RULEMAKING ISSUE
(Affirmation)

August 29, 1989 SECY-89-267

For: The Commissioners

From: James M. Taylor, Acting Executive Director for Operations

Subject: 10 CFR PART 20 REVISION: SUPPLEMENTAL INFORMATION

Purpose: To provide staff recommendations for resolution of outstanding technical issues related to the proposed revision of 10 CFR Part 20.

Category: The issuance of the revised 10 CFR Part 20 is a major policy issue.

Summary This paper discusses proposed staff resolutions for two of the three issues that have arisen with regard to the issuance of the revised Part 20 rule:

1. the impact of lowered uranium air concentration limits on fuel fabrication facilities and the question of using "annual doses" versus "committed doses,"

2. problems of uranium recovery facilities complying with a lowered air concentration limit for radon.

This paper also recommends several minor changes in the proposed revision to Part 20 and the Federal Register notice and that the effective date of the revised rule be changed to January 1, 1992. The third issue, conformance with the provisions of §50.109 (the "Backfit Rule"), was addressed by the General Counsel in a separate memorandum. (July 6, 1989)

Background: On November 3, 1988, the staff sent to the Commission a major policy paper (SECY-88-315) containing the final rule that would substantially revise the Commission's regulations for radiation protection in 10 CFR Part 20. Since that time, several issues have been raised by the staff and by industry. These issues included the treatment of internal dose accounting and the impact of the new uranium annual limits on intake, the value in 10 CFR Part 20, Appendix B, Table 2 for radon-222, and a number of points of clarification to both the language of the rule and the statement of considerations.

CONTACT:
H. Peterson, RES
49-23640

Discussion: 1. Recommendations for resolving difficulties in meeting uranium air concentration limits at uranium fuel fabrication facilities.

The concentration limits in the revised 10 CFR Part 20, Appendix B, are based on the latest consensus of scientific information. One of the consequences of the updated and revised models and parameters for calculating lung doses is that the air concentration limit for workers for insoluble uranium is lower by a factor of 5 than the value in the existing Part 20, Appendix B. This decrease reflects an increase in the risk associated with a given intake of uranium.

On November 10, 1988, the Commission held a public meeting and was briefed by the staff on the Part 20 revision. At that meeting, representatives from the Nuclear Utility Management and Advisory Council (NUMARC) and General Electric Company (GE) questioned the NRC staff's decision not to include in the final Part 20 rule §20.205 of the proposed (January 9, 1986) rule. The NRC staff response to the NUMARC comments provided to the NRC during the public comment period was included in SECY-88-315 as Enclosure 9. The Advisory Committee on Reactor Safeguards has also addressed this issue and favored the retention of §20.205 of the proposed rule. The ACRS comments and the NRC staff responses to them are in Enclosure 10 to SECY-88-315.

One of the provisions of proposed §20.205 would have allowed certain licensees, including uranium fuel fabricators, to calculate and record dose from internally-deposited radionuclides on an annual dose basis, rather than on the committed dose basis applied to all other licensees. NUMARC and GE contended that this feature should have been retained. This would have reduced the impact of the five-fold decrease in the allowable uranium intake. The Chairman of the EPA Interagency Task Force that prepared the Presidential occupational exposure guidance has expressed an opinion that the wording of proposed §20.205 is not consistent with the Federal Guidance (A. Richardson to Commissioner Curtiss, November 18, 1988).

In the Staff Requirements Memorandum of November 28, 1988, on SECY-88-315, Commissioner Roberts requested the Advisory Committee on Nuclear Waste (ACNW) to examine the question of including §20.205 in the final rule. Subsequently, the ACNW held a noticed public meeting on this issue on December 22, 1988. The ACNW, in a letter to Chairman Zech of December 30, 1988 (Enclosure 4), recommended that the proposed §20.205 not be included in the final rule (SECY-88-315).

The final 10 CFR Part 20 (SECY-88-315) limits internal exposures by use of the committed dose concept. The committed dose concept assigns the total dose from an intake of radioactive material to the year of intake, irrespective of whether the dose is actually delivered in that year, or at some time in the future. The quantity of material allowed to be taken into the body is constant, from year to year, and values for each isotope and solubility class are tabulated in Appendix B of 10 CFR Part 20 as Annual Limits of Intake (ALI). This is the approach which the NRC has traditionally used to control internal exposures as exemplified in Appendix B to the current Part 20 in effect today.

On February 22, 1989, NUMARC, representatives of all major commercial fuel fabricating firms, the NRC staff, DOE staff, and other interested parties met in a noticed public meeting to discuss the impact of the Part 20 revision on fuel fabricators. At this meeting, the representatives of the uranium fuel fabricators described the difficulties in demonstrating compliance with the five-fold lower concentration limits for uranium in the revised Part 20. They described the difficulties in demonstrating compliance with the committed dose through air sampling, including "breathing zone" lapel air samplers, and bioassay (fecal sampling and lung counting). During the meeting, a new proposal was outlined by the industry representatives for assessing and recording doses. The minutes of this meeting are provided in Enclosure 1. Additional information was submitted by NUMARC with a letter dated May 8, 1989 (Enclosure 5).

The industry proposal involved the use of the committed dose concept to set design and operational objectives for the workplace, and two levels of individual dose control. First, there would be an annual limit of 5 rems on the sum of the annual external dose and the total internal dose to the body from radionuclides residing in the body from intakes in the current and all previous years. There would also be an additional limit of 5N rems described in the industry proposal as follows: "The grand total of annual dose equivalence and the last residual 50 year committed dose equivalence from exposure to radiation at the licensee's facility, plus the 50 year committed dose equivalence received at other licensee's facilities shall not exceed 5 N, where N is the integer number of calendar years the worker was exposed to radioactive material at the facility." The industry proposal therefore, has some characteristics of an annual dose limitation system, as well as some characteristics of the committed dose system.

As requested by the Staff Requirements Memorandum of April 10, 1989 (COMLZ-89-13/COMKC-89-1) the staff has evaluated the industry proposal using metabolic data on the retention of uranium in the body. Uranium was selected for this evaluation because it is the most significant material involved in causing exposures at fuel fabrication facilities. It should be noted that the second criterion of the industry proposal could be interpreted in two ways: (1) to exclude future dose commitments from past intakes or (2) to include future dose commitments from past intakes. The examples provided in the February 22, 1989 NUMARC submittal follow the first interpretation.

The NRC staff has analyzed both interpretations (Enclosure 2) and has determined that the first interpretation of the industry position would permit significantly higher doses and risks from inhaled radioactive materials than would the revision of Part 20 proposed by the staff. As indicated in Table 1 of Enclosure 2, the risks from the industry proposal could be greater than the risk associated with use of the committed dose approach. For the second interpretation, the lifetime risk to the worker is numerically equivalent to that of the committed dose approach when exposures are assumed to be at the limit (Table 2). Implementation of the second interpretation when exposures are somewhat below the limits is described in Table 3 of Enclosure 2. Adoption of this concept would require development of further information, proposal for public comment and determination of the impacts of the system upon licensees and the NRC.

Because the committed dose concept has been in place in the current 10 CFR Part 20 since its inception, the staff believes that the origin of the uranium fuel fabrication industry's recent concerns and proposals is the decrease in the allowable air concentration limit attributable to the increase in estimated risk from the intake of a given quantity of uranium. This increase was determined by the ICRP based upon the scientific evidence accumulated during the last 25 years. The staff recognizes the possibility that the industry may have to make modifications to the design or operation of its facilities if it cannot demonstrate control of its operations within the dose limit.

However, the 10 CFR Part 20 revision permits more flexibility in the assessment of dose than does the current Part 20. Section 20.204 of the revised Part 20 (Enclosure 6) allows for the use of: (1) specific information on the physical and biochemical properties of the radionuclides taken into the body, (2) the behavior of the material in an individual in evaluation doses,

and (3) site-specific derived air concentration limits based upon actual particle size distributions and solubilities. These provisions provide greater flexibility to the licensee in demonstrating compliance with the health protection objectives of the revised rule. From preliminary particle size data presented at the February 22 meeting and data in the industry May 9 proposal (Enclosure 5), it appears that a site-specific air concentration limit 2-3 times higher than the generic limit (which is based on a standard 1 micron particle size distribution), might be justified and could permit licensees to demonstrate compliance without modifications to their facilities. As noted in the General Electric comments in Enclosure 5, use of this provision would greatly alleviate problems in complying with the revised 10 CFR Part 20. The staff recommends that the Statement of Considerations for the final rule (Enclosure 3 of SECY-88-315) be modified to call attention to the provisions of §20.204, in the revised Part 20 rule. (Enclosure 3).

The staff believes that there are two alternatives available to deal with the industry proposal of February 22, 1989. In the first alternative, the revision of 10 CFR Part 20 contained in SECY-88-315, would be published with an addition to the Statement of Considerations to indicate recognition that alternate methods may be identified in the future which might achieve the same degree of lifetime risk limitation for both short-term and long-term workers as that provided by the committed dose system, and, if necessary, the industry could submit a petition for rulemaking to adopt an alternate dose limitation system such as that presented to the staff during the February meeting with NUMARC. The NRC staff believes that any such approach would have to be consistent with the intent of the Federal Guidance to limit the risk from internal dose, should protect worker employability, and should not create an inordinate recordkeeping and compliance burden upon present or future employers. This approach has the advantages of giving additional time while the industry further considers whether an alternative approach is, in fact, necessary in light of the provisions of the final rule. The Statement of Considerations for the Part 20 revision indicates that fuel facility licensees may request additional time for implementation of the rule. The petition for rulemaking could be used as a basis for such a request, so that licensees would not be in the position of implementing a provision which might be changed.

The second alternative would be to publish the revision as contained in SECY-88-315, and direct the staff to immediately begin a rulemaking effort based on the industry proposal. The rulemaking might be completed prior to the implementation

of the 10 CFR Part 20 revision by fuel cycle licensees. However, before the staff could prepare a proposed amendment, a number of practical implementation issues would need to be addressed and resolved.

The staff recommends that the Commission pursue the first alternative. This will provide an opportunity to determine if rulemaking is necessary in view of the flexibility afforded by §20.204 in the revised Part 20. Appropriate additions to the Statement of Considerations are included in Enclosure 3.

2. Recommendation for resolving problems with the revised radon concentration limits for public exposure.

In a memorandum dated February 2, 1989, the Commission was notified that there was an apparent problem with uranium mills being able to comply with the new lower air concentration limit for radon. The Derived Air Concentration Limit for radon 222 in the revised Part 20 Appendix B, Table 2, is a factor of 30 lower than in the current Part 20.[1]

The staff used available data to assess whether uranium recovery licensees could comply with the new limit of 0.1 pCi/L for Rn-222 in Table 2 of Appendix B to 10 CFR Part 20. Industry generated Rn-222 data on 11 uranium recovery facilities (10 mills and one in situ facility) and one thorium/rare earth facility were examined. These facilities consisted of both NRC and Agreement States licensees. The mills are either operating or in standby status, and the one in situ facility is operating. Analysis of the data revealed background Rn-222 values ranging from 0.1 to 6.9 pCi/L and variability in the measured radon values. This large variability was due to contributions from sources other than the mill and tailings, varying quantities of tailings among the sites, varying sizes and status of impoundments, and choices of sampling locations. All facilities would not meet a limit of 0.1 pCi/L (1×10^{-10} µCi/ml).

The staff recommends a modification to Part 20 that permits (with NRC or Agreement State approval) the air and water concentration limits to be adjusted for actual site-specific exposure conditions (such as particle size, solubility, or percentage of decay product [daughter ingrowth). A similar provision already exists in revised §20.204(c) for occupational exposure (See Enclosure 6). Therefore, the change extends the same flexibility in adjusting concentration limits for the general public as already exists for workers.

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1 1×10^{-10} µCi/ml (or 0.1 pCi/L) in the revised Part 20 compared to 3×10^{-9} µCi/ml (or 3 pCi/L) in the present Part 20.

Use of this provision applied to the percentage of radionuclide equilibrium could provide a factor of 2 or 3 upward change in the appropriate air concentration limit. In addition, the licensee can demonstrate compliance by calculating the dose to the nearest resident rather than meeting the air concentration limit at the site boundary. This should provide an additional factor of 2 or 3 allowance. Lastly, if the 0.1 rem effective dose limit still cannot be met, the licensee can apply to NRC under §20.301(c) for permission to use a temporary 0.5 rem per year limit rather than the 0.1 rem per year limit. Section 20.301(c) of the revised rule requires that, in order to receive permission for use of this higher dose limit, the licensee has to specify (1) the need for and expected duration of the higher value, (2) their program to assess and control doses, (3) procedures to control doses to be ALARA. These options used singularly or in combination coupled with process or operational modifications of these facilities is expected to provide sufficient flexibility to enable most uranium recovery facilities to comply with the provisions of the revised 10 CFR Part 20. As in the case of the uranium fuel fabrication industry proposal discussed previously, the staff does not believe that concentration limits set on the basis of health protection should be modified in order to alleviate potential problems of compliance.

3. Recommended clarifying changes to the Part 20 Federal Register Notice

Enclosure 3 contains the modification discussed under item 2 above (§20.302) necessary to resolve the radon issue. The enclosure also contains other changes to the Part 20 statement of considerations (Enclosure 3 of SECY-88-315) the Part 20 rule (Enclosure 4 of SECY-88-315), and the Appendices (Enclosure 5 of SECY-88-315). The change to §20.302 permits air (and water) concentration limits for effluents to be adjusted (upon NRC approval) to reflect actual conditions.

The change to §20.208 permits direct calculation of the dose to the embryo/fetus, rather than requiring this dose to be based on the dose calculated for the declared pregnant woman as was done in the proposed rule. This change was suggested in public comments and permits improved dose calculations to be made. The other changes contained in Enclosure 3 are primarily clarifying in nature, and are the result of continued staff review and public comments on the proposed rule and on SECY-88-315.

Coordination: The Office of Governmental and Public Affairs concurs in the recommendations of this paper. The Office of General Counsel has reviewed this paper and has no legal objections to it.

Recommendations: The staff recommends:

1. That the Commission approve the final rule submitted in SECY-88-315 with the modifications suggested in this paper (Enclosure 3).

