DOE F 1325.8
(5-83)

503 PWL
5480.11

United States Government

Department of Energy
Oak Ridge Operations

memorandum

REPOSITORY Oak Ridge Operations (ORO)
COLLECTION Energy Programs Div., ER-11
BOX No. Active Records Gathered for Human Radiation Exp. Pj.t.
FOLDER

DATE: February 6, 1990

REPLY TO ATTN OF: SE-334:Monroe

SUBJECT: DATA FOR DETERMINING POSSIBLE IMPLICATIONS OF THE BEIR V REPORT

707533

TO: Rick Collier, Acting Branch Chief, Laboratory Operations Branch, ER-12
M. M. Heiskell, K-25 Site Manager, DP-825
J. W. Parks, Deputy Assistant Manager, Enriching Operations, EO-20
R. G. Hassell, Y-12, General Engineer, DP-81
Jay Jalovec, FMPC, Health Physicist, DP-84

As the attached information explains, DOE is compiling data on the implications of the BEIR V report. Attached is a copy of the questionnaire in three parts. Because of the short turnaround time, copies of these attachments plus a micro diskette (3.5 inch), are being sent directly to the site radiation control program managers. The micro diskette is for use with Lotus 1-2-3, Version 2.01.

Please ensure that the questionnaire data is prepared and, if possible, entered in the diskette. I need to compile the data and send it to Headquarters by March 1, so I need to receive your input by February 23. Call me if you have any questions at 6-9439 (FTS 626-9439).

Harold J. Monroe
Nuclear Safety Branch

Attachments:
As stated

cc w/attachments:
J. S. Bogard, X-10, Bldg. 4500-S, MS-6105 (w/diskette)
H. M. Butler, X-10, Bldg. 4500-S, MS-6106
G. L. Murphy, K-25, Bldg. 9210-3, MS-8065 (w/diskette)
G. L. Love, K-25, Bldg. 1001, MS-7155
D. L. Chumbler, PAD, Bldg. C743, MS-16 (w/diskette)
Ed Wagner, PORTS, Bldg. X-1000, MS-5020 (w/diskette)
J. B. Hunt, Y-12, Bldg. 9711-1, MS-8105 (w/diskette)

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DOE F 1325.8
(10-88)

United States Government **Department of Energy**

memorandum

DATE: JAN 30 1990

REPLY TO ATTN OF: EH-352

SUBJECT: Report of the BEIR V, "Health Effects of Exposure to Low Levels of Ionizing Radiation"

TO: Distribution

As indicated in the January 8, 1990, memorandum from the Acting Assistant Secretary for Environment, Safety and Health (EH), we are requesting your assistance and support in determining the implications to the Department of Energy (DOE) of the recently published "Health Effects of Exposure to Low Levels of Ionizing Radiation," BEIR V. Attachment 1 provides a discussion of the issues in BEIR V having possible implications to the DOE identified during our initial review of the BEIR V. Attachment 2 provides you with a list of questions and a format for your response. We request you provide answers to the questions in Attachment 2, using the format provided, by March 1, 1990. Providing responses to Attachment 2 in the format provided will allow efficient transfer of the data into a data base. All reasonable efforts should be made to provide complete responses by the indicated deadline so that results can be compiled and a meaningful interim report provided to the Secretary by March 20, 1990.

The internal review group and the technical committee, discussed in the January 8, 1990, memorandum from EH, have been established (members are listed in Attachment 3). The internal review group has reviewed and approved Attachments 1 and 2 and will participate in development of the Interim Report to the Secretary. The technical committee has been established and their initial input on their review of the BEIR V is due February 16, 1990.

For further discussion or questions concerning this request and your response, contact either Tony Weadock (EH-352) at FTS 233-3496 or Rick Jones (EH-352) at FTS 233-3889.

