	0
1057	CLEVELAND MEETING	35	1	0
1058	CLEVELAND MEETING	35	1	0
1059	CLEVELAND MEETING	35	1	0
1060	IEER & NACE	54	3	0
1062	CLEVELAND MEETING	35	1	0
1063	CLEVELAND MEETING	35	1	0
1064	IEER & NACE	54	3	0
1065	IEER & NACE	54	3	0
1066	CLEVELAND MEETING	35	1	0
1067	WESTERN STATES LEGAL	36	1	0
1068	WESTERN STATES LEGAL	36	1	0
1069	WESTERN STATES LEGAL	36	1	0
1070	WESTERN STATES LEGAL	36	2	0
1071	WESTERN STATES LEGAL	36	2	0
1072	IEER & NACE	54	3	0
1073	WESTERN STATES LEGAL	36	2	0
1074	WESTERN STATES LEGAL	36	2	0
1075	IEER & NACE	54	4	0
1076	WESTERN STATES LEGAL	36	4	0
1077	WESTERN STATES LEGAL	36	4	0
1078	IEER & NACE	54	4	0
1079	IEER & NACE	54	4	0
1080	IEER & NACE	54	4	0
1081	TLG SERVICES, INC.	37	1	0
1082	TLG SERVICES, INC.	37	1	0
1083	TLG SERVICES, INC.	37	1	0
1084	IEER & NACE	54	4	0
1087	TLG SERVICES, INC.	37	4	0
1088	IEER & NACE	54	5	0
1089	IEER & NACE	54	5	0
1091	TLG SERVICES, INC.	37	4	0
1092	IEER & NACE	54	5	0
1093	IEER & NACE	54	6	0
1094	IEFR & NACE	54	6	0
1095	IEER & NACE	54	6	0
1096	IEER & NACE	54	6	0
1098	IEER & NACE	54	6	0
1099	TLG SERVICES, INC.	37	5	0
1100	IEER & NACE	54	7	0
1103	IEER & NACE	54	7	0
1105	IEER & NACE	54	7	0
1106	WOODARD	55	1	0
1107	NUMARC	38	2	0
1108	NUMARC	38	2	0
1109	NUMARC	38	2	0
1110	NUMARC	38	2	0
1111	JOHNSRUD	56	1	0
1112	JOHNSRUD	56	1	0
1113	NUMARC	38	2	0
1114	JOHNSRUD	56	1	0
1115	JOHNSRUD	56	1	0
1116	JOHNSRUD	56	2	0
1117	NUMARC	38	2	0
1118	JOHNSRUD	56	2	0
1121	NUMARC	38	2	0
1122	JOHNSRUD	56	2	0
1123	NUMARC	38	2	0

1124	JOHNSRUD	56	2	0
1125	NUMARC	38	2	0
1126	JOHNSRUD	56	3	0
1127	JOHNSRUD	56	3	0
1128	NUMARC	38	3	0
1129	JOHNSRUD	56	3	0
1130	NUMARC	38	3	0
1131	JOHNSRUD	56	3	0
1132	JOHNSRUD	56	3	0
1133	JOHNSRUD	56	4	0
1134	NUMARC	38	3	0
1135	JOHNSRUD	56	4	0
1137	JOHNSRUD	56	4	0
1138	JOHNSRUD	56	4	0
1139	JOHNSRUD	56	4	0
1140	JOHNSRUD	56	4	0
1141	JOHNSRUD	56	5	0
1142	JOHNSRUD	56	5	0
1143	JOHNSRUD	56	5	0
1144	JOHNSRUD	56	5	0
1145	JOHNSRUD	56	5	0
1146	JOHNSRUD	56	5	0
1147	JOHNSRUD	56	5	0
1148	JOHNSRUD	56	5	0
1149	JOHNSRUD	56	5	0
1150	JOHNSRUD	56	5	0
1151	NUMARC	38	3	0
1152	JOHNSRUD	56	5	0
1153	JOHNSRUD	56	6	0
1154	JOHNSRUD	56	6	0
1155	NUMARC	38	3	0
1156	NUMARC	38	3	0
1157	JOHNSRUD	56	6	0
