Grabe —

From: Michael F. Weber (MFW)
To: RLB2, LBB, EWB, LJC1, WEC1, DMC, FCC, WLF, REH, JWH1,...
Date: Wednesday, November 18, 1992 3:32 pm
Subject: REVISED ISSUES PAPER FOR RULEMAKING

Attached please find a revised version of the Rulemaking Issues Paper for the Enhanced Participatory Rulemaking on radiological criteria for decommissioning. I just received this revised paper and wanted to dispatch it to you immediately for any comments you may have on the revisions (printing it in WP5.1 will indicate text in/out with redline and strikeout text).

RES prepared this version in response to the directions from the Commission in the 10/28/92 SRM. RES did not include three pieces in the Issues Paper that were specifically requested by the Commission -- the primer on technology terminology (e.g., best demonstrated available technology), case histories of actual cleanups to emphasize practical aspects of decommissioning, and Foriegn experiences with decommissioning. Staff intends to develop these pieces separately from the Issues Paper to avoid delaying completion of the paper, which needs to be sent to participants in the rulemaking by December 4, 1992.

I would appreciate any comments you may have on the changes to the Issues Paper. The rest of the paper has already been blessed by the Commission. Please E-mail or telephone any comments you or your staff may have on the changes to the Issues Paper by 10:00 a.m. on Monday morning, 11/23/92. RES (per Hugh Thompson, DEDS) is requesting office concurrence/comments on the Issues Paper Monday afternoon at a meeting immediately after lunch.

Once the Issues Paper is complete, NRC will publish the Federal Register notice concurrent with sending out invitations to the participants in the rulemaking workshops that will occur in January through May of next year. Chip Cameron will be developing a revised schedule for these workshops based on a meeting we had today. I will communicate this information to you or your designee as soon as it becomes available.

Thank you,
Mike Weber 504-1298 or mfw

CC: RWC, REC, JTG1,kbc,rmbl,wrl,dnf

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WJA CERTIFICATE → Grabe (lost)

wfh → phone in comments on 11/23/92

— We need to appoint a person as lead for RIII on these workshops.

— "Dry Run" is scheduled for Jan 11-12, 1992 in HQ

C-11

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 all licensed facilities and sites. 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 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. Such cases will be handled on a case-by-case basis.

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 ~~three~~ primary issues dealing with: 1) the objectives for developing radiological criteria; and 2) the application of practicality considerations~~; and 3) Agreement State standards~~. 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 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.

surface water

— or well *

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, buildings, and equipment 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 acting under the authority of 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, and 9 independent spent fuel storage installations. These facilities will have to be decontaminated 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 hundreds 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 (not uranium or other source material) 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 decommissioning[1].

Until new criteria are in place, the Commission intends to proceed with decommissioning nuclear facilities on a site-specific ALARA basis as the need arises ~~using~~ considering existing criteria. Case and activity-specific risk 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 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. These sites will be decommissioned on a site-specific ALARA basis using existing criteria until new criteria are in place. The NRC published an Action Plan to ensure timely remediation of sites listed in the SDMP in the Federal Register.[2] It should be noted that as a

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

[2] 57 FR 13389, April 16, 1992.

matter of policy the NRC does not plan to recuire 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 under 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. A summary of international activities is provided as Appendix A to this issues paper.

PERCEIVED 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 ~~the public and interest groups~~ an opportunity to reassess ~~and comment on~~ the basis for the residual ~~surface~~ contamination levels contained in existing guidance in light of changes in basic radiation protection standards[3] and decommissioning experience obtained during the past 15 years.

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

Current regulations do not explicitly address radiological criteria for decommissioning.[4] Pending NRC rulemaking on generic radiological criteria for decommissioning, the NRC continues to use its current criteria and practices.[5] 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 production plants, and independent spent fuel storage installations.[6] They

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[4] 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.

[5] 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.