Harry J. Pettengill, Director
Nuclear Safety Technology Division
Office of Safety Appraisals

2 Attachments

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FEB 01 1990

DISTRIBUTION:
Jerry Yesberger, RL
David Wheeler, NV
Ed Jascewsky, CHI
Bill Thornton, SR
Ralph Kopenhaver, SF
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BEIR V IMPACTS

The BEIR V Report titled "Health Effects of Exposure to Low Levels of Ionizing Radiation" was released by the National Research Council in December, 1989. Although the BEIR V Report does not discuss occupational radiation exposure limits, the report does suggest that the lifetime risk of cancer due to a given dose of gamma radiation is greater than formerly estimated. The report also identifies an increased risk of mental retardation to the developing embryo from exposure to low levels of radiation.

Review and interpretation of the BEIR V Report identified the following potential impacts to the DOE occupational exposure limits as listed in DOE Order 5480.11. Conservative interpretations of the BEIR V report were made, to identify the range of values for each potential impact. The basis for arriving at the impact is also provided, along with a suggested range of impact values that was used in developing the survey questionnaire. This survey questionnaire is being provided to the Operations Offices for completion by DOE facility contractors to aid Headquarters in the assessment of contractor status.

1. Annual Whole Body Effective Dose Equivalent Limit

The BEIR V Report indicates that the lifetime risk of cancer due to a given dose of gamma radiation is greater than formerly estimated in BEIR III. BEIR V Table 4-4 (p. 176), for example, gives ratio values for BEIR V/BEIR III cancer risk coefficients for solid cancers and leukemia. These ratios indicate an approximate 3 and 4 times greater probability of solid cancer and leukemia, respectively (based on comparison of relative risk models for solid cancers, and a 0.1 Gy exposure). BEIR V Table 4-2 (p. 172) estimates lifetime excess mortality from all cancer for three exposure scenarios. This leads to a risk coefficient for total cancer (male and female averaged) of 8E-4/Rem, (based on an average 800 excess mortalities for a 0.1 Sv exposure for 100,000 exposed persons). Previous estimates of total cancer mortality (ICRP 26, NCRP 91) generally give a risk coefficient of 1.25E-4/Rem, which is typically rounded to 1E-4/Rem.

The BEIR V estimates would therefore appear to represent a factor of from 3 - 8 increase in lifetime cancer risk; however application of a Dose Rate Effectiveness Factor (DREF) of 2, to account for decreased radiation effectiveness in low-dose, chronic exposure situations, may be applicable and would bring the increase down to a range of approximately 2 - 4. Use of a DREF of 2 is discussed in the BEIR V summary and on page 23, 220, and Table 1-4 of the report. Use of a DREF may be somewhat controversial, however arguments for it in BEIR V are better developed and more strongly stated than arguments against it.

The above arguments suggest the potential implications of BEIR V include a reduction in the occupational annual effective dose equivalent (EDE) limit by a factor of 2 to 4. During a previous study of exposure limit reductions (see DOE/EV-0045, Rev. 2-81, "Study of Anticipated Impact on DOE Programs for Proposed Reductions to the External Occupational Radiation Exposure Limit"), the impact of a reduction in annual dose equivalent by factors of 2, 5 and 10 was assessed. These factors corresponded to annual exposure limits of 2.5, 1.0, and 0.5 Rem. In an effort to remain consistent with and allow comparisons to the previous DOE study, the same factors and exposure limits will be used for the current study, with one modification. The upper bound value of 2.5 Rem is being reduced to 2.0 Rem (factor of 2.5 reduction), to better assess the potential impact of current ICRP deliberations as discussed below.

An alternative method in revising occupational exposure limits to reduce the lifetime risk of cancer would be to maintain the current annual limit but require that the cumulative radiation exposure over a longer time period be restricted to tighter limits. The ICRP, for example, is considering restricting the exposure over a five year period to 10 Rem, while maintaining the flexibility of the current annual limit of 5 Rem. This implies a de facto average annual limit of 2 Rem/year.

An additional method of reducing lifetime risk is by setting a cumulative lifetime exposure limit, and NCRP 91 has suggested a lifetime exposure limit of 1 Rem x Age in Years. Although BEIR V makes no such specific recommendations, it remains prudent to evaluate the impact of a lifetime exposure limit of 1 Rem x Age in Years in this study.