1158	NUMARC	38	5	0
1160	NUMARC	38	5	0
1161	JOHNSRUD	56	6	0
1162	JOHNSRUD	56	6	0
1163	NUMARC	38	5	0
1164	NUMARC	38	5	0
1165	NUMARC	38	5	0
1166	NUMARC	38	3	0
1167	JOHNSRUD	56	6	0
1168	JOHNSRUD	56	6	0
1169	JOHNSRUD	56	6	0
1170	JOHNSRUD	56	6	0
1171	JOHNSRUD	56	7	0
1174	NUMARC	38	7	0
1176	NUMARC	38	7	0
1177	JOHNSRUD	56	7	0
1178	NUMARC	38	7	0
1179	NUMARC	38	7	0
1180	JOHNSRUD	56	7	0
1181	JOHNSRUD	56	7	0
1182	JOHNSRUD	56	7	0
1187	JOHNSRUD	56	7	0
1188	NUMARC	38	8	0
1189	JOHNSRUD	56	7	0
1191	JOHNSRUD	56	8	0
1192	JOHNSRUD	56	8	0
1193	NUMARC	38	8	0

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1194	NUMARC	38	8	0	1259	COMMONWEALTH EDISON	41	4	0
1195	JOHNSRUD	56	8	0	1260	COMMONWEALTH EDISON	41	4	0
1196	JOHNSRUD	56	8	0	1261	COMMONWEALTH EDISON	41	4	0
1197	JOHNSRUD	56	8	0	1262	COMMONWEALTH EDISON	41	5	0
1198	JOHNSRUD	56	8	0	1263	ULAN	42	1	0
1199	JOHNSRUD	56	8	0	1264	NUCLEAR INFORMATION AND	43	1	0
1200	JOHNSRUD	56	8	0	1265	NUCLEAR INFORMATION AND	43	1	0
1201	JOHNSRUD	56	8	0	1266	NUCLEAR INFORMATION AND	43	1	0
1202	NUMARC	38	9	0	1267	NUCLEAR INFORMATION AND	43	2	0
1203	JOHNSRUD	56	8	0	1271	NUCLEAR INFORMATION AND	43	2	0
1205	JOHNSRUD	56	8	0	1272	NUCLEAR INFORMATION AND	43	3	0
1206	NUMARC	38	9	0	1273	NUCLEAR INFORMATION AND	43	3	0
1207	NUMARC	38	9	0	1274	NUCLEAR INFORMATION AND	43	3	0
1208	JOHNSRUD	56	9	0	1275	CONCERNED CITIZENS FOR	44	1	0
1209	JOHNSRUD	56	9	0	1276	CONCERNED CITIZENS FOR	44	1	0
1210	JOHNSRUD	56	9	0	1277	NUCLEAR INFORMATION AND	43	3	0
1212	NUMARC	38	9	0	1278	FULLER	45	1	0
1213	NUMARC	38	9	0	1279	FULLER	45	1	0
1214	JOHNSRUD	56	9	0	1281	NUCLEAR INFORMATION AND	43	4	0
1215	GOITEIN	57	1	0	1282	NUCLEAR INFORMATION AND	43	4	0
1216	GOITEIN	57	1	0	1283	NUCLEAR INFORMATION AND	43	4	0
1217	GOITEIN	57	1	0	1284	UTILITY DECOMMISSIONING	46	2	0
1218	NUMARC	38	9	0	1285	UTILITY DECOMMISSIONING	46	4	0
1219	GOITEIN	57	2	0	1286	NUCLEAR INFORMATION AND	43	5	0
1220	GOITEIN	57	2	0	1287	UTILITY DECOMMISSIONING	46	4	0
1222	GOITEIN	57	2	0	1288	STATE OF NEVADA	3	8	0
1223	BECHTEL ENVIRONMENTAL,	58	1	0	1289	STATE OF NEVADA	3	8	0
1224	BECHTEL ENVIRONMENTAL,	58	2	0	1290	STATE OF NEVADA	3	7	0