2. That the Commission approve the other related staff actions noted in SECY-88-315.

3. That the implementation date for the revision of 10 CFR Part 20 be changed from January 1, 1991 to January 1, 1992. [Note: Starting at the beginning of a year is advisable because of the record keeping requirements and annual dose limits.]

James M. Taylor
Acting Executive Director
for Operations

Enclosures:
1. Minutes of 2/22/89 Meeting with NUMARC
2. Staff Evaluation of NUMARC Proposal
3. Recommended Revisions to SECY-88-315, Enclosures 3 and 4
4. ACNW Letter of December 30, 1988
5. NUMARC Proposal of May 8, 1989
6. Annotated Version of § 20.204

Commissioners' comments or consent should be provided directly to the Office of the Secretary by COB Friday, `eptember 15, 1989.

Commission Staff Office comments, if any, should be submitted to the Commissioners NLT Friday, September 8, 1989, with an information copy to the Office of the Secretary. If the paper is of such a nature that it requires additional time for analytical review and comment, the Commissioners and the Secretariat should be apprised of when omments may be expected.

This paper is tentatively scheduled for affirmation at an Open Meeting during the Week of September 18, 1989. Please refer to the appropriate Weekly Commission Schedule, when published, for a specific date and time.

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ENCLOSURE 1

MINUTES OF FEBRUARY 22, 1989
MEETING OF NRC STAFF WITH
NUMARC STAFF

MEETING MINUTES

Date: February 22, 1989

Place: NRC Headquarters, One White Flint North Building

Time: 1:30-4:30 p.m

Purpose: Meeting of NRC staff with nuclear industry representatives to discuss effects of revisions to 10 CFR Part 20 on nuclear fuel fabrication facilities.

Attendees: List attached.

Mr. Paul Stansbury of the General Electric Company's Wilmington, N.C. reactor fuel fabrication facility described the 5-fold reduction in the allowable air concentration limit for insoluble uranium. He noted that a large portion of this change resulted mainly from the assumptions inherent in the ICRP revised task group on lung dynamics model that was used to calculate concentration limits for ICRP-30 and the revised Part 20 rather than the older ICRP-2 lung model. For an assumed 1-micron activity median aerodynamic diameter (AMAD) particle, the five-fold reduction in allowable air concentrations would present difficulties in demonstrating compliance with the revised 10 CFR Part 20 because fuel fabrication operations as currently implemented would result in air concentrations near the new limit.

A number of measurements of the particle size of the airborne particulates at the GE plant indicated that during normal operations the particle size was more in the range of 3-4 microns AMAD rather than the 1-micron size assumed in calculating the Part 20 derived air concentrations (DACs). A correction for this difference in average particle size could be used to derive a DAC different from that used in Part 20. Section 20.204(c) of the revised Part 20 rule permits altering the DAC with NRC approval based upon actual exposure conditions. Industry representatives indicated that they would examine the effect of using a more representative particle size on the magnitude of the DAC in order to see whether more realistic aerosol parameters would help alleviate potential problems. However, particle size adjustments would be of limited

usefulness for assigning committed dose from air sampling results because of the difficulty of determining particle size during a frequent operational perturbations causing elevated airborne levels. This limitation would not be significant in using action levels for controlling the workplace based on committed dose methodology.

Mr. Stansbury also discussed various monitoring methods including bioassay, whole body or lung counting, and air sampling. For insoluble uranium, fecal analyses rather than urine analyses are required. Fecal samples are difficult to collect and analyze and subject to considerable variation. Lung counting lower limits of detection and associated statistical uncertainty will not permit this bioassay technique to be used to determine intakes frequently. It was Mr. Stansbury's conclusion that bioassay techniques are not suitable for the routine determination of intakes needed to demonstrate compliance with committed dose limits.

Mr. Stansbury pointed out that use of a committed dose approach would result in significantly increased error in dose determination from lung counts. This effect is due to the need to subtract successive lung counts to assess the intake in the intervening period. The NRC staff agreed that this subtraction was necessary for the committed dose approach as the assigned commitment had to reflect only the intake that occurred in the year of interest. Mr. Stansbury stated that an annual dose approach would allow successive lung counts to be averaged which could reduce the overall error of measurement.

Mr. Philip Rosenthal of Combustion Engineering described an extensive air sampling program initiated at Combustion Engineering using lapel air samplers to measure "breathing zone" air concentrations. The lapel air samplers draw 2 or 4 liters per minute and when combined with appropriate analytical techniques can detect 7.1E-13 uCi/cc (LLD for a 4-hour sample or 2.4E-13 uCi/cc (LLD for a 12-hour sample.) Experience with the samplers has shown a failure rate of about 10% which necessitates that more air samplers be available than the number of workers being monitored. Additional samplers were also required because of the time to recharge and calibrate the samplers which can exceed 2 days. Also, it was mentioned that the power packs and samplers were cumbersome and heavy. Extensive records of use were required for each sampler.

Mr. Richard Cunningham of the NRC mentioned that the fact that the ICRP lung model did not accurately describe the behavior in 1 or 2 cases does not invalidate the model. The lung model was developed from a wide variety of experimental data and parameters appropriate to these actual exposure conditions may not have been used. Mr. Cunningham noted that the lower DAC limit required measurements that were at the limits of existing technology. He also noted that the limits were not ALARA values but basic health protection limits and that feasibility of showing compliance with the limits should not be a major consideration in setting these limits. He also noted the NRC staff's concerns regarding the future employability of ex-fuel plant workers and about the burden on future employers of these workers for monitoring pre-existing body burdens of long-lived radionuclides.

Mr. Richard Burklin of the Westinghouse Electric Company, presented a proposal for an alternative to the sole use of committed dose equivalent in the revised Part 20 and to the original §20.205 in the proposed Part 20 rule. The proposal made by Mr. Burkland was that each licensee should be given the option of controlling exposures either on: (a) the basis of the committed dose equivalent or (b) a shared annual dose equivalent and a residual 50-year committed dose equivalent. Alternative (a) is that currently in the revised 10 CFR Part 20. Alternative (b) would involve the following:

1. The external and internal annual dose, with the appropriate weighting factors, shall be summed. The annual dose equivalent resulting from exposure to radioactive material at the licensee's facility plus the committed dose equivalent resulting from exposure to radiation at any other licensee's facility shall not exceed 5 rem.

2. Within 90 days of the end of each calendar year (or employment period), the 'residual' 50 year committed dose equivalent shall be estimated.

3. The grand total of the annual dose equivalents and the last residual 50 year committed dose equivalent from exposure to radiation at the licensee's facility plus the 50 year committed dose equivalent received at other licensee's facilities shall not exceed 5N, where N is the integer

number of calendar years the worker was exposed to radioactive material at the facility.

An example calculation using hypothetical data was presented showing how this concept would work. However, NRC staff noted that the residual committed dose corresponding to an initial 1 rem annual dose was 0.8 rem, whereas for uranium-238 approximately 20% of the 50-year committed dose is delivered in the first year so the actual residual commitment for 1-rem annual dose would be closer to 4 rem.

It was agreed that:

1. NUMARC would provide to NRC within 1-2 weeks an estimate of the time it would take to evaluate their proposal using data based upon the retention models for insoluble uranium of ICRP-30.

2. The fuel manufacturers would examine and report to NRC through NUMARC the impact of using more realistic particle size distributions together with the provisions of §20.204(c) to request modified DACs specific to each plant or process areas, and

3. The NRC staff would evaluate the new industry proposal and provide the results of this evaluation to the Commission and NUMARC.

4. NUMARC would provide an assessment of how the proposal would affect (a) worker employability and (b) new employers who would have to account for dose monitoring of workers with body burdens from previous employment.

ATTENDEES AT
02/22/89 MEETING ON INTERNAL DOSES

NAME	AFFILIATION
Lynne Fairobent	NUMARC
John F. Schmitt	NUMARC
Philip R. Rosenthal	Combustion Enginering
C. W. Malody	Advanced Nuclear Fuel
Richard Burklin	Westinghouse
Paul Stansbury	General Electric
Altheia Wyche	SERCH Licensing/Bechtel
J. R. Clark	Nuclear Fuel Services
Rob Woolley	General Atomics
Judith D. Foulke	DOE
Dianne D'Arrigo	Nuclear Information Research Services
Bill M. Morris	NRC/RES
Zoltan Rosztoczy	NRC/RES
Stephen McGuire	NRC/RES
Barbara Brooks	NRC/RES
Harold T. Peterson, Jr.	NRC/RES
Walter Cool	NRC/Consultant
Richard Cunningham	NRC/NMSS
Leland C. Rouse	NRC/NMSS
Donald A. Cool	NRC/NMSS
John D. Buchanan	NRC/NRR
Joanna Becker	NRC/OGC
Sher Bahadur	NRC/OCM/LZ
Janice Dun Lee	NRC/OCM/LZ
Gail Marcus	NRC/OCM/KR
Margaret Federline	NRC/OCM/KC

Proposed Rules

Federal Register
Vol. 54, No. 26
Thursday, February 9, 1989

This section of the FEDERAL REGISTER contains notices to the public of the proposed issuance of rules and regulations. The purpose of these notices is to give interested persons an opportunity to participate in the rule making prior to the adoption of the final rules.

NUCLEAR REGULATORY COMMISSION

10 CFR Part 20

Public Meeting To Discuss Requirements for Control of Internal Doses

AGENCY: Nuclear Regulatory Commission.

ACTION: Notice of public meeting.

SUMMARY: The proposed revision to 10 CFR Part 20, published on January 9, 1986, (51 FR 1092), contained a section (§ 20.205) that would have allowed licensees to control the internal dose from certain long-lived radionuclides on the basis of the dose actually delivered during the year from all intakes, both past and present (annual dose). The control of all other nuclides was to be based upon the dose, both present and future, that would be delivered as a result of intakes of radioactive materials during the year (committed dose). The NRC staff, during preparation of the final rule that would implement the 10 CFR Part 20 revision, deleted this option. This deletion effectively continues the present practice of requiring that internal doses to workers from all radionuclides would be controlled on committed dose equivalents.

At the request of the Nuclear Utilities Management and Resources Council (NUMARC), a meeting between industry representatives and NRC staff members is scheduled to hear industry concerns regarding the deletion of the proposed § 20.205 and discuss the impact of the 5-fold reduction in the occupational air concentration limit for insoluble uranium on nuclear fuel fabrication facilities.

DATE: Meeting to be held February 22, 1989, from 1:30–3:30 p.m.

ADDRESS: Meeting to be held in room 10–B–11 of the Commission's headquarters building at One White Flint North, 11555 Rockville Pike, Rockville, MD 20852.

FOR FURTHER INFORMATION CONTACT: Harold T. Peterson, Jr., Office of Nuclear Regulatory Research, U.S. Nuclear Regulatory Commission, 5650 Nicholson Lane South [142], Rockville, MD 20852. Telephone: (301) 492–3640. Facsimile: (301) 443–7804 or 443–7836. Verification: (301) 492–3607.

SUPPLEMENTARY INFORMATION:

The deletion of § 20.205 has been previously discussed in public meetings of the NRC Advisory Committee on Reactor Safeguards (ACRS) Subcommittee on Occupational and Environmental Health on May 31, 1988 and before the full ACRS on June 3, 1988; in the Commission's public meeting on 10 CFR Part 20 on November 10, 1988; and the NRC Advisory Committee on Nuclear Waste on December 21, 1988.

Persons wishing to make statements on these issues should notify the contact person identified in this document and submit a written request including the statement to be presented at lease one week in advance of the meeting. The statement should be no longer than 3 minutes.

Dated at Rockville, Maryland, this 6th day of February 1989.

Alan K. Roecklein,

Acting Chief, Radiation Protection and Health Effects Branch, Division of Regulatory Applications, Office of Nuclear Regulatory Research.

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DEPARTMENT OF ENERGY

Office of the Secretary

10 CFR Part 600

Financial Assistance Rules; Technical Corrections

AGENCY: Department of Energy.

ACTION: Proposed rule.

SUMMARY: The Department of Energy (DOE) today proposes amendments to the Financial Assistance Rules, 10 CFR Part 600, to make technical, non-substantive corrections. Because of three changes to the rules in 1988, a detailed review of them has taken place and disclosed a number of technical errors (typographical errors, repetitions, incorrect citations, and the like) which warrant correction. These do not involve any substantive change.

DATE: Comments due by March 13, 1989.

ADDRESS: Comments should be addressed to: James J. Cavanagh, Director, Business and Financial Policy Division (MA–422), Procurement and Assistance Management, U.S. Department of Energy, 1000 Independence Avenue SW., Washington, DC 20585.

FOR FURTHER INFORMATION CONTACT:

Edward F. Sharp, Business and Financial Policy Division (MA–422), U.S. Department of Energy, 1000 Independence Avenue SW., Washington, DC 20585, (202) 586–8192

Christopher Smith, Office of the Assistant General Counsel Procurement and Finance (GC–34), U.S. Department of Energy, Washington, DC 20585, (202) 586–1526.

SUPPLEMENTARY INFORMATION:

I. Introduction

The Department of Energy (DOE) is today issuing a proposed rule to make non-substantive changes to the Financial Assistance Rules (10 CFR Part 600) to correct errors appearing in it. There have been three significant amendments to the Rules in 1988: Changes to the way in which cooperative agreements are handled (53 FR 5260, February 22, 1988), adoption of the A–102 Common Rule (53 FR 8044, March 11, 1988), and the establishment of procedures for dealing with determinations of noncompetitive financial assistance and justifications of restricted eligibility (53 FR 12137, April 13, 1988). These changes have not only involved policy issues, but, in the case of the common rule, a substantial reorganization of the Financial Assistance Rules, with renumbering of various sections. Inevitably, errors have appeared in the text, including typographical mistakes, repetitions, and incorrect references.