2. Annual Limit on Intake (ALI) and Derived Air Concentration (DAC)

The BEIR V Report did not include any direct reference to reduction of current ALI or DAC values. It is reasonable to assume, however, that any reduction in the annual EDE limits would result in a reduction of those ALIs based on stochastic considerations by the same factor. Consequently, this study will assess the impact in a reduction of the ALI and DAC values by a factor of 2.5, 5, and 10. Potential impacts from such a reduction include increased need for posting and control of areas, improvements in counting sensitivities, improved air sampling techniques, etc.

3. Non-Stochastic Effects (Skin, lens of eye, extremities)

The specific findings of the BEIR V Report do not imply that specific reductions may be necessary in occupational exposure

limits related to skin, lens of eye, and extremity exposure. These are non-stochastic limits (although the lens of the eye limit may contain a stochastic component) and BEIR V shows the biggest differences in the cancer induction area. Consequently, reduction of the lens of eye, skin, and extremity limits will not be evaluated.

4. General Public, Minors

DOE Order 5480.11 currently includes more restrictive exposure limits for these target groups than those suggested by ICRP 26 and EPA guidance (100 mrem vs. 500 mrem, respectively). Consequently, reduction to these limits do not appear necessary and will not be assessed.

5. Organ Weighting Factors

Changes in risk factors, as published in BEIR V, may result in modifications to the weighting factors employed for calculation of the effective dose equivalent (EDE). In general, under the relative risk model favored with BEIR V the cancer risk is reported to increase with age of the individual. Ultimate and strict implementation of the relative risk model might require the use of age specific weighting factors when computing EDE.

Although the BEIR V Report does suggest increased cancer risk for certain tissues, interpreting and evaluating potential changes in weighting factors is speculative and beyond the scope of this study. It should also be noted that any potential changes in weighting factors that would affect calculated EDE will most likely be encompassed in the overall annual EDE limit reductions discussed in paragraph 1.

6. Neutron Quality Factor

Although the BEIR V Report did not specifically assess the RBE of neutron radiation, the BEIR V committee consistently employed a quality factor of 20 for neutron radiation. As this is reflective of recommendations that have been made in the radiation protection community and represents a significant change to the neutron quality factor of 10 used by the DOE, the specific impact of switching to a neutron QF of 20 will be included in this study.

The BEIR V Report also briefly discusses (page 218 and 220) but does not specifically investigate the increased effectiveness of ortho-voltage X rays as compared to high energy gamma rays. Although no specific impact is being assessed, several questions were added to the survey questionnaire to gather information on low energy photon exposures.

7. Fetal Exposure

BEIR V identifies an increased frequency of mental retardation in A-bomb survivors exposed in utero at fetal age 8-15 weeks over that previously expected in BEIR III (p. 7). Risk is given as a 4% chance of occurrence per 0.1 Sv (i.e., 4E-3/rem). Although this represents an increase from the BEIR III Report, NCRP 91 used this higher risk factor in their suggested limit of 500 mrem total exposure over the period of gestation, with no more than 50 mrem per month. Consequently, the 5480.11 limit of 500 mrem to the fetus during the gestation period appears appropriate and reflective of current recommendations; however the monthly uniform exposure limit recommended in 5480.11 should be strengthened to a strict requirement. Consequently, this study will evaluate the impact of a 50 mrem/month limit for declared pregnant females.

8. Design Limits

The current 5480.11 section 9.j.(1)(b) external exposure design limit of 0.5 mrem/hr for continuous occupancy leads to a dose of 1 rem/yr. The impact of lowering this value by factors of 2 and 5 will also be evaluated.

9. Dose Limits for the Public and Environmental Studies

DOE has reduced its radiation protection standards for the public (draft Order DOE 5400.XX, final DOE 5400.5) significantly from 500 mrem whole body and 1500 mrem organ maximum annual dose equivalent to 100 mrem annual effective dose equivalent from all sources and pathways. The new Order allows annual doses to be as high as 500 mrem effective dose equivalent for short periods if it can be shown that the lifetime average annual dose to the individuals will be less than 100 mrem from all sources and pathways. These doses exclude only occupational, medical and natural background exposures. It is anticipated that the only potential change to the standard in response to BEIR V would be the elimination of the 500 mrem exception.