1225	BECHTEL ENVIRONMENTAL,	58	2	0	1291	RESNIKOFF	8	1	0
1226	NUMARC	38	10	0	1292	RESNIKOFF	8	1	0
1227	GEARY	39	1	0	1293	WASON	14	1	0
1228	BECHTEL ENVIRONMENTAL,	58	2	0	1294	ATSWMO	16	2	0
1229	BECHTEL ENVIRONMENTAL,	58	2	0	1295	ATSWMO	16	2	0
1230	MARINO	40	1	0	1296	WILLIAMS	22	1	0
1231	BECHTEL ENVIRONMENTAL,	58	2	0	1297	CAREY	25	1	0
1233	BECHTEL ENVIRONMENTAL,	58	2	0	1298	POWER	32	1	0
1234	COMMONWEALTH EDISON	41	1	0	1299	AMERICAN NUCLEAR SOCIETY	51	1	0
1235	COMMONWEALTH EDISON	41	1	0	1300	AMERICAN NUCLEAR SOCIETY	51	1	0
1236	COMMONWEALTH EDISON	41	2	0	1301	AMERICAN NUCLEAR SOCIETY	51	1	0
1237	COMMONWEALTH EDISON	41	2	0	1302	CITIZEN'S RESEARCH &	15	3	0
1238	BECHTEL ENVIRONMENTAL,	58	2	0	1303	CITIZEN'S RESEARCH &	15	3	0
1239	BECHTEL ENVIRONMENTAL,	58	2	0	1304	GEORGIANS AGAINST NUCLEAR	17	2	0
1240	BECHTEL ENVIRONMENTAL,	58	2	0	1305	SEQUOYAH ADVOCATES FOR	23	1	0
1241	COMMONWEALTH EDISON	41	2	0	1306	STATE OF NEVADA	3	5	0
1242	COMMONWEALTH EDISON	41	2	0	1307	STATE OF NEVADA	3	8	0
1243	BECHTEL ENVIRONMENTAL,	58	2	0	1308	STATE OF NEVADA	3	9	0
1244	BECHTEL ENVIRONMENTAL,	58	2	0	1309	STATE OF NEVADA	3	9	0
1245	COMMONWEALTH EDISON	41	2	0	1310	CITIZEN'S RESEARCH &	15	3	0
1246	COMMONWEALTH EDISON	41	2	0	1311	CITIZEN'S RESEARCH &	15	3	0
1247	COMMONWEALTH EDISON	41	3	0	1312	CITIZEN'S RESEARCH &	15	3	0
1248	COMMONWEALTH EDISON	41	3	0	1313	GEORGIANS AGAINST NUCLEAR	17	2	0
1249	COMMONWEALTH EDISON	41	3	0	1314	HITZ	4	1	0
1250	COMMONWEALTH EDISON	41	3	0	1315	HITZ	3	1	0
1251	COMMONWEALTH EDISON	41	3	0	1316	HITZ	3	1	0
1252	COMMONWEALTH EDISON	41	3	0	1317	GEORGIA POWER COMPANY	50	1	0
1254	COMMONWEALTH EDISON	41	3	0	1318	STATE OF NEVADA	3	10	0
1255	COMMONWEALTH EDISON	41	3	0	1319	ATSWMO	16	2	0
1256	COMMONWEALTH EDISON	41	4	0	1320	ATSWMO	16	2	0
1257	COMMONWEALTH EDISON	41	4	0	1321	ATSWMO	16	1	0
1258	COMMONWEALTH EDISON	41	4	0	1322	REDWOOD ALLIANCE	49	3	0

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1323	JOHNSRUD	2	1	0
1324	WILLIAMS	22	1	0
1325	CAREY	25	2	0
1326	CAREY	25	2	0
1327	CAREY	25	2	0
1328	KLINE	6	2	0
1329	KLINE	6	2	0
1330	KLINE	6	2	0
1331	TSCHAECH	7	2	0
1332	TSCHAECH	7	2	0
1333	TSCHAECH	7	2	0
1334	TSCHAECH	7	2	0
1335	TSCHAECH	7	2	0