II. Proposed Changes to 10 CFR Part 600

Section 600.2 is being amended by deleting the reference to OMB Circular A–102 in paragraph (f)(i) and to OMB Circular A–124 in paragraph (f)(iii). Circular A–102 was replaced by the Common Rule (adopted by DOE as Subpart E of the Financial Assistance Rules) and Circular A–124 was cancelled in March 1987. The remaining

STAFF EVALUATION OF NUMARC PROPOSAL

Enclosure 2

ENCLOSURE 2

COMPARISON OF 10 CFR PART 20 AND
NEW INDUSTRY PROPOSAL FOR LIMITING INTERNAL DOSES

The industry proposal consists of two limiting conditions:

1. A limit of 5 rem on the annual dose received in any 1 year from doses due to intakes in that year and from intakes in all previous years, and

2. A cumulative dose limit equal to 5 N where N is the number of years that the worker is employed at that facility. This limit is tested against the sum of:

   i. the total of all previous annual doses plus

   ii. the 50-year committed dose

This proposal can be interpreted in two ways: the first (as illustrated in the industry examples provided in the February 22, 1989 meeting) is that Item ii includes only the committed dose from the current year's intake and does not include the future commitments from previous intakes. The second interpretation is that all commitments to future doses from past and current intakes are included. Both of these alternatives were evaluated by the staff. Based on these limitations, the annual dose and committed dose from intake of uranium allowed during employment were determined. Doses from external radiation were assumed to be zero, and the employee was not assumed to have

been exposed to radioactivity during any previous employment. Uranium is the material which is most significant in causing internal radiation doses at fuel fabrication plants.

In Table 1, annual doses, committed doses, and total lifetime risks allowed under the first interpretation of the industry proposal, are compared to those allowed under the revision of Part 20. It can be seen that the allowed annual dose under the industry proposal rapidly approaches the 5-rem dose limit and remains at this level. In contrast, in the committed dose approach of 10 CFR Part 20, the annual dose only reaches 5 rem in the 50th year. The committed dose resulting from the intake of radioactive material in any year under the Part 20 approach is fixed at a constant 5 rem. The committed dose under the industry proposal due to each year's intake varies in a nonuniform manner (this is because the limiting condition changes at about the third year from the cumulative limit [which governs in early years] to the annual dose limit). The committed dose allowed under this industry proposal would be about 25 percent higher than allowed under the revised Part 20.

The cumulative or lifetime committed dose is a measure of the overall risk from radiation exposure. This quantity is obtained by summing the committed doses from all intakes. The last column, which compares the total lifetime committed doses or risks allowed under the two systems, shows that, under the industry proposal, the lifetime risks are greater by 40 percent up to 83 percent over the risks allowed under 10 CFR Part 20 depending on the duration of employment.

The second interpretation of the industry position includes the future dose commitments from previous intakes of radioactive materials. Table 2 shows a comparison of calculated annual and committed doses that could be permitted under the second interpretation of the industry proposal. Under this interpretation, the dose allowed in each year is numerically equivalent to the dose allowed in the committed dose approach. However, if exposures are less than the maximum value permitted, the cumulative (5N) criterion permits the accumulation of an allowance which can be withdrawn from at a rate up to 5 rem per year. The committed dose system proposed by the ICRP and incorporated in the revised Part 20 does not permit for such a allowance except for planned special exposures. The revised Part 20 would also eliminate the 5(N-18) cumulative dose limit for external radiation that is in the current Part 20. This cumulative limit, combined with the 3 rem quarterly dose limit, permitted doses up to 12 rem per year.

TABLE 1

COMPARISON OF INDUSTRY PROPOSAL #1* DOSE LIMITATION
SYSTEM TO THAT IN REVISED 10CFR20

Year	Annual Dose (Rem) 10CFR20	Annual Dose (Rem) Industry	Committed Dose From Annual Intake (Rem) 10CFR20	Committed Dose From Annual Intake (Rem) Industry	Lifetime Risk From Annual Intake Industry/10CFR20
1	1.00	1.00	5	5.0	1.0
2	1.69	2.49	5	9.0	1.4
3	2.18	4.17	5	12.2	1.75
4	2.54	5.0	5	10.4	1.83
5	2.80	5.0	5	7 3	1.76
6	3.00	5.0	5	7.15	1.7
7	3.16	5.0	5	7.0	1.66
8	3.28	5.0	5	6.9	1.62
9	3.38	5.0	5	6.75	1.59
10	3.46	5.0	5	6.70	1.57
11	3.53	5.0	5	6.95	1.55
12	3.59	5.0	5	6.90	1.54
13	3.64	5.0	5	6.55	1.52
14	3.69	5.0	5	6.50	1.50
15	3.73	5.0	5	6.45	1.49
16	3.77	5.0	5	6.40	1.48
17	3.81	5.0	5	6.30	1.46
18	3.84	5.0	5	6.30	1.45
19	3.88	5.0	5	6.20	1.44
20	3.91	5.0	5	6.15	1.43

* Only current year's committed dose equivalent included.

TABLE 2

INCLUDES RESIDUAL COMMITTED DOSES AT LIMIT

Year	Annual Dose	Committed Dose	Cumulative Committed Dose	Residual Dose[a]
1st Year N=1 CUML=5	1.0	5.0	5.0	0.
2nd Year N=2 CUML=10	1.0	5.0	10.0	0.69
3rd Year N=3 CUML=15	1.0	5.0	15.0	1.18
4th Year N=4 CUML=20	1.0	5.0	20.0	1.54
5th Year N=5 CUML=25	1.0	5.0	25.0	1.8
6th Year N=6 CUML=30	1.0	5.0	30.0	2.0

TABLE 3

INCLUDES RESIDUAL COMMITTED DOSES AT 25% OF LIMIT

Annual Dose	Committed Dose	Cumulative Committed Dose	Residual Dose[a]	Available Comm. Dose[b]
0.25	1.25	1.25	0.	3.75
0.25	1.25	2.50	0.17	7.50
0.25	1.25	3.75	0.295	11.25
0.25	1.25	5.0	0.385	15.00
0.25	1.25	6.25	0.45	18.75
0.25	1.25	7.50	0.50	22.50

(a) Residual dose is the contribution from previous year's intakes to the annual dose in the current year.
(b) Available Committed Dose is the allowance under the 5N criterion available during subsequent years. It is the difference between the 5N criterion and the actual cumulative committed dose. Use of this allowance is limited by the 5 rem annual dose limit.

RECOMMENDED REVISIONS TO SECY-88-315,
ENCLOSURES 3 AND 4

Enclosure 3

ENCLOSURE 3, RECOMMENDED REVISIONS TO FEDERAL REGISTER NOTICE

CHANGES TO ENCLOSURE 3 TO SECY-88-315, STATEMENT OF CONSIDERATIONS

Enclosure 3, bottom page 32, and top of page 33 in § 20.204, replace both paragraphs with:

Interim Dose Calculation Factors and Parameters. Because the existing Part 20 is based on ICRP-2[16] dosimetry and metabolic models and the revised Part 20 employs the ICRP-30[17] dose parameters, there was concern regarding whether the more recent ICRP-30 parameters should be used, particularly when the value is to be compared with the intake limits in the existing Part 20.

Until the effective date of the revision, licensees must continue to demonstrate compliance with the intake limits of the present rule. Because the concentration limits, ALIs and DACs in Appendix B of the revised Part 20 are based upon the effective dose equivalent, they should not be used until after the effective date of the rule. The NRC is planning to issue a Regulatory Guide that will address the use of bioassay measurements for determining compliance with Part 20. Appropriate parameters for calculating organ doses from radionuclide intakes that do not incorporate the w_T weighting factors can be found in ICRP-30 and its supplements. Dose factors for individual organs in Federal Guidance Report #11[18] are acceptable for use for occupational exposure. The effective dose equivalent factors in Federal Radiation Report # 11 do not employ a rounding method suggested in ICRP 30 and, for this reason, may be slightly different (10-20%) than the effective dose factors that correspond to the ALI's and DAC's in both the revised Part 20 and Report # 11. Licensees may use the effective dose factors in Report # 11 for compliance purposes, as these effective dose factors would be more restrictive (give slightly higher doses for the same intake) than dose factors computed using the ICRP 30 round-off procedure.

Effective dose factors should not be used for compliance determinations prior to the effective date of the rule. However, can be used for purposes other than demonstrating compliance, such as environmental reports, prior to the effective date of this revision, providing that it is clearly indicated as being an "effective dose equivalent."

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16 International Commission Radiological Protection, "Report of Committee II on Permissible Dose for Internal Radiation," ICRP Publication No. 2, (1959).

17 International Commission on Radiological Protection, "Limits for Intakes of Radionuclides by Workers," ICRP Publication No. 30, Annals of the ICRP; Vol. 2, No. 314 (1979).

18 Environmental Protection Agency, Federal Guidance Report No. 11, "Limiting Values of Radionuclide Intake and Air Concentration, and Dose Conversion Factors for Inhalation, Submersion and Ingestion." USEPA Report EPA-520/1-88-020 (September 1988).

Enclosure 3, pages 36 bottom; top page 37; replace the last two paragraphs with:

The use of an annual dose limitation system, even with a reduction in the allowable dose limit from 5 rems to 3 rems such as in proposed § 20.205, does not provide a limitation on the lifetime radiation dose or risk equivalent to that provided by the committed dose limitation system of the final rule for all classes of workers. Although long-term workers would be protected to the same degree under either the annual or committed dose systems, short-term or temporary workers could get somewhat higher lifetime doses under a dose limitation system based on limiting only individual annual dose.

Furthermore, it is neither reasonable nor practical to expect future employers to take special measures to control radiation dose to workers who transfer because a previous employer, working under annual organ dose limits, permitted intakes that would result in future dose rates that are appreciable fractions of the allowable dose limits. Such a practice would not be fair to workers whose future employability may be limited because of the additional restrictions a new employer would have to put on their exposure. The annual dose system also requires a complex bookkeeping effort because the annual dose limit for each worker depends upon the worker's pre-existing body burden of radioactive materials. This also would complicate NRC inspections as more records would have to be examined in order to confirm compliance.

Final Rule. For the reasons discussed above, the Commission has decided not to adopt §20.205 and the exemptions for certain long-lived radionuclides from the final rule. The use of the committed dose equivalent will be applied uniformly to all radionuclides, regardless of half-life. The Commission recognizes that the removal of this exemption, combined with the lowering of the airborne concentration limits for several radionuclides (notably thorium and uranium), could impact on the current and future facilities that use these materials. Licensees that are affected by these changes may request an extension of the implementation time in order to make the necessary modifications to comply with the revised limits as they relate to long-lived radionuclides identified in the proposed § 20.205. In addition, licensees should note the flexibility provided in the revised rule which can mitigate this impact. Specifically, § 20.204 allows the use of actual particle size distributions and physiochemical characteristics of airborne particulates to define a site-specific derived air concentration to be used in lieu of the generic values in Appendix B. This section also allows for whole-body counting or bioassay measurements to determine the behavior of radioactive materials in the individual and the use of this data to calculate internal doses. A 7-month delay between a bioassay or retention measurement and recording of the associated dose is also permitted in order to make confirmatory measurements.

The Commission recognizes that alternate methods may be identified in the future which might achieve the same degree of lifetime risk limitation for both short-term and long-term workers as that provided by the committed

dose system recommended by the ICRP, the Radiation Protection Guidance to Federal Agencies for Occupational Exposure, and adopted in the current and revised 10 CFR Part 20. The Commission further believes that to be acceptable, such alternatives should not result in an adverse impact on worker employability or result in undue recordkeeping or excessive monitoring requirements for the future employers of transferring workers.

Enclosure 3, page 30, insert the following paragraph before § 20.203:

Note: Section 20.202(c) states that: "The assigned deep dose equivalent and shallow dose equivalent must be for the part of the body receiving the highest exposure." This requirement is intended to apply primarily to situations where there are steep gradients in the radiation dose rate depending upon location within the facility and spatial orientation of the worker's body. For example, good practice for a worker in a nuclear powerplant who is reaching up into a radioactive steam generator would be to wear at least two personnel dosimeters: one to monitor the extremity dose (worn on the finger or wrist) and one to monitor the whole body dose (worn on the upper arm). For routine monitoring in relatively homogeneous radiation fields, special consideration to identify the actual "highest" exposed area would not be required.

Enclosure 3, page 45 bottom; top page 46 replace with:

Response: The concept used in the proposed rule of relating the dose to the embryo/fetus to the dose received by the mother has been deleted. The final rule permits direct calculation of the dose to the embryo/fetus. This was done so that the use of more accurate dose assessments would not be precluded by the rule. The internal dose to the embryo/fetus may or may not be directly proportional to the dose received by the mother.

Forthcoming Regulatory Guides will provide guidance on methods for calculating the dose to the embryo/fetus. For interim assessments of the dose to the embryo/fetus, it may be assumed that the dose to the embryo/fetus from external radiation and from radionuclides in the body that are relatively uniformly distributed, such as cesium-137 and compounds of tritium and carbon-14 that are not organically bound, is the same as the dose to the mother.

Enclosure 3, page 49, Before second paragraph, beginning "Inclusion of doses from ...," insert:

The dose rate limit of 2 millirems in any one hour from §20.105(b)(1) of the present Part 20 was omitted in the proposed rule but has been reinstated in the revised rule. The reason for this is that this limit provides a more readily measurable quantity than the 100 millirem per year value and can be more easily verified by short-term measurements.

Enclosure 3, page 50, Add to last paragraph a new last sentence:

The 0.5 rem limit is intended to be applied primarily to temporary situations where operation of a facility or the person's exposure to radiation and radioactive emissions is not expected to result in doses above 0.1 rem over long periods of time. For design of new installations, the 0.1-rem limit should be used. However, existing facilities may apply for NRC approval to use the 0.5 rem-limit while more complete evaluation of the need for any additional modifications is performed.

Enclosure 3, page 50, Add following last paragraph:

The Commission is aware that some categories of licensees, such as uranium mill and in situ uranium mining facilities, may experience difficulties in determining compliance with the revised values in Appendix B, Table 2 for radionuclides such as radon-222.

Provision has been made for licensees to use air and water concentration limits or protection of members of the general public that are different from those in Appendix B, Table 2, if the licensee can demonstrate that the physio-chemical properties of the effluent justify such modification and the revised value is approved by the NRC. This provision permits the use of concentration limits for members of the general public that better represent actual exposure conditions. For example, uranium mill licensees could, under this provision, adjust the Table 2 value for radon with daughters to take into account the actual degree of equilibrium present in the environment. This is similar to the allowance for use of modified derived air concentrations (with Commission approval) in §20.204(c)(3) of the revised rule..