Recent EPA standards (i.e. radionuclide NESHAPs) have been promulgated on a risk factor of 4E-4 health effects/Rem. This factor is effectively equivalent to the BEIR V risk factors when the DREF of 2 is applied to the BEIR V total cancer risk coefficient of 8E-4/Rem. Therefore, no changes in current standards are anticipated in response to BEIR V; however some DOE facilities or projects have used older risk factors in NEPA or CERCLA documents. Unilateral adoption of the 4E-4 health effects/Rem may impact DOE environmental and safety analysis reports and associated decisions. The magnitude of this impact on

DOE facilities will be assessed during this study.

10. Backfitting and Modification of DOE Facilities

The desired mechanism in achieving the reduction of annual effective dose equivalent limits to the values discussed in paragraph 1 is by modification of existing facilities and improvement of engineering controls. The magnitude of this impact on DOE facilities will be specifically assessed during this study.

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SUMMARY OF IMPACTS

1. Annual Dose Equivalent - The BEIR V Report indicates an increased risk of cancer associated with gamma exposure of from 2 - 4. To allow comparison with DOE/EV-0045, this study will evaluate an annual dose limit reduction to 2.0, 1.0, and 0.5 Rem.

2. Lifetime Exposure Limit - This study will evaluate the impact of a lifetime exposure limit of 1 Rem x Age in Years.

3. ALI and DAC Values - This study will evaluate the impact of lowering the stochastic ALI values (and consequently the derived DAC values) by a factor of 2.5, 5 and 10.

4. Skin, lens of eye, extremities - Unaffected.

5. General public, minors - Unaffected.

6. Organ/Tissue weighting factors - Not evaluated.

7. Neutron Quality Factor(QF) - This study will evaluate raising the neutron QF from 10 to 20.

8. Fetal Exposure - This study will keep the 500 mrem/gestation period limit, and evaluate the impact of a strict 50 mrem/month limit.

9. Design Limits - This study will evaluate the impact of reducing the continuous occupancy design limit by a factor of 2 and 5. Consequent limits are 0.25 and 0.1 mrem/hr.

10. Environmental Limits - This study will evaluate the impact of eliminating the 500 mrem effective dose equivalent exception to the annual 100 mrem limit and of adopting a cancer risk coefficient of 4E-4/Rem DOE wide.

11. Backfitting and Modifications - This study will include an evaluation of the extent of design modifications and engineering controls needed to reduce the annual occupational exposure limit by a factor of 2.5, 5 and 10.

DIRECTIONS FOR QUESTIONNAIRE

This questionnaire responds to the latest estimates of risks from external ionizing radiation given in BEIR V (NRC 1990) and will be used to produce a report for the Secretary of Energy due March 20, 1990. Responses are due from Field Offices by March 1, 1990 to meet this deadline.

1. Each Field Office has a hardcopy of the questionnaire as well as a computer diskette with the same questionnaire in Lotus 123. It is preferred that you respond by filling out the information on the diskette, and that Field Offices compile information for each Facility Type (see attached listing from DOE Order 5484.1 Chg 3--Attachment 8, Page 7) on a single questionnaire. Note: only ONE Facility Type per questionnaire, even if this means several questionnaires for a single Field Office.

2. If you do not have Lotus 123, the hardcopy of the questionnaire may be photocopied and distributed to each Facility Type.

3. If you do have Lotus 123, to use the diskette provided, put the diskette in the A Drive and begin Lotus 123 as usual; next press /, then File, then Retrieve. The name of the file, BEIRV2, should be highlighted. Press Enter, and the Questionnaire will appear on the screen.

> Note: the Questionnaire is "protected" which means that you can only type in the areas indicated for answers. If you attempt to write in other areas the system will give you an "error" message.