1336	RESNIKOFF	8	2	0
1337	RESNIKOFF	8	2	0
1338	RESNIKOFF	8	2	0
1339	CITIZEN'S RESEARCH &	15	3	0
1340	CITIZEN'S RESEARCH &	15	3	0
1341	REDWOOD ALLIANCE	49	1	0
1342	REDWOOD ALLIANCE	49	1	0
1343	REDWOOD ALLIANCE	49	2	0
1344	AMERICAN NUCLEAR SOCIETY	51	2	0
1345	AMERICAN NUCLEAR SOCIETY	51	2	0
1346	POWER	32	3	0
1347	POWER	32	3	0
1348	HITZ	4	1	0
1349	KLINE	6	2	0
1350	KLINE	6	2	0
1351	KLINE	6	2	0
1352	WILLIAMS	22	3	0
1353	JAMES	27	1	0
1354	ENERGY RESEARCH	30	2	0
1355	RESNIKOFF	8	2	0
1356	SEQUOYAH ADVOCATES FOR	23	2	0
1357	COMBUSTION ENGINEERING	13	1	0
1358	REDWOOD ALLIANCE	49	2	0
1359	REDWOOD ALLIANCE	49	2	0
1360	REDWOOD ALLIANCE	49	2	0
1361	AMERICAN NUCLEAR SOCIETY	51	2	0
1362	TSCHAECH	7	2	0
1363	TSCHAECH	7	2	0
1364	TSCHAECH	7	2	0
1365	TSCHAECH	7	2	0
1366	TSCHAECH	7	2	0
1367	TSCHAECH	7	2	0
1368	TSCHAECH	7	2	0
1369	TSCHAECH	7	2	0
1370	WILLIAMS	22	2	0
1371	WILLIAMS	22	2	0
1372	CITIZEN'S RESEARCH &	15	2	0
1373	TSCHAECH	7	1	0
1374	TSCHAECH	7	1	0
1375	TSCHAECH	7	2	0
1376	TSCHAECH	7	2	0
1377	TSCHAECH	7	2	0
1378	TSCHAECH	7	2	0
1379	HITZ	4	1	0
1380	HITZ	4	1	0
1381	TSCHAECH	7	2	0
1382	JOHNSRUD	2	2	0

1383	JOHNSRUD	2	2	0
1384	CITIZEN'S RESEARCH &	15	4	0
1385	CITIZEN'S RESEARCH &	15	4	0
1386	SEQUOYAH ADVOCATES FOR	23	3	0
1387	JOHNSRUD	2	2	0
1388	WILLIAMS	22	3	0
1389	SEQUOYAH ADVOCATES FOR	23	1	0
1390	WILLIAMS	22	2	0
1391	CAREY	25	1	0
1392	CAREY	25	1	0
1393	KENNECOTT URANIUM COMPANY	9	4	0
1394	JOHNSRUD	2	6	0
1395	SEQUOYAH ADVOCATES FOR	23	1	0
1396	SEQUOYAH ADVOCATES FOR	23	1	0
1397	JAMES	27	1	0
1398	JOHNSRUD	2	6	0
1399	CITIZEN'S RESEARCH &	15	2	0
1400	CITIZEN'S RESEARCH &	15	2	0
1401	JAMES	27	1	0
1402	STATE OF NEVADA	3	8	0
1403	CITIZEN'S RESEARCH &	15	2	0
1404	JOHNSRUD	2	6	0
1405	JOHNSRUD	2	6	0
1406	STATE OF NEVADA	3	5	0
1407	STATE OF NEVADA	3	8	0
1408	JOHNSRUD	2	2	0
1409	JOHNSRUD	2	6	0
1410	JOHNSRUD	2	6	0
1411	HITZ	4	2	0
1412	ATSWMO	16	1	0
1413	WILLIAMS	22	1	0
1414	WILLIAMS	22	3	0
1415	WILLIAMS	22	3	0
1416	WILLIAMS	22	3	0
1417	ATSWMO	16	1	0
1418	ATSWMO	16	2	0
1419	KLINE	6	1	0
1420	KLINE	6	1	0
1421	SEQUOYAH ADVOCATES FOR	23	1	0
1422	SEQUOYAH ADVOCATES FOR	23	2	0
1423	SEQUOYAH ADVOCATES FOR	23	2	0
1424	REDWOOD ALLIANCE	49	1	0