[6] The criteria would not apply to the disposition of uranium mill tailings, low-level waste burial facilities, or high level waste repositories since these have already been addressed in separate regulatory actions.

would apply to nuclear facilities that operate through their normal lifetime, as well as to those that may be shut down prematurely.

On July 3, 1990, the Commission published in the Federal Register its Below Regulatory Concern (BRC) Policy Statement.[7] This statement had been intended by the Commission as a policy framework for rulemakings of this type--including radiological criteria for decommissioning. However, there was considerable opposition to the Policy Statement, and the Commission has placed an indefinite moratorium on implementation of its BRC Policy. It is emphasized that the Commission is now addressing decommissioning because of the need to resolve the issues described in this paper. Thus, the Commission determined that it should proceed with a fresh approach that is independent of the BRC Policy Statement.

Simultaneous with the NRC rulemaking activity, the Environmental Protection Agency is preparing guidance to Federal Agencies in the areas of public exposure and decommissioning. In keeping with a recent Memorandum of Understanding between NRC and EPA, it is the objective of both agencies to promulgate regulations and guidance in their respective areas of jurisdiction, and to do so in a manner which both protects the public health and safety and the environment and minimizes duplication of effort. This rulemaking and the EPA development of guidance will be carried out in accordance with these objectives.

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

[7] 55 FR 27522, July 3, 1990.

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) 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 all licensed facilities and sites. 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 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 Ssupporting documents ~~for this rulemaking effort~~ 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 ~~is intended to~~ 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, (2) rulemaking to require licensees to list in one location all land, buildings, and equipment involved in licensed operations, and (3) assessment of some previous disposals of wastes under 10 CFR 20.302 and 20.304. These activities will not be

specifically considered as part of the discussions on radiological criteria for decommissioning.

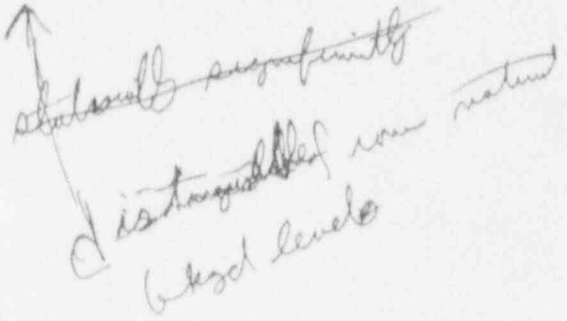
ISSUES FOR DISCUSSION

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 ~~three~~ primary issues dealing with the objectives for developing radiological criteria, and the application of practicality considerations.~~, and Agreement State standards.~~ 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.



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. ~~In the ideal case, cost is not taken into consideration.~~ 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 that a return to background levels had been achieved could

be especially difficult for isotopes like 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).[8] The limits pose the boundary of unacceptable public risk regardless of the cost required to achieve such reduction, and should be further reduced to levels which are as low as reasonably achievable (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 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

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

particular source of radiation exposure such as a decommissioned facility.[9] 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 As Low As Reasonably Achievable (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. ~~EPA's Clean Air Act regulations, however, used a much lower risk limit (3 x 10^{-4} lifetime risk of fatal cancer) than ICRP, NRC, and its own previously promulgated 40 CFR Part 190.~~

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 technology, costs to remove radionuclides, numbers of individuals involved, etc.[10] 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 not distinguishing between levels and goals.

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

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[9] International Commission on Radiation Protection, ICRP Publication 60, November 1990.

[10] ~~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.~~

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 Safe Drinking Water Act, 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. The proposed approach has not yet been implemented by the EPA.

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

The Clean Air Act and proposed EPA regulations provide practical examples of the application of ~~this~~ 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.[11] 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 others factors listed in the Clean Air Act.[12]

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-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 consideration under RCRA, Clean

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

[12]For examples, see, Federal Register, Vol. 56, 64382, December 9, 1991, "National Emission Standards for Hazardous Air Pollutants for Source Categories: Perchloroethylene Emissions From Dry Cleaning Facilities," (Proposed Rule), and Federal Register, Vol. 55, 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).