4. To begin the questionnaire, for respondent, please put last name, the first name, middle initial. For Facility Type refer to attached list.

5. For any missing information on the questionnaire, please put a zero when numerical data is expected or NA for questions where text is expected.

6. Costs are normally to be expressed in thousands (for example 100 will be used when $100,000 is meant) unless otherwise stated.

7. Many questions ask for information about workers by occupational code; a list of the codes is attached, also from DOE 5484.1 Chg 3).

8. Question II is a matrix. Please indicate a one for yes or a zero for no at the intersection of each radiation level/type for your Facility Type; there may be many ones on the matrix, when several levels/types occur.

9. Some question sets (for example III-A through III-J) are repeated a second time (in III-K as III-K-A, K-B, K-C, and so on) for a different level; the numbering should keep things as clear as possible.

10. A Facility Modification Codesheet has been provided and should be used in responding to Questions III-G and III-K.

Table 2

Facility Type

CODE	FACILITY TYPE OR OPERATION 1/
10	ACCELERATOR
21	FUEL/URANIUM ENRICHMENT
22	FUEL FABRICATION
23	FUEL PROCESSING
40	MAINTENANCE AND SUPPORT (SITE-WIDE)
50	REACTOR
61	RESEARCH, GENERAL
62	RESEARCH, FUSION
70	WASTE PROCESSING/MANAGEMENT
80	WEAPONS FABRICATION AND TESTING
99	OTHER

1/ Workers should be assigned to one facility type where the predominant amount of the individual's work takes place.

Vertical line denotes change.

Table 3

Occupational Codes 1/

CODE	OCCUPATIONAL CODES OCCUPATIONAL CATEGORIES	SOC REFERENCE 1/
110	MANAGERS AND ADMINISTRATORS	11 - 14
-	PROFESSIONAL	15 - 39
160	Engineers	16
170	Scientists	17 - 19
184	Health Physicists	1843
200	Misc. Professionals	20 - 25, 32 - 34
260	Doctors and Nurses	26 - 30
350	Technicians	35 - 39
360	Health Technicians	36
370	Engineering Technicians	37
380	Science Technicians	38
-383	Radiation Monitors/Techs.	383
390	Misc. Technicians	39
400	SALES	40 - 44
450	ADMIN. SUPPORT AND CLERICAL	45 - 47
-	SERVICE	50 - 52
512	Firefighters	512
513	Security Guards	513/4
521	Food Service Employees	521
524	Janitors	524
525	Misc. Service	523, 525/6
-	AGRICULTURE	55 - 58
562	Groundskeepers	562
570	Forest workers	57
580	Misc. Agriculture	55, 561, 58
-	REPAIR/CONSTRUCTION	60 - 65
610	Mechanics/Repairers	60 - 61
641	Masons	641
642	Carpenters	642
643	Electricians	643
644	Painters	644
645	Pipe Fitter	645
650	Miners/Drillers	65
660	Misc. Repair/Construction	63, 646
-	PRECISION/PRODUCTION	67 - 78
681	Machinists	681
682	Sheet Metal Workers	682
690	Operators, Plant/System/Utility	69
710	Machine Setup/Operators	71 - 76
771	Welders and Solderers	771
780	Misc. Precision/Production	67, 683 - 686, 772 - 78

Vertical line denotes change.

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-	TRANSPORT	81 - 83
820	Truck Drivers	8212 - 8214
821	Bus Drivers	8215
825	Pilots	825
830	Equipment Operators	83
840	Misc. Transport	81, 8216 - 824, 826
850	HANDLERS/LABORERS/HELPERS	85 - 87
910	MILITARY	91
990	MISCELLANEOUS	99

1/ The occupational classifications provided have been standardized to the codes in the Department of Commerce's Standard Occupational Classification (SOC) Manual (1980). If a differing classification system exists onsite, arrangements should be made with EG&G Idaho to have them develop a conversion program if retention of the existing classification system is desired.

Vertical line denotes change.