1425	REDWOOD ALLIANCE	49	2	0
1426	REDWOOD ALLIANCE	49	2	0
1427	ENERGY RESEARCH	30	2	0
1428	ENERGY RESEARCH	30	2	0
1429	ENERGY RESEARCH	30	2	0
1430	AMERICAN NUCLEAR SOCIETY	51	1	0
1432	AMERICAN NUCLEAR SOCIETY	51	2	0
1434	IEER & NACE	54	2	0
1435	JOHNSRUD	56	4	0
1436	NUMARC	38	5	0
1437	NUMARC	38	5	0
1438	NUMARC	38	3	0
1439	JOHNSRUD	56	6	0
1440	JOHNSRUD	56	6	0
1441	JOHNSRUD	56	6	0
1442	NUMARC	38	10	0
1443	COMMONWEALTH EDISON	41	2	0

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1444	NUCLEAR INFORMATION AND	43	2	0
1445	NUCLEAR INFORMATION AND	43	2	0
1446	UTILITY DECOMMISSIONING	46	2	0
1447	CLEVELAND MEETING	35	1	0
1448	JOHNSRUD	56	2	0
1449	CONCERNED CITIZENS FOR	44	1	0
1450	FULLER	45	1	0
1451	WORLD WATCH INSTITUTE	33	1	0
1452	AMERICAN MINING CONGRESS	34	8	0
1453	JOHNSRUD	56	6	0
1454	JOHNSRUD	56	6	0
1455	JOHNSRUD	56	7	0
1456	JOHNSRUD	56	7	0
1457	JOHNSRUD	56	8	0
1458	JOHNSRUD	56	8	0
1459	BECHTEL ENVIRONMENTAL,	58	2	0
1460	JOHNSRUD	56	6	0
1461	NUMARC	38	7	0
1462	NUMARC	38	7	0
1463	CALIFORNIA	47	1	0
1464	REDWOOD ALLIANCE	49	2	0
1465	REDWOOD ALLIANCE	49	2	0
1466	AMERICAN NUCLEAR SOCIETY	51	2	0
1467	AMERICAN MINING CONGRESS	34	2	0
1468	IEER & NACE	54	6	0
1469	IEER & NACE	54	6	0
1470	NUMARC	38	5	0
1471	NUMARC	38	7	0
1472	NUMARC	38	7	0
1473	NUMARC	38	7	0
1474	JOHNSRUD	56	7	0
1475	BECHTEL ENVIRONMENTAL,	58	2	0
1476	BECHTEL ENVIRONMENTAL,	58	2	0
1477	COMMONWEALTH EDISON	41	3	0
1478	ENERGY RESEARCH	30	2	0
1479	REDWOOD ALLIANCE	49	1	0
1480	ENERGY RESEARCH	30	2	0
1481	AMERICAN NUCLEAR SOCIETY	51	1	0
1482	JOHNSRUD	56	1	0
1483	JOHNSRUD	56	4	0
1484	JOHNSRUD	56	6	0
1485	NUCLEAR INFORMATION AND	43	3	0
1486	NUCLEAR INFORMATION AND	43	3	0
1487	NUCLEAR INFORMATION AND	43	4	0
1488	NUMARC	38	3	0
1489	AMERICAN MINING CONGRESS	34	3	0
1490	NUMARC	38	2	0
1491	IEER & NACE	54	6	0
1492	IEER & NACE	54	6	0
1493	IEER & NACE	54	6	0
1494	NUMARC	38	2	0
1495	AMERICAN NUCLEAR SOCIETY	51	1	0
1496	NUMARC	38	5	0
1497	BECHTEL ENVIRONMENTAL,	58	2	0
1498	POWER	32	2	0
1499	IEER & NACE	54	4	0
1500	TLG SERVICES, INC.	37	1	0
1501	TLG SERVICES, INC.	37	1	0
1502	TLG SERVICES, INC.	37	1	0
1503	NUMARC	38	2	0

1504	NUMARC	38	7	0
1505	NUMARC	38	8	0