Water Act (CWA), or Safe Drinking Water Act (SDWA). 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. ~~Similarly,~~ 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 analyses 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? Does the goal need to be feasible, or can it represent an ideal which may be unlikely or impossible to achieve?

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 ~~has proposed using~~ 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.[13] Are there other established or proposed risk objectives that should be considered~~, such as EPA standards related to RCRA and CERCLA~~?

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 ~~will meet the Commission's basic objective for decommissioning~~? are appropriate for unrestricted use?

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[13] 40 CFR Part 61, "National Emission Standards for Hazardous Air Pollutants; Radionuclides." Final Rule and Notice of Consideration, 54 FR 51654, December 15, 1989

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. If the Commission were to adopt either the Risk Limit objective or the Risk Goal objective in its radiological criteria for decommissioning rule, how should practicality considerations be applied?

Discussion:

ALARA is an acronym for as low as 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 imorovement in relationship to the benefits 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.[14] 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.[15] 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, transportation) associated with the decontamination and decommissioning the site. It should also include a sensitivity 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

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[14]52 FR 2822, January 27, 1987.

[15]56 FR 7750, February 25, 1991.

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?

~~NOTE: IF THE COMMISSION ADOPTS THE STAFF RECOMMENDATION THAT COMPATIBILITY NOT BE INCLUDED AS AN ISSUE FOR DISCUSSION IN THE WORKSHOPS, ISSUE III WOULD BE~~

~~DELETED AND THE FOLLOWING LANGUAGE WOULD BE INCLUDED IN THE RULEMAKING ISSUES PAPER:~~

The issue of compatibility

The issue of compatibility has not been included as a topic for discussion in the enhanced participatory rulemaking workshops because of the Commission's ongoing process to establish a general policy on compatibility. The Commission does not believe that it would be efficient to have two separate forums focussing on the same subject and 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 parties to focus their comments upon the particular proposal, and will allow the workshops to focus upon the central technical issues and approaches to the radiological criteria for decommissioning.

~~*Issue III: How should the Commission handle the issue of Agreement State compatibility when establishing radiological criteria for decommissioned sites?*~~

~~Discussion:~~

~~Having uniform radiological criteria for decommissioning of nuclear facilities throughout the United States would result in uniform levels of risk to the public and the environment from a decommissioned site regardless of where the site is located. Some believe that it would also facilitate decommissioning planning and establishment of decommissioning funding requirements, and eliminate any question concerning what radiological criteria should be used for decommissioning of nuclear power plants located in Agreement States. This latter question arises from potential differences between the Commission's~~

~~criteria for unrestricted release and independent criteria of Agreement States. Others believe that requiring implementation of NRC developed radiological criteria for decommissioned sites may affect the ability of state officials to effectively regulate programs within their states in accordance with the wishes of state residents.~~

~~In addition to the strictly limited issue of compatibility on radiological criteria for decommissioning of sites licensed under the Atomic Energy Act (AEA), the Agreement States have additional responsibilities which could be affected. In particular, States have responsibility for regulation of Naturally Occurring and Accelerator Produced Radioactive Material (NARM), and criteria established for AEA material will likely be viewed as precedents for dealing with NARM materials. Thus, for the States, the resolution of Issue III will be particularly critical.~~

~~An additional responsibility of the States is the disposal of low level radioactive waste, either as a part of a compact, or as an individual state. The selection of criteria for decommissioning has been perceived as having a nexus to the low level waste disposal issue because the numerical value of the criteria will influence the amounts and types of materials which must be disposed of as waste.~~

~~As currently constituted, the Commission has 4 levels of compatibility for regulations. The first level of compatibility is to require that an Agreement State adopt the NRC requirements without modification. The second level would require the Agreement State to adopt the regulation, but the State could impose more stringent requirements if it chose to do so. The third level would not require the Agreement State to adopt the requirement, but the State could do so at its option. Finally, the fourth level is reserved for those rules which are outside of the agreements with the States, such as requirements for power reactors. The Commission has, separate from this rulemaking, initiated an examination of the compatibility issues with the Agreement States. In December 1991, the Commission published notice in the Federal Register of this activity and solicited comments. These comments, and~~