Facility Modification Codesheet

The following generic modifications and corresponding codes should be used as appropriate in responding to survey questions III-G and III-K. Coding your responses will allow direct entry of your responses onto the survey database. If the generic facility modifications are not specific enough or do not address all modifications that would be required at your facility, write in your specific response(s) in the space provided on questions III-G and III-K.

Codes

01 - Increase gamma/photon shielding
02 - Increase neutron shielding
03 - Decontaminate systems/process equipment
04 - Decontaminate general plant areas
05 - Increase use of remote-handling tools and equipment
06 - Implement use of robotics
07 - Reconfigure production/process lines
08 - Reduce handling steps
09 - Reduce amount of unit activity handled in production process
10 - Increase use of temporary, portable ventilation
11 - Improve general facility ventilation
12 - General maintenance/improvement of existing glovebox lines
13 - Improve glovebox shielding
14 - Obtain additional gloveboxes
15 - Additional source vaults/storage areas
16 - General maintenance/improvement of existing process equipment
17 - Obtain new process equipment
18 - Modifications/upgrades to facility air and radiation monitoring equipment
19 - Obtain new fume hoods

BEIR V
Facility Questionnaire

Facility Name: _____

Facility Type (use 5484.1 designation): _____

Name of Respondent: _____

Phone: FTS ____ _____ Commercial: (____) _____

DOE Operations Office: _____

I - General Information

A. Provide Total Facility Collective Exposure for 1988 (person-rem)

_____

B. Collective internal exposure for 1988 (person-rem)

_____

C. Total number of personnel monitored during 1988

External Exposure-

_____

Internal Exposure-

_____

D. Total number of personnel with measureable exposure for 1988

_____

E. Value in rem for highest exposed male worker for 1988

_____

Value in rem for highest exposed female worker for 1988

_____

F. For 1988, total number of monitored workers receiving neutron exposure in the following ranges

0 to <0.2 rem

_____

0.2 to <0.5 rem

_____

0.5 to <1.0 rem

_____

1.0 to <1.5 rem

_____

1.5 to <2.0 rem

_____

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[illegible] to <3.0 rem

_____

>3.0 rem

_____

Total collective neutron exposure (person-rem)

_____

Average neutron quality factor used-

_____

G. Number of monitored workers routinely exposed to low energy (<100 KeV) photon radiation

_____

H. Number of monitored workers who received exposure to low energy photons in excess of the following in 1988

[illegible] rem

_____

[illegible] rem

_____

[illegible] rem

_____

I. Total number of monitored workers exposed to both low energy photons and neutrons in 1988

_____

II - RADIONUCLIDE SOURCE TERM

For 1988, indicate (Yes=1 and No=0) radiation type and energy which contribute to personnel exposure at your facility

	0 to <100KeV	100 KeV to <1 MeV	1 MeV to <5MeV	5 MeV to <10 MeV	>10 MeV
alpha					
beta*					
gamma					
X-ray					
neutron					
high energy					
other					

* For beta list the isotopes-

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III - REDUCTION OF OCCUPATIONAL WHOLE BODY LIMITS

Assume a neutron quality factor of 10 when answering the following

A. Total number of workers in 1988 exceeding the below

2.0 rem

_____

1.0 rem

_____

0.5 rem

_____

B. Predominant worker categories (use 5484.1 category codes) exceeding

1.0 rem

_____

_____

_____

1.0 rem

_____

_____

_____

1.0 rem

_____

_____

_____

C. Percent response when internal EDE is added to external EDE for 1988 in range significant

Yes

_____

No

_____

Total number of workers >2.0 rem

_____

Total number of workers>1.0 rem

_____

Total number of workers >0.5 rem

_____

Worker categories >2.0 rem

_____

_____

_____

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Worker categories >1.0 rem

_____

_____

_____

Worker categories >0.5 rem

_____

_____

_____

D. Revised response if workload were at a "normal" production level

Is change significant:

Yes-

_____

No-

_____

Total number of workers >2.0 rem

_____

Total number of workers >1.0 rem

_____

Total number of workers >0.5 rem

_____

Worker categories >2.0 rem

_____

_____

_____

Worker categories >1.0 rem

_____

_____

_____

Worker categories >0.5 rem

_____

_____

_____

Data year used for this determination-

_____

E. Increased number of workers (by 5484.1 category codes) for annual DOE limit (including internal dose) for the below categories

2.0 rem

1021853 Total number of workers:

_____

Top ten worker category codes-

Worker Category	Number of personnel
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
Total=	0

Total Cost

_____

1.0 rem

Total number of workers-

_____

Top ten worker category codes-

Worker Category	Number of personnel
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
Total=	0

Total Cost

_____

0.5 rem

Total number of workers-

_____

Top ten worker category codes-

Worker Category	Number of personnel
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

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Total= 0

Total Cost

F. Estimate increase or decrease in total man-rem by worker category if annual EDE limits were

2.0 rem

Worker Category	Total man-rem (indicate + or -)

1.0 rem

Worker Category	Total man-rem (indicate + or -)

0.5 rem

Worker Category	Total man-rem (indicate + or -)

G. Facility modifications and costs associated with the below annual EDE limits. Use modification codes provided!

2.0 rem

Modifications:	One time costs:	Annual costs:

1021855

Total= 0 Total= 0

1.0 rem
Modifications: One time costs: Annual costs:

Total= 0 Total= 0

0.5 rem
Modifications: One time costs: Annual costs:

Total= 0 Total= 0

H. Radiation protection program changes due to indicated annual EDE limits. List costs in thousands ($K)

2.0 rem

	One time costs:	Annual costs:
Instrumentation-		
Record keeping-		
Dosimeters-		
Passive-		
Active-		
General controls-		
Staffing-		
Training-		
Total=	0	0

1.0 rem

	One time costs:	Annual costs:
Instrumentation-		
Record keeping-		

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Dosimeters-	_____		_____	
Passive-	_____		_____	
Active-	_____		_____	
General controls-	_____		_____	
Staffing-	_____		_____	
Training-	_____		_____	
Total=		0	Total=	0

0.5 rem

	One time costs:		Annual costs:	
Instrumentation-	_____		_____	
Record keeping-	_____		_____	
Dosimeters-	_____		_____	
Passive-	_____		_____	
Active-	_____		_____	
General controls-	_____		_____	
Staffing-	_____		_____	
Training-	_____		_____	
Total=		0	Total=	0

I. Phases of current operations which would be abandoned due to high costs of indicated annual EDE

1.0 rem

_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

1.0 rem

_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

0.5 rem

_____
_____
_____
_____
_____
_____
_____
_____

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_____
_____

J. What time frame (in months) would be necessary to permit transition to the indicated reduced EDE values

2.0 rem

_____

1.0 rem

_____

0.5 rem

_____

K. Now assume a neutron QF of 20 is adopted in addition to the reduced annual EDE values and readdress questions III A-J above. The questions are reproduced here for your convenience.

K-A. Total number of workers in 1988 exceeding the below

2.0 rem

_____

1.0 rem

_____

0.5 rem

_____

K-B. Predominant worker categories (use 5484.1 category codes) exceeding

2.0 rem

_____
_____
_____

>1.0 rem

_____
_____
_____

>0.5 rem

_____
_____
_____

K-C. Revised response when internal EDE is added to external EDE for 1988.

Is change significant-

1021858 Yes-

_____

No-

Total number of workers >2.0 rem

Total number of workers>1.0 rem

Total number of workers >0.5 rem

Worker categories >2.0 rem

Worker categories >1.0 rem

Worker categories >0.5 rem

K-10. Revised response if workload were at a "normal" production level

Is change significant-

Yes-

No-

Total number of workers >2.0 rem

Total number of workers>1.0 rem

Total number of workers >0.5 rem

Worker categories >2.0 rem

Worker categories >1.0 rem

1021859

_____

Worker categories >0.5 rem

_____
_____
_____

Data year used for this determination-

_____

K-E. Increased number of workers (by 5484.1 category codes) for annual TEDE limit (including internal dose) for the below categories