1506	BECHTEL ENVIRONMENTAL,	58	2	0
1507	BECHTEL ENVIRONMENTAL,	58	2	0
1508	ENERGY RESEARCH	30	1	0
1509	ENERGY RESEARCH	30	1	0
1510	AMERICAN NUCLEAR SOCIETY	51	2	0
1511	AMERICAN NUCLEAR SOCIETY	51	2	0
1512	POWER	32	2	0
1513	POWER	32	2	0
1514	POWER	32	2	0
1515	POWER	32	2	0
1516	JOHNSRUD	56	1	0
1517	NUMARC	38	5	0
1518	JOHNSRUD	56	8	0
1519	JOHNSRUD	56	8	0
1520	BECHTEL ENVIRONMENTAL,	58	2	0
1521	BECHTEL ENVIRONMENTAL,	58	2	0
1522	BECHTEL ENVIRONMENTAL,	58	2	0
1523	CALIFORNIA	47	1	0
1524	CALIFORNIA	47	1	0
1525	AMERICAN NUCLEAR SOCIETY	51	2	0
1526	POWER	32	2	0
1527	POWER	32	3	0
1528	IEER & NACE	54	2	0
1529	IEER & NACE	54	2	0
1530	JOHNSRUD	56	5	0
1531	NUMARC	38	3	0
1532	NUMARC	38	8	0
1533	NUMARC	38	9	0
1534	COMMONWEALTH EDISON	41	5	0
1535	IRIGONEGARAY & ASSOCIATES	53	2	0
1536	AMERICAN MINING CONGRESS	34	7	0
1537	NUMARC	38	3	0
1538	NUMARC	38	3	0
1539	NUCLEAR INFORMATION AND	43	3	0
1540	NUCLEAR INFORMATION AND	43	3	0
1541	COMMONWEALTH EDISON	41	3	0
1542	NUMARC	38	8	0
1543	IEER & NACE	54	1	0
1544	IEER & NACE	54	3	0
1545	TLG SERVICES, INC.	37	1	0
1546	NUMARC	38	3	0
1547	BECHTEL ENVIRONMENTAL,	58	2	0
1548	COMMONWEALTH EDISON	41	3	0
1549	REDWOOD ALLIANCE	49	2	0
1550	IEER & NACE	54	6	0
1551	IEER & NACE	54	6	0
1552	JOHNSRUD	56	2	0
1553	COMMONWEALTH EDISON	41	2	0
1554	COMMONWEALTH EDISON	41	2	0
1555	COMMONWEALTH EDISON	41	2	0
1556	CONCERNED CITIZENS FOR	44	1	0
1557	CONCERNED CITIZENS FOR	44	1	0
1558	REDWOOD ALLIANCE	49	1	0
1559	ENERGY RESEARCH	30	2	0
1560	ENERGY RESEARCH	30	2	0
1561	GRAY	31	1	0
1562	AMERICAN NUCLEAR SOCIETY	51	1	0
1563	AMERICAN NUCLEAR SOCIETY	51	1	0

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1564	AMERICAN NUCLEAR SOCIETY	51	1	0	8859	DEPARTMENT OF ENERGY	99	1	0
1565	AMERICAN NUCLEAR SOCIETY	51	1	0	8860	DEPARTMENT OF ENERGY	99	1	0
1566	AMERICAN NUCLEAR SOCIETY	51	1	0	8861	DEPARTMENT OF ENERGY	99	1	0
1567	JOHNSRUD	56	4	0	8862	DEPARTMENT OF ENERGY	99	1	0
1568	JOHNSRUD	56	5	0	8863	DEPARTMENT OF ENERGY	99	2	0
1569	NUCLEAR INFORMATION AND	43	3	0	8864	DEPARTMENT OF ENERGY	99	2	0
1570	NUCLEAR INFORMATION AND	43	3	0	8865	DEPARTMENT OF ENERGY	99	2	0
1571	AMERICAN NUCLEAR SOCIETY	51	1	0	8866	DEPARTMENT OF ENERGY	99	2	0