~~the more general considerations related to compatibility, will be factored into any Commission decision.~~

~~Sub-issue:~~

~~1. Should the Commission make radiological criteria for decommissioned sites a matter of strict Agreement State compatibility? Should the Commission allow individual Agreement States to establish criteria different from NRC criteria for application within the state? Should the Commission allow individual Agreement States to establish criteria different from NRC criteria only if it is more stringent than the NRC criteria?~~

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. ~~The Commission believes that the meaning of unrestricted should follow directly from the dictionary definitions. That is,~~ 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, ~~the Commission currently believes that~~ consideration ~~would~~ 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 years. For 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 water[16] and, under the authority of RCRA and CERCLA, applies these limits to most potable ground water, but there are no Federal standards for onsite 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,

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[16] 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 effective dose equivalent (see 56 FR 33050).

TEDE, that enables comparison of doses regardless of the pathway of exposure--external, ingestion or inhalation.[17]

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.

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 Levels[18], as a screening criterion based upon an analysis for a generic site. The ~~reasoning would~~ 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

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[17] 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.

[18] 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. ~~in excess of EPA standards.~~

reasonable margin of safety for all sites are likely 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?

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? ~~in order~~ Should the basis for such levels be to provide reasonable assurance that EPA drinking water standards will not be exceeded? ~~If so,~~ 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.[19]

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

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[19]Radon 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.

radium in rocks and soils and the resulting concentrations of radon[20], (2) the variability of doses at a given site from naturally occurring radon[21], and (3) the difficulty in correlating indoor radon levels with the concentrations of radon in the soil outside the structures.[22] There are some who believe it may be virtually impossible to demonstrate that doses from 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.[23]

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

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[20] 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.

[21] 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.

[22] 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.

[23] The level at which EPA suggests action be taken to reduce radon concentrations in homes. See " A Citizen's Guide to Radon, 2nd Edition - ~~What It Is and What to do About It," EPA 86-0004~~ A Guide to Protecting Yourself and Your Family", EPA-402-K92-0001, Office of Air and Radiation; U.S. Department of Health and Human Services; Centers for Disease Control, ~~1986~~ June,1992.

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)?

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 ~~to be removed from the~~ site for ~~before~~ decommissioning?

2. Should a site specific analysis of the risks, costs, and benefits ~~will~~ be performed before a decision is made to ~~exhume any~~ 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) ~~and removal of some~~ involving radioactive material previously disposed of at a site?

APPENDIX A

INTERNATIONAL ACTIVITIES

The NRC staff was requested by the Commission to provide information on standards that are being used by other countries for decommissioning nuclear facilities. A summary of the staff's investigation follows:

The U.S. Nuclear Regulatory Commission (NRC) appears to hold the lead in the development of a generic methodology for estimating the dose to an average individual in a critically exposed group using lands and structures after decommissioning. Based on the experience of NRC staff who are consultants or advisors to the International Atomic Energy Agency (IAEA), the current international practice is to derive decommissioning criteria on a case-by-case basis with the guidance of the IAEA Safety Series No. 89, "Principles for the Exemption of Radiation Sources and Practices from Regulatory Control" kept in mind. 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. 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, including a NRC staff member, 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." A separate IAEA consultants meeting in November 1991, included another NRC staff member and produced a draft document, "National Policies and Regulations for

Decommissioning Nuclear Facilities." This latter document is early in its development and will require further work before it is suitable for distribution as a draft.

Internationally, the recent regulatory focus has been on waste and recycle--reuse. The criterion is typically set at 10 μSv [1 mrem] per year based on the IAEA Safety Series No. 89 guidance. An IAEA advisory group, including an NRC staff member, 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. 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.