Use of this provision applied to the percentage of radionuclide equilibrium could provide a factor of 2 or 3 upward change in the appropriate air concentration limit. In addition, the licensee can demonstrate compliance by calculating the dose to the nearest resident rather than meeting the air concentration limit at the site boundary. This should provide an additional factor of 2 or 3 allowance. Lastly, if the 0.1 rem effective dose limit still cannot be met, the licensee can apply to NRC under §20.301(c) for permission to use a temporary 0.5 rem per year limit rather than the 0.1 rem per year limit. Section 20.301(c) of the revised rule requires that, in order to receive permission for use of this higher dose limit, the licensee has to specify (1) the need for and expected duration of the higher value, (2) their program to assess and

control doses, (3) procedures to control doses to be ALARA. These options used singularly or in combination coupled with process or operational modifications of these facilities is expected to provide sufficient flexibility to enable most uranium recovery facilities to comply with the provisions of the revised 10 CFR Part 20.

Enclosure 3, Page 63, §20.703 add to "Final Rule", Section at top of page after : "...factors."

Allowance has been made for use of respirators that do not provide protection factors that would keep exposures below the Derived Air Concentrations, if (and only if) such use would keep the total effective dose equivalent ALARA.

Enclosure 3, Page 72, first paragraph, line 6 - Insert "meets the requirements of §35.92 'Decay-In-Storage' of 10 CFR Part 35," between "Part 20" and "or".

Enclosure 3, Page 72, second paragraph, lines 4 - 7, make third sentence read:

However, the provisions included in 10 CFR 35.92 and certain specific license conditions pertain to relatively short-lived radionuclides and are neither appropriate nor applicable to other classes of licenses, such as those issued under Part 50.

Enclosure 3, Page 72, insert the following before the section on §20.1003.

Final Rule. Section 20.1001 has been modified to incorporate the requirements that were in § 20.1002(b) of the proposed rule. These provisions require NRC licenses for persons who receive wastes containing licensed radioactive materials for treatment, for treatment or disposal by incineration, decay-in-storage, or disposal in facilities licensed under Part 60 or Part 61.

Enclosure 3, Page 73, At the end of the first "Response" add:

"The prohibition on disposal of insoluble materials via the sanitary sewer was intended to prevent disposal via sanitary sewers of material in which the radioactive material is primarily in an insoluble form. Such materials may accumulate in the sewer system, in the sewer treatment plants, and in the sewer sludge."

[Addresses concerns that have been raised by licensees regarding the intent of the prohibition on disposal of insoluble materials via sewers.]

Enclosure 3, Page 75, Replace "Response" for §20.1005 with:

Response: The Commission agrees that such levels would be useful and has issued advance notices of proposed policy making (51 FR 30839, August 29, 1986 and 53 FR 49886, December 12, 1988) concerning the bases for developing and employing such levels.

Enclosure 3, page 100, last paragraph, add the following sentences after the sentence ending, "...occupational radiation exposures."

The radiation dosed to be reported are those required to be recorded under §20.1106. These doses are listed in the 1987 Federal Guidance to be reported to the worker. "Annual dose" is also specified in the guidance and is used for external doses. However, "annual dose" is not required to be recorded by the revised Part 20 for internal doses. As noted in footnote 5 to the Federal Guidance (Federal Register of January 27, 1977; 52 FR 2832):

> "When these conditions on intake of radioactive materials have been satisfied [i.e., meeting the committed dose limits], it is not necessary to assess contributions from such intakes to annual doses in future years, and, as an operational procedure, such doses may be assigned to the year of intake for the purpose of assessing compliance."

CHANGES TO ENCLOSURE 4 OF SECY-88-315, REVISED RULE

Enclosure 4, page 9, "Commission" substitute for the definition, the following:

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

[restores traditional definition.]

Enclosure 4, page 12, "Generally-applicable Environmental Standards"

Delete last line of definition that reads: "These standards are set out in 40 CFR Parts 190, 191, and 192."

[Removal of this statement alleviates the need for rulemaking each time another EPA generally-applicable standard is issued.]

Enclosure 4, page 19, "Rem" - change first sentence to read:

"'Rem' is the special unit of any of the quantities expressed as dose equivalent."

Enclosure 4, page 19, "Sievert" - change first sentence to read:

"'Sievert' is the SI unit of any of the quantities expressed as dose equivalent."

[These changes clarify the applicability to all quantities of dose equivalent]

Enclosure 4, page 22 §20.8(a) change the last line to read:

"OMB clearance will be obtained prior to January 1, 1992, the effective date of the rule."

[This provides for a possible situation that the OMB clearance will not be obtained at the time of publication.]

Enclosure 4, page 25, §20.202(c), line 3:

Insert "oral" between "applicable" and "ALI."

[Clarifies meaning.]

Enclosure 4, page 27, §20.204(e)(1):

Change "and" in first line to "to"

[Grammatical improvement.]

Enclosure 4, page 27, §20.204(e)(2):

Change "divided by" in second line to "to"

[Grammatical improvement.]

Enclosure 4, page 27, §20.204(h)(2), revise last line to read:

"However, if the licensee uses the stochastic ALIs, the licensee must also demonstrate that the limit in §20.201(a)(1)(ii) is met."

[the initial wording did not indicate that external doses were also to be included in the 50-rem limit.]

Enclosure 4, page 28, in §20.206, replace (c)(3) by:

"(3) Instructed in the measures to be taken to keep the dose ALARA considering other risks that may be present."

[Clarifies intent and removes apparent requirement for keeping other risks, not regulated by the NRC, "as low as is reasonably achievable."]

Enclosure 4, page 28, in §20.206, replace (d) by:

"(d) Prior to permitting an individual to participate in a planned special exposure, the licensee ascertains prior doses as required by § 20.1104(b)."

[Avoids duplicating the requirements in §20.1104(b) in this section.]

Enclosure 4, page 29, §20.208(c)(2), change to read:

"(2) the dose to the embryo/fetus from radionuclides in the embryo/fetus and in the declared pregnant woman."

[This change permits more accurate dose assessments of embryo/fetus dose to be used than the approximation that the embryo/fetus dose is the same as the dose to the mother.]

Enclosure 4, page 30, §20.301(a)(2):

Insert "from external sources" after "unrestricted area."

[Clarifies intent to exclude internal dose rates as they cannot be measured.]

Enclosure 4, page 31, §20.302 add a paragraph (c) as follows:

"(c) Upon approval from the Commission, the licensee may adjust the concentration values in Appendix B, Table 2, for members of the public, to take into account the actual physical and chemical characteristics of the effluents (e.g. aerosol size distribution, solubility, density radioactive decay equilibrium, chemical form, etc.)

[This addition provides for the same degree of flexibility and improved precision of dose assessments for members of the public as is permitted for workers under §20.204(c)(3).]

Enclosure 4, page 32, In §20.501, replace (c)(1) with:

"(1) Holding current personnel dosimetry accreditation from the National Voluntary Laboratory Accreditation Program (NVLAP) of the National Institute of Standards and Technology; and"

[Reflects name change of former National Bureau of Standards.]

Enclosure 4, page 33, In §20.601(a)(1), on third line, replace "dose" with "deep dose equivalent"

Enclosure 4, page 35, In §20.603(a)(1)(ii), on fourth line, replace "dose" with "deep dose equivalent"

Enclosure 4, page 35, In §20.603(a)(1)(iii), on second line, replace "dose" with "deep dose equivalent"

Enclosure 4, page 35, In §20.603(a)(2)(i), on third line, replace "dose" with "deep dose equivalent"

Enclosure 4, page 36, In §20.603(a)(3)(i), on second line replace "dose" with "deep dose equivalent"

Enclosure 4, page 36, In §20.603(a)(8), on fourth line, replace "dose" with "deep dose equivalent"

[All of these changes improve the specificity and meaning of the rule.]

Enclosure 4, page 40, §20.703(b)(1), line 5,

Insert between "Table I, Column 3." and "The concentration...", the following:

"If the selection of a respiratory protection device with a protection factor greater than the peak concentration is inconsistent with the goal specified in §20.702 of keeping the total effective dose equivalent ALARA, the licensee may select respiratory protective equipment with a lower protection factor only if such a selection would result in keeping the total effective dose equivalent ALARA."

[This modification removes an apparent inconsistency between §20.702 and the previous §20.703 in that §20.702 permitted flexibility in respiratory protection by permitting external and internal doses to be traded off against each other in order to keep doses ALARA while §20.703 does not permit such flexibility.]

Enclosure 4, page 40, §20.703(b)(1), line 7, Replace the word "ambient" with "average"

[Improved clarity.]

Enclosure 4, page 51, In §20.1104(b)(2) delete "annual" before "limits" in first line

[Prior to this revision, the primary dose limits were quarterly dose limits.]

Enclosure 4, page 52, In §20.1105(a), change (1) to read:

"(1) The exceptional circumstances requiring the use of the planned special exposure; and"

[§20.206(a) cited in the current text does not actually require an "evaluation."]

Enclosure 4, page 54, §20.1106, replace (e) with:

(e) The licensee shall maintain the records of dose to an embryo/fetus with the records of dose to the declared pregnant woman. The declaration of pregnancy shall also be kept on file, but may be maintained separately from the dose records.

[change provides an explicit requirement for keeping the declaration of pregnancy. This was implied by the definition of a "declared pregnant woman," but not stated.]

CHANGES TO ENCLOSURE 5 TO SECY-88-315, APPENDICES

Enclosure 5, page 129: Paragraph B.2., line 6 Change "Section II" to "Section I" in order to correct typographical error.

Enclosure 5, page 130: Paragraph C.2., lines 1 & 2, change "Section II" to "Section I" and change "Section III" to "Section II" in order to correct typographical errors in proposed rule.

Enclosure 5, page 145, before section on Part 39 insert a section on Part 35 as follows:

"PART 35 - MEDICAL USE OF BYPRODUCT MATERIAL

25. The authority citation for Part 35 continues to read as follows:

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

§35.92(a)

26. Change reference to "§20.301" to "§20.1001."

§35.205(a)

27. Change reference to "§20.103" to "§20.201"

28. Change reference to "§20.106" to "§20.302."

§35.315(a)(8)

29. Change reference to "§20.401(c)(1)" to "§20.1106(a)."

§35.415

30. Change reference to "§20.105(b)" to "§20.301(a)."

§35.630(a)(1)

31. Change reference to "National Bureau of Standards" to "National Institute of Standards and Technology."

§35.630(a)(2)

32. Change reference to "National Bureau of Standards" to "National Institute of Standards and Technology."

§35.641(a)(2)(i)

33. Change reference to "§20.101" to "§20.201."

§35.641(a)(2)(ii)

34. Change reference to "§20.105(b)" to "§20.301."

§35.641(b)(2)

35. Change reference to "§20.501" to "§20.1301."

§35.643(a)

36. Change reference to "§20.105(b)" to "§20.301."

§35.643(a)(1)

37. Change reference to "§20.105(b)" to "§20.301."

§35.643(b)

38. Change reference to "§20.105(a)" to "§20.301(c)."

39. Change reference to "§20.105(b)" to "§20.301(a)."

[These changes correct citations to Part 20 in the new Part 35 which was issued in final form after the proposed Part 20 rule.]

Renumber all subsequent amendments.

ACNW LETTER OF DECEMBER 30, 1988

Enclosure 4

UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON NUCLEAR WASTE
WASHINGTON, D.C. 20555

Morris
Rosztoczy
Roecklein
Peterson (2)
File
pt

December 30, 1988

The Honorable Lando W. Zech, Jr.
Chairman
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Chairman Zech:

SUBJECT: COMMENTS ON THE PROPOSED DELETION OF SECTION 20.205 FROM THE PROPOSED REVISION OF 10 CFR PART 20, "STANDARDS FOR PROTECTION AGAINST RADIATION" (SECY-88-315)

During the fifth meeting of the Advisory Committee on Nuclear Waste, December 21, 1988, we held additional discussions with the NRC staff on the proposed revision of 10 CFR Part 20, Standards for Protection Against Radiation. In response to the inquiry from Commissioner Roberts (SRM dated November 28, 1988), these discussions were directed primarily to procedures for the control of certain long-lived radionuclides, such as those handled at fuel cycle facilities.

As you know, the proposed rule published in the Federal Register on January 9, 1986 contained a new Section 20.205 which addressed the procedures noted above. The proposed section recommended a modified procedure that had been drafted in recognition of the difficulties in measuring (in a practical manner and with the required accuracy) air concentrations in restricted areas and the amounts of radionuclides in bioassay samples taken from workers whose intakes had been held at or below the permissible annual limits of intake (ALI). Although the proposed revision would have required licensees to design facilities so that air concentrations averaged over the year in restricted areas would be below the derived air concentration limits and would also have required that such facilities be operated in a manner that would ensure that any individual would be unlikely to have an intake from occupational exposure in any one year in excess of the ALI value, the modified procedure would have allowed licensees to permit doses to workers in excess of the limits in Section 20.201 as long as the sum of the internal and external effective dose equivalent would not have exceeded 5 rem, and the annual effective dose equivalent from certain specified internally deposited long-lived radionuclides would not have exceeded 3 rem.

We believe that such a modified procedure is unacceptable. First, it would not be in accord with what we understand are the recommendations of either the International Commission on Radiological Protection (ICRP Publication 26, 1977) or the National Council on Radiation Protection and Measurements (NCRP Report No. 91, 1987). In addition, it is our interpretation that such a position would not be in conformance with the requirements outlined in the "Radiation Protection Guidance to Federal

Agencies for Occupational Exposure," approved by President Reagan on January 20, 1987.

Based on our review of this issue, we recommend that annual doses arising from the intake of long-lived radionuclides be limited to a dose commitment no higher than the annual dose limit of proposed Section 20.201. To make an exception for any specific group of radionuclides or licensees would, in our opinion, be inappropriate. Hence, we concur with the NRC staff's recommendation to delete Section 20.205.

In addition, we recommend that the NRC encourage licensees to follow the guidelines contained in the Radiation Protection Guidance to Federal Agencies referred to above; namely, that record keeping include data on both the annual and committed effective dose equivalent, as well as on the cumulative (lifetime) dose.

We hope these additional comments will be helpful.