1572	AMERICAN NUCLEAR SOCIETY	51	1	0	8867	DEPARTMENT OF ENERGY	99	2	0
1573	AMERICAN NUCLEAR SOCIETY	51	2	0	8868	DEPARTMENT OF ENERGY	99	2	0
1574	POWER	32	3	0	8869	DEPARTMENT OF ENERGY	99	2	0
1575	POWER	32	3	0	8870	DEPARTMENT OF ENERGY	99	2	0
1576	IEER & NACE	54	1	0	8871	DEPARTMENT OF ENERGY	99	2	0
1577	IEER & NACE	54	1	0	8872	DEPARTMENT OF ENERGY	99	2	0
1578	IEER & NACE	54	1	0	8873	DEPARTMENT OF ENERGY	99	2	0
1579	IEER & NACE	54	1	0	8874	DEPARTMENT OF ENERGY	99	2	0
1580	IEER & NACE	54	3	0	8875	DEPARTMENT OF ENERGY	99	3	0
1581	IEER & NACE	54	3	0	8876	DEPARTMENT OF ENERGY	99	3	0
1582	IEER & NACE	54	3	0	8877	DEPARTMENT OF ENERGY	99	3	0
1583	IEER & NACE	54	3	0	8878	DEPARTMENT OF ENERGY	99	3	0
1584	CLEVELAND MEETING	35	1	0	8879	DEPARTMENT OF ENERGY	99	3	0
1585	WOODARD	55	1	0	8880	DEPARTMENT OF ENERGY	99	3	0
1586	WOODARD	55	1	0	8881	DEPARTMENT OF ENERGY	99	3	0
1587	COMMONWEALTH EDISON	41	4	0	8882	DEPARTMENT OF ENERGY	99	3	0
1588	COMMONWEALTH EDISON	41	4	0	8883	DEPARTMENT OF ENERGY	99	3	0
1589	COMMONWEALTH EDISON	41	4	0	8884	DEPARTMENT OF ENERGY	99	3	0
1590	IRIGONEGARAY & ASSOCIATES	53	1	0	8885	DEPARTMENT OF ENERGY	99	3	0
1591	JOHNSRUD	56	5	0	8886	DEPARTMENT OF ENERGY	99	3	0
1592	NUMARC	38	9	0	8887	DEPARTMENT OF ENERGY	99	3	0
1593	REDWOOD ALLIANCE	49	3	0	8888	DEPARTMENT OF ENERGY	99	3	0
1594	CITIZEN'S RESEARCH &	15	3	0	8889	DEPARTMENT OF ENERGY	99	3	0
1595	CAWLEY	59	1	1	8890	DEPARTMENT OF ENERGY	99	3	0
1596	CAWLEY	59	1	1	8891	DEPARTMENT OF ENERGY	99	4	0
1597	RICHMOND	60	1	2	8892	DEPARTMENT OF ENERGY	99	4	0
1598	RICHMOND	60	1	2	8893	DEPARTMENT OF ENERGY	99	4	0
1599	RICHMOND	60	1	2	8894	DEPARTMENT OF ENERGY	99	4	0
1600	RICHMOND	60	1	2	8895	DEPARTMENT OF ENERGY	99	4	0
1601	NY D E C	61	1	4	8896	DEPARTMENT OF ENERGY	99	4	0
1602	NY D E C	61	2	1	8897	DEPARTMENT OF ENERGY	99	4	0
1603	NY D E C	61	2	5	8898	DEPARTMENT OF ENERGY	99	4	0
1604	NY D E C	61	2	6	8899	DEPARTMENT OF ENERGY	99	4	0
1605	NY D E C	61	2	6	8900	DEPARTMENT OF ENERGY	99	4	0
1606	NY D E C	61	2	5	8901	DEPARTMENT OF ENERGY	99	4	0
1607	NY D E C	61	2	5	8902	DEPARTMENT OF ENERGY	99	5	0
1608	NY D E C	61	3	3	8903	DEPARTMENT OF ENERGY	99	5	0