Sincerely,

Dade W. Moeller

Dade W. Moeller
Chairman

References:

1. SECY-88-315 dated November 4, 1988 for The Commissioners from Victor Stello, Jr., Subject: Revision of 10 CFR Part 20, "Standards for Protection Against Radiation."
2. Staff Requirements Memo dated November 28, 1988 for Victor Stello, Jr., EDO, W. C. Parler, OGC, and D. W. Moeller, ACNW, regarding Briefing on Final Rule on Standards for Protection Against Radiation in Part 20.

NUMARC PROPOSAL OF MAY 8, 1989

Enclosure 5

NUCLEAR MANAGEMENT AND RESOURCES COUNCIL

1776 Eye Street, N.W. • Suite 300 • Washington, DC 20006-2496
(202) 872-1280

May 8, 1989

Dr. William M. Morris
Director
Division of Regulatory Applications
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Dr. Morris:

At the February 22, 1989 meeting between NUMARC, representatives of the U. S. Fuel Fabricators and the NRC, the NRC staff asked that the fuel fabricators transmit through NUMARC additional data on particle size distributions and an example calculation based on real data using the proposed alternative to 10 CFR 20.205 presented during this meeting. NUMARC has received information from three fuel fabricators regarding particle size distribution information. This information is attached.

With respect to the request that the fabricators run an actual calculation using the proposed alternative developed and presented at the February 22, 1989 meeting, the letter from General Electric contains an example of such a calculation.

If you have any questions regarding this information, please contact Lynne Fairobent or me.

Sincerely,

Thomas E. Tipton

Thomas E. Tipton
Director
Operations, Management and
Support Services

TET:laf

Attachments

cc: Richard Cunningham, NRC/NMSS
Paul Stansbury, General Electric
Chuck Malody, Advanced Nuclear Fuels
Rich Burklin, Westinghouse

April 25, 1989

NUMARC
Attn: Ms. Lynne Fairobent
1776 Eye St. N.W.
Suite 300
Washington, D.C. 20006-2496

Dear Lynne:

At the February 22, 1989, meeting of the NRC staff and U.S. low enrichment uranium fuel (LEUF) fabricators), it was requested that the LEUF fabricators provide data on airborne uranium particle size distributions and illustrations of the dose control scheme in which compliance with dose limits would be based on annual dose while an estimate of compartmentalized lung contents would be tracked to provide an estimate of the residual committed dose. The particle size data are discussed below. The models and actual individual dose history used to illustrate the scheme of annual dose with committed dose tracking are attached.

In 1982 a preliminary study of uranium particle size in the fuel manufacturing areas was undertaken. An eight-stage cascade impactor (Andersen 1 cfm) ambient air sampler was used sampling the air at one location for 24 to 48 hours. The glass fiber substrates on which the aerosols impacted were counted with an alpha scintillation detector. The long sampling times were necessary to collect sufficient samples to permit statistically accurate analysis of each stage of interest. The results are summarized as follows: four measurements were made in the vicinity of pellet grinders yielding activity mean aerosol diameters (AMAD's) of 6 to 8 μm and five measurements were made near calciners yielding AMAD's of 4 to 8 μm. In three of the five calciner measurements there was some indication of a smaller (approximately 10% weight fraction) second distribution with AMAD of 0.5 μm. This second mode could indicate the presence of a second smaller distribution or re-entrainment of a few particles from larger stages due to overloading of a single stage or vibration of the apparatus in the factory environment. It should be noted that a significant amount of effort was necessary to calibrate the detector and develop and debug measurement and data analysis protocols.

These data, although scanty, compare favorably with two recent publications addressing uranium oxide particle size [see K.S. Thind, "A Comparison of ICRP Publication 30 Lung Model - Based Predictions With Measured Bioassay Data for Airborne Natural UO_2 Exposure," Health Physics Vol. 53, No. 1 (July 1987), pp 50-66, and H. Schieferdecker, et. al., "Inhalation of U Aerosols from UO_2 Fuel Element Fabrication," Health Physics Vol. 48, No. 1 (January 1985), pp 29-48]. Thind, studying workers at a Canadian natural uranium fuel fabrication facility, found AMAD's in the range of 3.7 to 7.2 µm among seven different work aras. Schieferdecker, studying eight varying types of work stations, consistently found a particle size of 8.2 µm AMAD.

Parenthetically it should be noted that both studies indicated clearance times shorter than the 500 days used by the ICRP. Thind found a clearance halftime of 250 days best characterized the data in his study. Shieferdecker found a clearance halftime of 109 days.

GE believes that a complete and definitive particle size study of its fuel manufacturing facilities would likely provide justification for adjusting the 1 µm DAC for Class Y uranium to a level near 5×10^{-11} µCi/ml. For the purposes of design and of control of the workplace, as outlined in the January 1987 Presidential Guidance, such an adjustment of DAC would do much to ameliorate the impact of the cost of compliance with the proposed 10CFR20 changes. Current airborne levels average 1.5 to 2.0×10^{-11} µCi/ml.

Such an adjusted DAC should not be used as the primary basis for assessment of dose to individuals. Adjusted DAC's will fluctuate in time, and because of the inherently indirect nature of air sampling and particle size measurements, it would be difficult to defend the assignment doses to individuals based on particle-size-adjusted DAC's. Difficulties would be anticipated during inspections and, potentially, during litigation proceedings.

In accordance with the January 1987 Presidential Guidance, GE believes the dose of record for individual workers (i.e., the dose to demonstrate compliance with 10CFR20 limits) should be based on annual dose. At the February 22, 1989, meeting the LEUF fabricators suggested a combined system as follows:

1. The dose of record for an individual would be the sum of the external dose, the committed dose from all but Class Y compounds, and the annual dose for Class Y compounds.

2. Estimates of the compartmentalized lung contents would be tracked and worker exposures to Class Y uranium would be managed

such that the sum of annual doses (as in 1 above) during the period of employment plus an estimate of the residual committed dose at the end of every year would not likely be in excess of five rems times the number of years worked at a facility processing Class Y uranium.

GE has completed a preliminary study in which the ICRP 30 lung model was adapted to perform the desired computations. In the study, the adapted model was applied to historical data for a group of nine individuals who have been exposed to airborne uranium and been lung counted for six or more years. Attachment A explains the modeling and the assumptions used. Attachment B gives the results for the nine individuals studied. Attachment C shows a test case used to validate the differential equations of the compartment model.

The model was developed to demonstrate the feasibility, reasonableness, and benefit of the combined annual/committed dose proposal made by the LEUF fabricators. As outlined in Appendix A, the model is based on some simplifications which were made to minimize hand-keying of data and to speed model development. Should the LEUF recommended approach be incorporated in the new 10CFR20, the model would be made more accurate and it is expected that the frequency of lung counts would be increased two to four-fold. Also, the timing of lung counts would be optimized to provide the best estimate of lung contents.

GE believes the model shows the feasibility of the combined annual/committed dose approach and its ability to minimize the overprediction of dose inherent in the simple application of committed dose control. Because the tracking of committed dose prevents the dose from depositions in long term compartments from increasing in an unbounded manner, the combined scheme will provide fully adequate protection under the 5-rem per year limit. Indeed, it is functionally equivalent to a committed dose control scheme based on perfectly accurate and complete intake data. Further, the scheme is superior because it depends heavily on the direct measurement of lung contents and thus accounts for individual variability in intake and retention.

Should the NRC staff desire further discussion or assistance in framing the actual provisions to incorporate into the final rule, GE would be happy to respond in a prompt manner. In fact, the best approach would be to have another meeting of LEUF fabricators with the NRC Staff to resolve any questions and finalize details as desired.

Sincerely,

GE NUCLEAR ENERGY

Paul S. Stansbury, PhD

Ms. Lynne Fairobent
April 25, 1989

ATTACHMENT A

ADAPTATION OF ICRP 30 LUNG MODEL,
ASSUMPTIONS USED IN ITS DEVELOPMENT, AND
DISCUSSION OF AREAS OF IMPROVEMENT

DESCRIPTION OF MODEL

1. Only ICRP 30 model compartments with clearance halftime of 500 days or greater are considered (i.e., compartments e, g, h, i, and j). See Figure A-1. All other compartments have a clearance time of one day or less and would not contribute to committed dose.

2. Lung counter is presumed to measure contents in e, g, h, i, and j. It is assumed that any compartment f contents have cleared. This assumption biases lung counts upwards since workers are often counted in the middle of their work week.

3. The dynamics of the model are based on deposition to, transfer between, and clearance from compartments e, g, h, i, and j.

   a. Transfer and clearance are based strictly on ICRP 30 models, i.e. $t_{1/2}$ for e, g, and h of 500 days, $t_{1/2}$ for i of 1000 days, and no clearance from j. Branching ratios are as shown in Figure A-1.

   b. Deposition in e, g, and h is based on air sampling and lung counting data.

4. The deposition in e, g, and h is computed using a mass balance approach at the end of each year. For a given year:

the contents from prior years less the transfer and clearance during the year	+ Dp x	the deposition during the year less clearance during the year	$\geq$	the end of the year lung contents as determined from lung count data

5. The computation in step 4 above results in a Dp, a factor which adjusts depositions in a given year for the lung contents measured at the end of the year. The Dp inferred reflects the variation in deposition based on particle size and also accounts for other factors, in particular, the fraction of airborne uranium which was measured by air sampling which was Class D or W. Dp was arbitrarily constrained to lie between 0.08 and 0.50 corresponding to particle size of 0.2 and 5.7 μm in the ICRP log-normal model. The value of 0.50 only occurs in initial or final years and is believed to be an artifact caused by the statistical uncertainty of lung counts.

6. Simplifying assumptions used in computing intakes and depositions:

   a. Quarterly sums of intakes were used by assigning 1/3 of the quarterly total at the middle of each month.

   b. The end-of-year lung contents were estimated by a simple average of all lung counts within six months plus or minus of the end of the calendar year.

   c. Thirty day months and 360 day years were used for the compartment modeling.

7. Conversion constants used in modeling:

   a. Air sampling results are archived in individual dose records in units of μCi-hr/ml. These were converted to activity (i.e., μCi) by assuming a a constant standard breathing rate of 1.2×10^{6} ml/hr.

   b. Lung count results are archived in individual dose records in units of the observed μg of ^{235}U. These results were converted to a total uranium activity by assuming a constant plant average enrichment of 2.2% ^{235}U and a specific activity of 1.25×10^{-6} μCi per μg of uranium as calculated from the 10CFR20 Appendix B formula.

   c. Results in the calculation of compartment activities for each individual as tabularized in units of pCi to enhance readability.

DOSE COMPARISON

1. The dose calculations are in two sections as calculated for each individual. The three left most columns pertain to strict committed dose. The intake is computed from unadjusted air sampling and the committed dose from the equivalence of 4×10^{-2} μCi = 5 rems (ALI). The right most four columns demonstrate the combined annual/committed dose.

2. The lung count averages are based on a point-to-point time integral during the year (and, thus, are a different quantity than the year-end contents presented in the uppermost table).

3. The annual dose is calculated by using the ICRP 30 specific effective energy (see Figure A-2) and the number of transformations in a year. The annual dose is weighted with a factor of 0.12 to convert it to effective dose. The specific factor used in the calculations is 217 rems per μCi-year.

4. The residual committed dose is projected each year based on the compartment contents given in the middle table. Effective committed doses are calculated from a dose factor of 0.595 rems/μCi-day times the mean residence time of 721 days for compartments e, g, and h yielding a factor of 429 rems/μCi. For h the mean life is 1443 days and the dose factor is 859 rems/μCi. Note that the mean life calculation method is equivalent to the 50 year integral. The residual committed dose for the j compartment is computed for each year of interest by prorating the remaining 50 years integral for each prior year's intake. For example, consider an individual at the tenth year of exposure. The residual committed dose for the 10th year's intake is the full 50 years (i.e., 10,850 rems/μCi) while the residual committed dose at the 10th year for the first year's intake is 8,680 rems/μCi.

DISCUSSION OF MODEL

1. The method of computing year-end lung contents from lung counting needs improvement. The processes of averaging the counts six months either side of year-end makes use of all available data but could be improved upon with a "best estimate" routine which considers the statistical error in each count and the dynamics in lung clearance in the intervening intervals. Further, current day lung count scheduling practices could be improved to have one or more counts at times providing better estimate of year-end contents. Scheduling could be further improved to count workers after a weekend ensuring clearance of the f compartment.

2. Half times of 500 and 1000 days were used in this model. Published studies show that shorter clearance times provide better fit to uranium worker data. Such sophistication is beyond the scope of this study designed to show feasibility and reasonableness of the combined dose approach. Multivariate analysis studies using daily airborne estimates of intake along with more frequent lung counts could be used to provide better estimates of these parameters and more accurate, individualized estimates of compartmentalized lung counts and residual committed dose.

3. This study assumed all airborne uranium was Class Y. If a practical method, perhaps compositing various air sample filters over time, could be developed, accounting for Class D uranium (UNH) and super D uranium (UF_6) separately would improve the estimating of compartmentalized lung contents.

4. It should be noted that the simplifications used to estimate lung contents, annual dose, and residual committed dose are conservative. They tend to bias the estimates upwards.

GENERAL ELECTRIC CO.
Nuclear Energy Business Operations
ENGINEERING CALCULATION SHEET

NUMBER _____ DATE 4/25/89

SUBJECT _____ BY P.L. Stansbury SHEET ____ OF ____

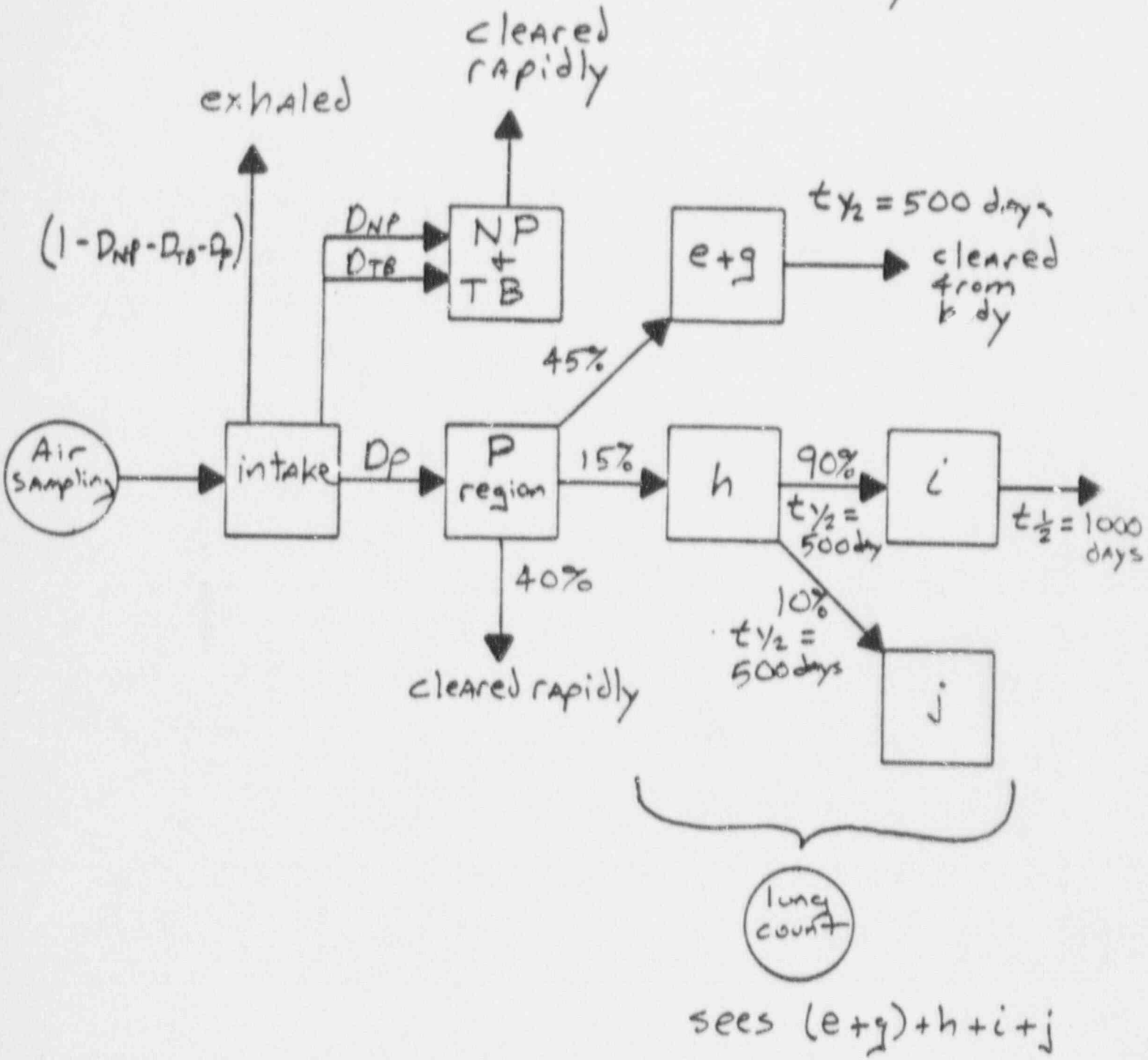

Figure A - 1

FIGURE A-2

Specific Effective Energy

From ICRP 30 Supplement to Part 1

U-234	9.7 E-02	$\frac{\text{MeV/g}}{\text{trans}}$
U-235	8.9 E-02	
Th-231	1.7 E-04	
U-238	8.5 E-02	
Th-234	6.1 E-05	
Pa-234m	8.2 E-04	
Pa-234	5.9 E-04	

Note

1. Lung-to-lung target to source
2. U-234 SEE is the largest

$$\frac{9.7 \times 10^{-2}\ \text{MeV/g}}{\text{trans}} \times \frac{1\ \text{rem}}{6.24 \times 10^{7}\ \text{MeV/g}} = \frac{1.55 \times 10^{-9}\ \text{rem}}{\text{trans}}$$

Ms. Lynne Fairobent
April 25, 1989

ATTACHMENT B

INDIVIDUAL MODELING STUDY RESULTS

Calculations as outlined in Attachment A were performed for nine individuals, seven males and two females. Five currently work in areas where the exposure is strictly Class Y, four work in areas where there is a mixture of Class Y and more soluble forms of uranium.

The long term agreement of lung contents, as calculated from air sampling and inferred Dp (top table, column 3) and lung contents from lung counts (same table, column 6) is good considering the simplifying assumptions as given in Attachment A.

No explicit comparison is given for the sum of annual doses plus the residual committed dose (bottom table, right most column) with 5 rems times the number of years worked. The sample of worker histories studied is believed to be representative enough to demonstrate that managing worker exposures under such a limit or guide would not be an operational difficulty.

Results of ICRP 30 Modelling Calculations
Individual Id. No. 19[illegible]2

Year End	From Air Sampling and Dp: Residual Lung Contents (pCi)	Current Year Addition (pCi)	Year End Contents (pCi)	Inferred Dp	Inferred Particle Size (microns)	From Lung Counting: Year End Contents (pCi)	Number Of Lung Counts
1975	0	774	774	0.08	5.7		0
1976	536	2886	3422	0.08	5.7	0	2
1977	2391	4275	6666	0.08	5.7	6185	9
1978	4687	3485	8171	0.08	5.7	5408	7
1979	5791	3015	8806	0.08	5.7	5140	4
1980	6299	1740	8039	0.08	5.7	7498	5
1981	5820	2188	8009	0.13	2.9	8009	5
1982	5831	232	6062	0.08	5.7	2670	3
1983	4505	113	4617	0.08	5.7	3578	3
1984	3504	64	3569	0.08	5.7	3238	1

Calculated Compartment Contents (pCi)
From Air Sampling and Dp

Year End	Total Contents	Compartment: e + g	h	i	j
1975	774	571	190	11	1
1976	3422	2376	792	226	28
1977	6666	4441	1480	657	88
1978	8171	5156	1719	1132	165
1979	8806	5201	1734	1614	257
1980	8039	4345	1448	1906	340
1981	8009	4180	1393	2027	408
1982	6062	2675	892	2029	466
1983	4617	1689	563	1863	502
1984	3569	1063	354	1626	525

Dose Comparison

Year End	Intake Based on Air Sampling (pCi)	Committed Dose Based on 1 Micron (rems)	Cumulative Committed Dose (rems)	Lung Count Average (pCi)	Annual Dose From Average Lung Count (rems)	Residual Committed Dose (rems)	Cumulative Annual Dose Plus Residual Committed Dose (rems)
1975	16920	2.12	2.12	0	0.00	0.35	0.35
1976	72240	9.03	11.14	3516	0.76	1.85	2.62
1977	107160	13.39	24.54	3359	0.73	4.05	5.54
1978	84600	10.58	35.11	4262	0.92	5.69	8.11
1979	78120	9.77	44.88	6190	1.34	7.09	10.85
1980	44760	5.59	50.48	7063	1.53	7.69	12.98
1981	31800	3.98	54.45	5064	1.10	8.37	14.76
1982	6240	0.78	55.23	4170	0.90	8.05	15.35
1983	2880	0.36	55.59	3004	0.65	7.64	15.58
1984	1560	0.20	55.79	3234	0.70	7.21	15.86

Results of ICRP 30 Modelling Calculations
Individual Id. No. 19889

Year End	From Air Sampling and Dp: Residual Lung Contents (pCi)	Current Year Addition (pCi)	Year End Contents (pCi)	Inferred Dp	Inferred Particle Size (microns)	From Lung Counting: Year End Contents (pCi)	Number Of Lung Counts
1975	0	840	840	0.08	5.7		0
1976	581	3388	3969	0.08	[illegible]	0	4
1977	2772	4096	6868	0.08	[illegible]	1676	6
1978	4832	1065	5897	0.08	5.7	5737	1
1979	4216	923	5139	0.08	5.7	0	1
1980	3724	2751	6475	0.29	0.8	6475	1
1981	4676	708	5384	0.08	5.7	4544	1
1982	3948	632	4579	0.08	5.7	4355	3
1983	3402	440	3842	0.08	5.7	2158	1
1984	2894	741	3635	0.15	2.4	3635	1
1985	2750	658	3408	0.12	3.1	3408	1
1986	2592	958	3550	0.31	0.7	3550	2
1987	2691	1399	4090	0.35	0.5	4090	2
1988	3070	2104	5173	0.50	0.2	8094	2

Calculated Compartment Contents (pCi)
From Air Sampling and up

Year End	Total Contents	Compartment: e + g	h	i	j
1975	840	620	207	12	1
1976	3969	2769	923	247	30
1977	6868	4554	1518	702	94
1978	5897	3482	1161	1092	163
1979	5139	2746	915	1263	215
1980	6475	3592	1197	1416	269
1981	5384	2662	887	1513	321
1982	4579	2047	682	1489	361
1983	3842	1541	514	1396	391
1984	3635	1450	483	1285	417
1985	3408	1333	444	1190	441
1986	3550	1479	493	1113	464
1987	4090	1883	628	1086	492
1988	5173	2625	875	1144	529

Dose Comparison

Year End	Intake Based on Air Sampling (pCi)	Committed Dose Based on 1 Micron (rems)	Cumulative Committed Dose (rems)	Lung Count Average (pCi)	Annual Dose From Average Lung Count (rems)	Residual Committed Dose (rems)	Cumulative Annual Dose Plus Residual Committed Dose (rems)
1975	18360	2.29	2.29	0	0.00	0.38	0.38
1976	83880	10.48	12.78	1030	0.22	2.13	2.35
1977	102360	12.79	25.58	1390	0.30	4.22	4.74
1978	27720	3.46	29.04	3805	0.83	4.67	6.02
1979	23160	2.90	31.93	2233	0.48	4.93	6.76
1980	19080	2.39	34.32	5818	1.26	6.08	9.18
1981	17640	2.20	36.52	4369	0.95	6.14	10.19
1982	15960	2.00	38.52	3894	0.85	6.13	11.02
1983	11160	1.40	39.92	2763	0.60	6.01	11.50
1984	9960	1.25	41.16	3530	0.77	6.05	12.31
1985	10800	1.35	42.51	3853	0.84	6.07	13.17
1986	6240	0.78	43.29	3929	0.85	6.26	14.20
1987	7800	0.98	44.26	5782	1.25	6.66	15.86
1988	8280	1.03	45.30	9531	2.07	7.43	18.70

Results of ICRP 30 Modelling Calculations
Individual Id. No. 19921

Year End	From Air Sampling and Dp: Residual Lung Contents (pCi)	Current Year Addition (pCi)	Year End Contents (pCi)	Inferred Dp	Inferred Particle Size (microns)	From Lung Counting: Year End Contents (pCi)	Number Of Lung Counts
1975	0	143	143	0.08	5.7		0
1976	99	1730	1829	0.08	5.7	0	1
1977	1275	2322	3597	0.08	5.7	0	6
1978	2526	4650	7176	0.16	2.2	7176	6
1979	5052	2030	7082	0.08	5.7	4398	7
1980	5048	1410	6458	0.08	5.7	6225	5
1981	4661	3768	8429	0.18	1.7	8429	5
1982	6064	1233	7297	0.08	5.7	3881	3
1983	5322	0	5322				0
1984	3972	0	3972				0
1985	3033	652	3686	0.08	5.7	3436	2
1986	2824	870	3694	0.08	5.7	2329	3
1987	2825	1264	4090	0.20	1.5	4090	2
1988	3096	1467	4563	0.10	4.2	4563	3

Calculated Compartment Contents (pCi)
From Air Sampling and Dp

Year End	Total Contents	Compartment: e + g	h	i	j
1975	143	105	35	2	0
1976	1829	1289	430	98	12
1977	3597	2419	806	329	43
1978	7176	4740	1580	752	105
1979	7082	4288	1429	1185	180
1980	6458	3572	1191	1449	247
1981	8429	4817	1606	1689	317
1982	7297	3759	1253	1895	390
1983	5322	2263	754	1865	440
1984	3972	1363	454	1685	470
1985	3686	1286	429	1479	492
1986	3694	1383	461	1336	515
1987	4090	1746	582	1223	538
1988	4563	2088	696	1208	571

Dose Comparison

Year End	Intake Based on Air Sampling (pCi)	Committed Dose Based on 1 Micron (rems)	Cumulative Committed Dose (rems)	Lung Count Average (pCi)	Annual Dose From Average Lung Count (rems)	Residual Committed Dose (rems)	Cumulative Annual Dose Plus Residual Committed Dose (rems)
1975	3120	0.39	0.39	0	0.00	0.06	0.06
1976	42600	5.33	5.71	0	0.00	0.95	0.95
1977	57480	7.19	12.90	2855	0.62	2.13	2.75
1978	58080	7 26	20.16	6202	1.35	4.48	6.45
1979	50400	6.30	26.46	4696	1.02	5.39	8.37
1980	35640	4.46	30.91	7130	1.55	5.89	10.42
1981	40800	5.10	36.02	6108	1.33	7.52	13.38
1982	31800	3.98	39.99	3301	0.72	7.82	14.39
1983	0	0.00	39.99	3210	0.70	7.39	14.66
1984	0	0.00	39.99	3206	0.70	6.95	14.92
1985	15720	1.96	41.96	2837	0.62	6.86	15.44
1986	22200	2.77	44.73	2162	0.47	6.94	15.99
1987	11640	1.46	46.18	3710	0.81	7.19	17.05
1988	28920	3.62	49.80	6421	1.39	7.61	18.86

Results of ICRP 30 Modelling Calculations
Individual Id. No. 22110

Year End	From Air Sampling and Dp: Residual Lung Contents (pCi)	Current Year Addition (pCi)	Year End Contents (pCi)	Inferred Dp	Inferred Particle Size (microns)	From Lung Counting: Year End Contents (pCi)	Number Of Lung Counts
1977	0	708	708	0.08	5.7	0	3
1978	490	4836	5326	0.08	5.7	3361	6
1979	3715	2551	6267	0.08	5.7	2545	5
1980	4430	2470	6900	0.08	5.7	4771	4
1981	4922	1616	6537	0.08	5.7	4757	4
1982	4715	1080	5795	0.08	5.7	5775	3
1983	4229	998	5227	0.08	5.7	4752	3
1984	3853	1031	4884	0.08	5.7	3124	3
1985	3624	1678	5301	0.10	4.5	5301	3
1986	3923	1232	5155	0.08	5.7	5155	4
1987	3834	1818	5652	0.12	3.4	5652	4
1988	4191	910	5101	0.08	5.7	4601	2