1609	NY D E C	61	3	4	8904	DEPARTMENT OF ENERGY	99	5	0
1610	NY D E C	61	3	4	8905	DEPARTMENT OF ENERGY	99	5	0
1611	NY D E C	61	3	5	8906	DEPARTMENT OF ENERGY	99	5	0
1612	NY D E C	61	3	6	8907	DEPARTMENT OF ENERGY	99	5	0
1613	NY D E C	61	4	1	8908	DEPARTMENT OF ENERGY	99	5	0
1614	NY D E C	61	4	2	8909	DEPARTMENT OF ENERGY	99	5	0
1615	NY D E C	61	3	3	8910	DEPARTMENT OF ENERGY	99	5	0
1616	AZ PUBLIC SVC CO	62	1	2	8911	DEPARTMENT OF ENERGY	99	5	0
1617	AZ PUBLIC SVC CO	62	1	3	8912	DEPARTMENT OF ENERGY	99	5	0
1618	AZ PUBLIC SVC CO	62	1	4	8913	DEPARTMENT OF ENERGY	99	5	0
1619	AZ PUBLIC SVC CO	62	1	5	8914	DEPARTMENT OF ENERGY	99	6	0
1620	AZ PUBLIC SVC CO	62	2	1	8915	DEPARTMENT OF ENERGY	99	6	0
8856	DEPARTMENT OF ENERGY	99	1	0	8916	DEPARTMENT OF ENERGY	99	6	0
8857	DEPARTMENT OF ENERGY	99	1	0	8917	DEPARTMENT OF ENERGY	99	6	0
8858	DEPARTMENT OF ENERGY	99	1	0	8918	DEPARTMENT OF ENERGY	99	6	0

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8919	DEPARTMENT OF ENERGY	99	7	0
8920	DEPARTMENT OF ENERGY	99	7	0
8921	DEPARTMENT OF ENERGY	99	7	0
8922	DEPARTMENT OF ENERGY	99	7	0
8923	DEPARTMENT OF ENERGY	99	7	0
8924	DEPARTMENT OF ENERGY	99	7	0
8925	DEPARTMENT OF ENERGY	99	8	0
8926	DEPARTMENT OF ENERGY	99	8	0
8927	DEPARTMENT OF ENERGY	99	8	0
8928	DEPARTMENT OF ENERGY	99	8	0
8929	DEPARTMENT OF ENERGY	99	8	0
8930	DEPARTMENT OF ENERGY	99	8	0
8931	DEPARTMENT OF ENERGY	99	8	0
8932	DEPARTMENT OF ENERGY	99	9	0
8933	DEPARTMENT OF ENERGY	99	9	0
8934	DEPARTMENT OF ENERGY	99	9	0
8935	DEPARTMENT OF ENERGY	99	9	0
8936	DEPARTMENT OF ENERGY	99	9	0
8937	DEPARTMENT OF ENERGY	99	9	0
8938	DEPARTMENT OF ENERGY	99	9	0
8939	DEPARTMENT OF ENERGY	99	9	0
8940	DEPARTMENT OF ENERGY	99	9	0
8941	DEPARTMENT OF ENERGY	99	9	0
8942	DEPARTMENT OF ENERGY	99	9	0
8943	DEPARTMENT OF ENERGY	99	10	0
8944	DEPARTMENT OF ENERGY	99	10	0
8945	DEPARTMENT OF ENERGY	99	10	0
8946	DEPARTMENT OF ENERGY	99	10	0
8947	DEPARTMENT OF ENERGY	99	10	0
8948	DEPARTMENT OF ENERGY	99	10	0
8949	DEPARTMENT OF ENERGY	99	10	0
8950	DEPARTMENT OF ENERGY	99	10	0
8951	DEPARTMENT OF ENERGY	99	10	0
8952	DEPARTMENT OF ENERGY	99	10	0

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