Calculated Compartment Contents (pCi)
From Air Sampling and Dp

Year End	Total Contents	Compartment: e + g	h	i	j
1977	708	523	174	10	1
1978	5326	3737	1246	305	37
1979	6267	4019	1340	801	108
1980	6900	4153	1384	1185	179
1981	6537	3629	1210	1453	245
1982	5795	2946	982	1566	301
1983	5227	2473	824	1583	347
1984	4884	2223	741	1535	385
1985	5301	2519	840	1517	426
1986	5155	2386	795	1507	467
1987	5652	2719	906	1516	511
1988	5101	2277	759	1512	553

Dose Comparison

Year End	Intake Based on Air Sampling (pCi)	Committed Dose Based on 1 Micron (rems)	Cumulative Committed Dose (rems)	Lung Count Average (pCi)	Annual Dose From Average Lung Count (rems)	Residual Committed Dose (rems)	Cumulative Annual Dose Plus Residual Committed Dose (rems)
1977	15480	1.94	1.94	2952	0.64	0.32	0.96
1978	119400	14.92	16.86	3399	0.74	2.80	4.18
1979	66720	8.34	25.20	3216	0.70	4.15	6.23
1980	62520	7.82	33.02	6107	1.33	5.30	8.70
1981	41280	5.16	38.17	4443	0.96	5.92	10.28
1982	27000	3.38	41.55	4767	1.03	6.17	11.57
1983	25320	3.16	44.71	3929	0.85	6.35	12.60
1984	25080	3.14	47.85	3688	0.80	6.51	13.56
1985	35280	4.41	52.26	5765	1.25	7.02	15.32
1986	30600	3.83	56.08	4662	1.01	7.29	16.60
1987	31080	3.89	59.97	4956	1.08	7.86	18.25
1988	22800	2.85	62.82	5575	1.21	7.94	19.55

Results of ICRP 30 Modelling Calculations
Individual Id. No. 22387

Year End	From Air Sampling and Dp: Residual Lung Contents (pCi)	Current Year Addition (pCi)	Year End Contents (pCi)	Inferred Dp	Inferred Particle Size (microns)	From Lung Counting: Year End Contents (pCi)	Number Of Lung Counts
1978	0	362	362	0.08	5.7	0	3
1979	251	3693	3944	0.10	4.0	3944	7
1980	2748	4363	7111	0.12	3.5	7111	5
1981	5000	2488	7488	0.09	4.8	7488	6
1982	5327	1731	7057	0.09	4.8	7057	4
1983	5078	1549	6627	0.08	5.7	4449	3
1984	4815	664	5480	0.08	5.7	4260	3
1985	4043	444	4487	0.26	0.9	4487	2
1986	3360	169	3529	0.08	5.7	1534	1
1987	2693	260	2954	0.09	4.7	2954	1
1988	2286	1701	3986	0.50	0.2	5055	1

Calculated Compartment Contents (pCi)
From Air Sampling and Dp

Year End	Total Contents	Compartment: e + g	h	i	j
1978	362	267	89	5	1
1979	3944	2786	929	202	24
1980	7111	4736	1579	705	93
1981	7488	4595	1532	1189	173
1982	7057	3986	1329	1497	245
1983	6627	3486	1162	1670	309
1984	5480	2552	851	1715	362
1985	4487	1856	619	1616	398
1986	3529	1238	413	1456	423
1987	2954	928	309	1274	441
1988	3986	1755	585	1181	465

Dose Comparison

Year End	Intake Based on Air Sampling (pCi)	Committed Dose Based on 1 Micron (rems)	Cumulative Committed Dose (rems)	Lung Count Average (pCi)	Annual Dose From Average Lung Count (rems)	Residual Committed Dose (rems)	Cumulative Annual Dose Plus Residual Committed Dose (rems)
1978	7920	0.99	0.99	1827	0.40	0.16	0.56
1979	68760	8.60	9.59	4956	1.08	2.03	3.51
1980	76440	9.55	19.14	5627	1.22	4.31	7.01
1981	55560	6.95	26.08	7498	1.63	5.50	9.82
1982	37800	4.73	30.81	5206	1.13	6.16	11.61
1983	39240	4.91	35.71	4555	0.99	6.67	13.10
1984	18000	2.25	37.97	5239	1.14	6.67	14.25
1985	3240	0.41	38.37	2920	0.63	6.50	14.71
1986	4080	0.51	38.88	2031	0.44	6.20	14.85
1987	5640	0.70	39.59	3776	0.82	5.97	15.44
1988	6840	0.86	40.44	4916	1.07	6.53	17.06

Results of ICRP 30 Modelling Calculations
Individual Id. No. 23743

Year End	From Air Sampling and Dp: Residual Lung Contents (pCi)	Current Year Addition (pCi)	Year End Contents (pCi)	Inferred Dp	Inferred Particle Size (microns)	From Lung Counting: Year End Contents (pCi)	Number Of Lung Counts
1980	0	710	710	0.23	1.2	710	2
1981	492	3442	3933	0.28	0.8	3933	4
1982	2734	2193	4927	0.08	5.7	3048	3
1983	3470	350	3820	0.08	5.7	3664	2
1984	2740	2329	5069	0.14	2.7	5069	4
1985	3631	1146	4777	0.08	5.7	4714	3
1986	3458	1768	5226	0.13	2.9	5226	3
1987	3792	4699	8491	0.08	5.7	3987	5
1988	6072	1232	7304	0.08	5.7	3313	3

Calculated Compartment Contents (pCi)
From Air Sampling and Dp

Year End	Total Contents	Compartment: e + g	h	i	j
1980	710	524	175	10	1
1981	3933	2829	943	144	17
1982	4927	3240	1080	536	71
1983	3820	2199	733	772	116
1984	5069	2976	992	943	158
1985	4777	2595	865	1110	208
1986	5226	2809	936	1228	252
1987	8491	5133	1711	1346	300
1988	7304	3959	1320	1649	377

Dose Comparison

Year End	Intake Based on Air Sampling (pCi)	Committed Dose Based on 1 Micron (rems)	Cumulative Committed Dose (rems)	Lung Count Average (pCi)	Annual Dose From Average Lung Count (rems)	Residual Committed Dose (rems)	Cumulative Annual Dose Plus Residual Committed Dose (rems)
1980	5400	0.68	0.68	1618	0.35	0.32	0.67
1981	22200	2.77	3.45	4165	0.90	1.93	3.19
1982	55680	6.96	10.41	1272	0.28	3.08	4.61
1983	8640	1.08	11.49	4597	1.00	3.16	5.68
1984	32880	4.11	15.60	5228	1.13	4.19	7.85
1985	29040	3.63	19.23	4357	0.95	4.59	9.20
1986	26640	3.33	22.56	4960	1.08	5.27	10.95
1987	105120	13.14	35.70	3757	0.82	7.17	13.67
1988	30840	3.85	39.56	2696	0.59	7.52	14.61

Results of ICRP 30 Modelling Calculations
Individual Id. No. 27013

Year End	From Air Sampling and Dp: Residual Lung Contents (pCi)	Current Year Addition (pCi)	Year End Contents (pCi)	Inferred Dp	Inferred Particle Size (microns)	From Lung Counting: Year End Contents (pCi)	Number Of Lung Counts
1982	0	1407	1407	0.50	0.2	4260	3
1983	974	1790	2764	0.12	3.3	2764	3
1984	1940	457	2397	0.08	5.7	0	1
1985	1708	1479	3187	0.08	5.7	3053	4
1986	2273	1437	3711	0.12	3.2	3711	3
1987	2662	3671	6333	0.31	0.7	6333	2
1988	4510	647	5156	0.08	5.7	4430	3

Calculated Compartment Contents (pCi)
From Air Sampling and Dp

Year End	Total Contents	Compartment: e + g	h	i	j
1982	1407	1038	346	20	2
1983	2764	1864	621	247	31
1984	2397	1447	482	409	58
1985	3187	1924	641	537	86
1986	3711	2152	717	718	123
1987	6333	3897	1299	964	174
1988	5156	2802	934	1191	230

Dose Comparison

Year End	Intake Based on Air Sampling (pCi)	Committed Dose Based on 1 Micron (rems)	Cumulative Committed Dose (rems)	Lung Count Average (pCi)	Annual Dose From Average Lung Count (rems)	Residual Committed Dose (rems)	Cumulative Annual Dose Plus Residual Committed Dose (rems)
1982	4920	0.62	0.62	3195	0.69	0.64	1.33
1983	30960	3.87	4.49	1864	0.40	1.61	2.71
1984	11160	1.40	5.88	1806	0.39	1.80	3.29
1985	36000	4.50	10.38	3211	0.70	2.47	4.66
1986	24720	3.09	13.47	4518	0.98	3.15	6.31
1987	23400	2.93	16.39	5145	1.12	4.88	9.16
1988	16200	2.02	18.42	4454	0.97	5.02	10.27

Results of ICRP 30 Modelling Calculations
Individual Id. No. 27038

Year End	From Air Sampling and Dp: Residual Lung Contents (pCi)	Current Year Addition (pCi)	Year End Contents (pCi)	Inferred Dp	Inferred Particle Size (microns)	From Lung Counting: Year End Contents (pCi)	Number Of Lung Counts
1983	0	2286	2286	0.09	4.7	2286	4
1984	1590	2940	4530	0.09	5.2	4530	4
1985	3177	2047	5223	0.08	5.7	3025	4
1986	3703	1727	5430	0.08	5.7	4374	4
1987	3886	1217	5103	0.08	5.7	3919	3
1988	3693	609	4303	0.08	5.7	3351	1

Calculated Compartment Contents (pCi)
From Air Sampling and Dp

Year End	Total Contents	Compartment: e + g	h	i	j
1983	2286	1638	546	91	11
1984	4530	3070	1023	387	50
1985	5223	3281	1094	743	105
1986	5430	3196	1065	1009	160
1987	5103	2763	921	1206	213
1988	4303	2094	698	1257	253

Dose Comparison

Year End	Intake Based on Air Sampling (pCi)	Committed Dose Based on 1 Micron (rems)	Cumulative Committed Dose (rems)	Lung Count Average (pCi)	Annual Dose From Average Lung Count (rems)	Residual Committed Dose (rems)	Cumulative Annual Dose Plus Residual Committed Dose (rems)
1983	47040	5.88	5.88	3489	0.76	1.13	1.89
1984	67560	8.45	14.33	4278	0.93	2.63	4.31
1985	52080	6.51	20.84	2732	0.59	3.65	5.92
1986	42840	5.36	26.19	4807	1.04	4.39	7.71
1987	32280	4.04	30.23	3479	0.75	4.86	8.93
1988	15120	1.89	32.12	3321	0.72	4.91	9.71

Results of ICRP 30 Modelling Calculations
Individual Id. No. 27061

Year End	From Air Sampling and Dp: Residual Lung Contents (pCi)	Current Year Addition (pCi)	Year End Contents (pCi)	Inferred Dp	Inferred Particle Size (microns)	From Lung Counting: Year End Contents (pCi)	Number Of Lung Counts
1983	0	3891	3891	0.22	1.2	3891	4
1984	2711	1151	3862	0.14	2.7	3862	3
1985	2731	1396	4127	0.13	2.8	4127	3
1986	2946	1100	4047	0.08	5.7	3933	4
1987	2916	1117	4033	0.08	5.7	3825	3
1988	2927	2185	5112	0.15	2.3	5112	2

Calculated Compartment Contents (pCi)
From Air Sampling and Dp

Year End	Total Contents	Compartment: e + g	h	i	j
1983	3891	2752	917	198	24
1984	3862	2470	823	501	67
1985	4127	2469	823	727	110
1986	4047	2265	755	878	149
1987	4033	2150	717	980	186
1988	5112	2830	943	1109	230

Dose Comparison

Year End	Intake Based on Air Sampling (pCi)	Committed Dose Based on 1 Micron (rems)	Cumulative Committed Dose (rems)	Lung Count Average (pCi)	Annual Dose From Average Lung Count (rems)	Residual Committed Dose (rems)	Cumulative Annual Dose Plus Residual Committed Dose (rems)
1983	34680	4.33	4.33	4314	0.94	2.00	2.94
1984	16680	2.08	6.42	3740	0.81	2.57	4.32
1985	21120	2.64	9.06	4396	0.95	3.20	5.91
1986	27240	3.41	12.46	3046	0.66	3.62	6.99
1987	27960	3.50	15.96	4659	1.01	4.02	8.39
1988	28680	3.58	19.55	7973	1.73	4.95	11.05

Ms. Lynne Fairobent
April 25, 1989

ATTACHMENT C

The differential equations used in the model were tested with a case in which 1000 pCi was deposited in the P-region on day zero and the compartment contents were calculated for up to 50 years as indicated. Verification of the 500 day halftime in compartments e + g and h is apparent. Note that all months are 30 days and years 360 days. The build-up of material in compartment i is as predicted reaching a maximum in between the 33rd and 34th month as expected for the "no equilibrium" case. The proper transfer of material from h to i and j can be verified by hand calculation within the limit of round-off error.

TIME	e + g	h	i	j	TOTAL
0 months	4500	1500	0	0	6000
1 month	4316	1439	55	6	5816
2 months	4140	1380	106	12	5638
3 months	3971	1324	154	18	5466
4 months	3809	1270	199	23	5301
5 months	3653	1218	242	28	5141
6 months	3504	1168	281	33	4986
7 months	3361	1120	318	38	4837
8 months	3224	1075	352	43	4693
9 months	3092	1031	384	47	4554
10 months	2966	989	414	51	4419
11 months	2844	948	441	55	4289
12 months	2728	909	467	59	4164
13 months	2617	872	490	63	4042
14 months	2510	837	512	66	3925
15 months	2407	802	532	70	3812
16 months	2309	770	550	73	3702
17 months	2215	738	567	76	3597
18 months	2124	708	583	79	3494
19 months	2038	679	596	82	3395
20 months	1954	651	609	85	3300
21 months	1875	625	620	88	3207
22 months	1798	599	630	90	3118
23 months	1725	575	639	93	3031
24 months	1654	551	647	95	2947
25 months	1587	529	654	97	2866
26 months	1522	507	660	99	2788
27 months	1460	487	664	101	2712
28 months	1400	467	669	103	2639
29 months	1343	448	672	105	2567
30 months	1288	429	674	107	2499
31 months	1235	412	676	109	2432
32 months	1185	395	677	111	2368
33 months	1137	379	678	112	2305
34 months	1090	363	678	114	2245
35 months	1046	349	677	115	2186
36 months	1003	334	676	117	2129
37 months	962	321	674	118	2074
38 months	923	308	672	119	2021
39 months	885	295	669	121	1970
40 months	849	282	666	122	1920
41 months	814	271	663	123	1871
42 months	781	260	659	124	1824
43 months	749	250	655	125	1779
44 months	718	239	651	126	1735
45 months	689	230	646	127	1692
46 months	661	220	641	128	1650
47 months	634	211	636	129	1610
4 years	608	203	631	130	1571
5 years	369	123	554	138	1184
6 years	224	75	470	143	911
7 years	136	45	390	145	716
8 years	82	27	318	147	574
9 years	50	17	256	148	471
10 years	30	10	205	149	394
20 years	0	0	18	150	169
30 years	0	0	2	150	152
40 years	0	0	0	150	150
50 years	0	0	0	150	150

To: U. S. Nuclear Regulatory Commission

Dear Sir:

Per the request of the Nuclear Regulatory Commission, attached is a summary of particle size data amassed at the Westinghouse Commercial Nuclear Fuel Division in Columbia, SC, from 1984 until the present.

The data was collected using an Anderson 1 ACFM Particle Size Sampler. The Activity Median Aerodynamic Diameters (AMADs) were estimated by plotting the particle size. As all distributions were assumed to have a single mode, these estimates are somewhat crude. Additionally, many of the sample locations have had engineering and/or process changes since sampled.

The Commission is reminded that deposition in the respiratory tract for a given distribution of a specific contaminant is a function of respiratory tract geometry (airway caliber, branching pattern of the tracheobronchial tree, and path length to terminal airways), ventilation characteristics (mode of breathing - oral, nasal, oronasal, respiratory rate, tidal volume, flow rates and velocities, interlobular distribution of ventilation, and length of respiratory pauses), and other factors as lung disease, etc. Even laboratory animals exposed under the same controlled conditions demonstrate considerable deposition variation.

Further, even if monodispersed and polypdispersed aerosols with the same AMAD deposit the same amount in the respiratory tract, the spatial distribution will be considerably different.

Particle size measurements in the workplace may also be subject to variability which could affect deposition rates in the lung. These include spatial distribution problems and particle size distribution variations between routine and nonroutine conditions. For these reasons, it is suggested that particle size data is best used to control and assess the workplace and not as a key parameter in the calculation of dose. As discussed in our meeting on February 22, 1989, we believe that invivo counting provides the best estimate of internal dose from Class Y materials.

WESTINGHOUSE ELECTRIC CORPORATION

Richard K Burklin

Richard K. Burklin

WP2980E:3p.5

DRY CONVERSION

AREA	NAME	AMAD
MAP	2 Blender Top	4.4
MAP	3 Blender Discharge	4.4
MAP	1 Kiln Discharge	5.1
MAP	2 Kiln Discharge	3.0
MAP	2 Slug Press	2.7
MAP	1 Slug Press	2.7
MAP	1 Blender Bottom	3.8
MAP	1 Pellet Press	3.6
MAP	1 Grinder	5.1
MAP	2 Kiln Discharge	1.8
MAP	3 Blender Top	2.0
MAP	3 Blender Input	3.2
MAP	2 Blender Bottom	3.6
	Mean:	3.5
	Standard Deviation of Mean:	1.0
	Range:	1.8-5.1

WP29805:3b.1

ADU CONVERSION

AREA	NAME	AMAD
Conv.	1 Feed End Top	3.8
Conv.	1 Feed End Bottom	3.2
Conv.	1 PEB Vent Stat	5.5
Conv.	2 Feed End Top	4.1
Conv.	2 Calciner Recy	8.9
Conv.	2 PEB Vent Stat	6.9
Conv.	2 Product End Bottom	5.8
Conv.	2 Drying Hood	4.6
Conv.	3 Cal Recy Hood	8.2
Conv.	3 Feed End Top	4.8
Conv.	3 Feed End Top	3.3
Conv.	3 PEB Mill	4.8
Conv.	3 Cal Product Hood	4.4
Conv.	3 Cal Product Hood	4.0
Conv.	3 Dry Hood	5.5
Conv.	4 Feed End Bottom	5.2
Conv.	4 Feed End Bottom	7.0
Conv.	4 PEB Vent Stat	10
Conv.	4 PEB Mill	6.8
Conv.	4 PEB Mill	8.0
Conv.	4 PEB Cal Prod Hood	7.0
Conv.	4 PEB Cal Prod Hood	8.4
Conv.	4 Dry Hood	12.0
Conv.	4 Dry Hood	8.0
Conv.	5 Feed End Bottom	3.1
Conv.	5 Feed End Top	3.7

Mean: 5.8
Standard Deviation of Mean: 2.2
Range: 3.1-12

WP2980I:3p.2

BULK BLENDING

AREA	NAME	LOCATION CODE	ASHD
Bulk Blend	1 MH11		3.4
Bulk Blend	1 MH11		2.9
		Mean:	3.2

WRD

WRD	Ash Hood		4.2
WRD	Scrap Sort Hood		5.3
WRD	Solvent Extraction		2.8
WRD	Incinerator		3.3
WRD	Drum Baler		8.2
		Mean:	4.4
		Standard Deviation of Mean:	2.2
		Range:	2.8-8.2

PELLET

AREA	PLANT	AMAD
Pellet	1 Oxidation Hood	9.2
Pellet	2 Oxidation Hood	8.0
Pellet	2 Oxidation Hood	6.4
Pellet	3 Oxidation Hood	13
Pellet	3 Pellet Press	6.8
Pellet	3 Furnace	4.9
Pellet	3 Pellet Table	6.4
Pellet	4 Oxidation Hood	9.8
Pellet	4 Oxidation Hood	8.0
Pellet	4 Roll Hood	4.8
Pellet	4 Roll Hood	3.1
Pellet	4 Pellet Grinder	5.8
Pellet	4 Pellet Table	3.6
Pellet	4 Pellet Grinder	5.0
Pellet	5 Pellet Press	5.8
Pellet	5 Pellet Press	5.0
	Mean:	6.4
	Standard Deviation of Mean:	2.5
	Range:	3.1-13

QC

QC	1 QC Desk	4.7
QC	3 QC Desk	4.2
QC	3 QC Desk	3.3
	Mean:	4.1
	Range:	3.3-4.7

WPE980E:3p.4

COST ESTIMATE

If the NRC retains the annual dose provision, we will have the flexibility of monitoring/controlling personnel doses using bioassay techniques such as invivo counting. We would retain the existing air sampling system, but most of our efforts would be directed towards actual dose reduction. The cost of this option is estimated to be $5M-$10M.

If the annual dose is not retained, intakes will be calculated via air sampling rather than measured via bioassay. This has several disadvantages: (a) Much effort will be required to justify using air sampling to calculate intakes (characterization of particle size and transportability), (b) Intakes will be based upon indirect measurements rather than direct measurements, (c) Financial resources may be directed to air sampling rather than dose reduction. The cost of this option is estimated to be $12-$15M.

WP2263E:3p.72

Received from Advanced Nuclear Fuels 5/1/89

ESTIMATED IMPACT OF PARTICLE SIZE ADJUSTMENT TO DERIVED AIR CONCENTRATION VALUES

The proposed revision to 10 CFR 20 (Radiological Safety Standards) was discussed at a meeting with NRC staff and Industry Representatives on February 22, 1989 at NRC Headquarters, One White Flint North Building.

During the meeting, Industry Representatives presented a proposal for using annual dose equivalent in place of committed dose equivalent as the basis for controlling worker exposure. Industry Representatives were in agreement on controlling the workplace on a committed dose basis using air sampling as a control. It was pointed out, however, that industry was planning to use the option allowed in the proposed regulation for modifying the annual limit of intake (ALI) and derived air concentration (DAC) based upon actual plant airborne conditions with respect to particle size. The purpose of this letter is to provide an estimate of the impact of using modified, more realistic limits in the workplace for Class Y material.

Little plant data is available on particle size in the U.S. in that it was not directly involved in the administration of limits under current or past standards. There are studies of particle size in fuel fabrication plants reported in the literature, however, and those data are repeated and used here for the purpose of estimating the change in standard. Two studies are reported in the Health Physics journal; one referencing a Canadian fuel fabrication plant[1], and the second references two Federal Republic of Germany (FRG) fuel fabrication plants[2]. In both cases, an Andersen Cascade Impactor was used for sample collection. In the case of the Canadian study, an average AMAD value of 6.1 μm was determined, and in the case of the FRG study, the

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1 K. S. Thind, "Determination of Particle Size for Airborne UO_2 Dust at a Fuel Fabrication Work Station and Its Implication on the Derivation and Use of ICRP Publication 30 Derived Air Concentration Values," Health Physics, Vol. 51, No. 1, pp. 97-105, July 1986.

2 Horst Shieferdecker, et al, "Inhalation of U Aerosols From UO_2 Fuel Element Fabrication," Health Physics, Vol. 48, No. 1, pp. 29-48, January 1985.

value determined was 8.2 μm. In the case of the Canadian study, particle sizes were measured over a 10-month time period at one workstation. In the FRG study, samples were taken from various workstations in different parts of the plant, including different operations and chemistry; however, the particle size distribution at the various sampling points was quite similar.

Based upon the studies referenced above, and from bits of data accumulated from some U.S. plants, it is estimated that actual plant airborne conditions are best characterized at an average AMAD of 5-9 μm. If one then applies the models and calculational methods described in Chapter 5 of ICRP30, Part 1, it is determined that the DAC and ALI under workplace conditions for Class Y material are a factor of 3 to 5.5 times larger than those listed in Appendix B of the proposed 10 CFR 20. The correct DAC for the workplace would lie between 6×10^{-11} μCi/mℓ and 1.1×10^{-10} μCi/mℓ, and for the ALI between 1.2×10^{-1} μCi and 2.2×10^{-1} μCi.

The caveat, which applies to the above estimate, is that the sampling equipment, procedure and plan used in the studies were undoubtedly different from that which will ultimately be used to adjust plant limits; and, the U.S. workplace conditions will differ both as to chemistry and process from those tested in Canada and FRG. However, modified limits similar to those estimated above should not be unexpected.

ANNOTATED VERSION OF § 20.204

Enclosure 6

ENCLOSURE 6

SECTION 20.204 OF THE REVISED PART 20 RULE
SHOWING FLEXIBILITY PERMITTED IN MEASUREMENT AND
DOSE ASSESSMENT PROCEDURES

§ 20.204 Determination of internal exposure.

(a) For purposes of assessing dose used to determine compliance with occupational dose equivalent limits, the licensee shall, when required under §20.502, take suitable and timely measurements of:
(1) Concentrations of radioactive materials in air in work areas; or
(2) Quantities of radionuclides in the body; or
(3) Quantities of radionuclides excreted from the body; or
(4) Combinations of these measurements.

[Methods for assessing dose are not limited to air sampling.]

(b) Unless respiratory protective equipment is used, as provided in §20.703, or the assessment of intake is based on bioassays, the licensee shall assume that an individual inhales radioactive material at the airborne concentration in which the individual is present.

(c) When specific information on the physical and biochemical properties of the radionuclides taken into the body or the behavior of the material in an individual is known, the licensee may:

(1) Use that information to calculate the committed effective dose equivalent, and, if used, the licensee shall document that information in the individual's record; and

[Models for predicting and calculating committed dose equivalents are not limited to ICRP models. Actual retention data on individuals may be used to evaluate doses.]

(2) Upon prior approval of the Commission, adjust the DAC or ALI values to reflect the actual physical and chemical characteristics of airborne radioactive material (e.g., aerosol size distribution or density); and

[Actual site-specific data on actual exposure conditions may be used to evaluate doses.]

(3) Separately assess the contribution of fractional intakes of Class D, W, or Y compounds of a given radionuclide (see Appendix B) to the committed effective dose equivalent.

(d) If the licensee chooses to assess intakes of Class Y material using the measurements given in § 20.204(a)(2) or (3), the licensee may delay the recording and reporting of the assessments for periods up to 7 months, unless

otherwise required by §§ 20.1202 or 20.1203, in order to permit the licensee to make additional measurements basic to the assessments.

[This permits additional measurements and analyses to be made in order to confirm dose estimates.]

(e) If the identity and concentration of each radionuclide in a mixture are known, the fraction of the DAC applicable to the mixture for use in calculating DAC-hours must be either:

(1) The sum of the ratios of the concentration to the appropriate DAC value (e.g., D, W, Y) from Appendix B for each radionuclide in the mixture; or

(2) The ratio of the total concentration for all radionuclides in the mixture to the most restrictive DAC value for any radionuclide in the mixture.

(f) If the identity of each radionuclide in a mixture is known, but the concentration of one or more of the radionuclides in the mixture is not known, the DAC for the mixture must be the most restrictive DAC of any radionuclide in the mixture.

(g) When a mixture of radionuclides in air exists, licensees may disregard certain radionuclides in the mixture if:

(1) The licensee uses the total activity of the mixture in demonstrating compliance with the dose limits in § 20.201 and in complying with the monitoring requirements in § 20.502(b); and

(2) The concentration of any radionuclide disregarded is less than 10 percent of its DAC; and

(3) The sum of these percentages for all of the radionuclides disregarded in the mixture does not exceed 30 percent.

(h)(1) In order to calculate the committed effective dose equivalent, the licensee may assume that the inhalation of one ALI, or an exposure of 2,000 DAC-hours results in a committed effective dose equivalent of 5 rems (0.05 Sv) for radionuclides which have their ALIs or DACs based on the committed effective dose equivalent.

[This is a simplifying assumption that is permitted for dose assessment.]

(2) When the ALI (and the associated DAC) is determined by the nonstochastic organ dose limit of 50 rems (0.5 Sv), the intake of radionuclide that would result in a committed effective dose equivalent of 5 rems (0.05 Sv) (the stochastic ALI) is listed in parentheses in Table 1 of Appendix B. In this case, the licensee may, as a simplifying assumption, use the stochastic ALIs to determine committed effective dose equivalent. However, if the licensee uses the stochastic ALIs, the licensee must also demonstrate that the limit in § 20.201(a)(1)(ii) is met.