1.0 rem

Total number of workers-

_____

Top ten worker category codes-

Worker Category	Number of personnel
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
Total=	0

Total Cost

_____

1.0 rem

Total number of workers-

_____

Top ten worker category codes-

Worker Category	Number of personnel
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
Total=	0

1021860

Total Cost

_____

0.5 rem

Total number of workers-

_____

Top ten worker category codes-

Worker Category	Number of personnel
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
Total=	0

Total Cost

_____

M-P. Estimate increase or decrease in total man-rem by worker category if annual MDE limits were

3.0 rem

Worker Category	Total man-rem (indicate + or)
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

1.0 rem

Worker Category	Total man-rem (indicate + or -)
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

0.5 rem

Worker Category	Total man-rem (indicate + or -)
_____	_____
_____	_____

1021861

M-G. Facility modifications and costs associated with the below annual EDE limits. Use modification codes provided!

1.0 rem

Modifications:	One time costs:	Annual costs:
Total=	0	Total= 0

1.0 rem

Modifications:	One time costs:	Annual costs:
Total=	0	Total= 0

0.5 rem

Modifications:	One time costs:	Annual costs:
Total=	0	Total= 0

M-H. Radiation protection program changes due to indicated annual EDE limits. List costs in thousands ($K)

1021862

2.0 rem

	One time costs:	Annual costs:
Instrumentation-	_____	_____
Record keeping-	_____	_____
Dosimeters-	_____	_____
Passive-	_____	_____
Active-	_____	_____
General controls-	_____	_____
Staffing-	_____	_____
Training	_____	_____
Total=	0	Total= 0

1.0 rem

	One time costs:	Annual costs:
Instrumentation-	_____	_____
Record keeping-	_____	_____
Dosimeters-	_____	_____
Passive-	_____	_____
Active-	_____	_____
General controls-	_____	_____
Staffing-	_____	_____
Training-	_____	_____
Total=	0	Total= 0

0.5 rem

	One time costs:	Annual costs:
Instrumentation-	_____	_____
Record keeping-	_____	_____
Dosimeters-	_____	_____
Passive-	_____	_____
Active-	_____	_____
General controls-	_____	_____
Staffing-	_____	_____
Training-	_____	_____
Total=	0	Total= 0

K-I. Phases of or current operations which would be abandoned due to high costs of indicated annual EDE

2.0 rem

_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

1.0 rem

_____
_____
_____

1021863

_____
_____
_____
_____
_____
_____
_____

0.5 rem

_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

[illegible]. What time frame (in months) would be necessary to permit transition to the indicated reduced EDE values

[illegible] rem

_____

[illegible] rem

_____

[illegible] rem

_____

[illegible]. What percentage of the current annual EDE (i.e., 5 rem) is the basis for your facility administrative limit

_____

IV.- LIFETIME EXPOSURE LIMIT

A. For current worker population, number of workers exceeding or within 10% of exceeding a lifetime cumulative exposure limit of age in years times 1 rem.

_____

B. For each individual from A. above, top ten, indicate the following

Worker Occupational Code-

_____

Age in years-

1021864

_____

Lifetime cumulative exposure-

_____

Worker Occupational Code-

_____

Age in years-

_____

Lifetime cumulative exposure-

_____

Worker Occupational Code-

_____

Age in years-

_____

Lifetime cumulative exposure-

_____

Worker Occupational Code-

_____

Age in years-

_____

Lifetime cumulative exposure-

_____

Worker Occupational Code-

_____

Age in years-

_____

Lifetime cumulative exposure-

_____

Worker Occupational Code-

_____

Age in years-

1021865

_____

Lifetime cumulative exposure-

_____

Worker Occupational Code-

_____

Age in years-

_____

Lifetime cumulative exposure-

_____

Worker Occupational Code-

_____

Age in years-

_____

Lifetime cumulative exposure-

_____

Worker Occupational Code-

_____

Age in years-

_____

Lifetime cumulative exposure-

_____

Worker Occupational Code-

_____

Age in years-

_____

Lifetime cumulative exposure-

_____

7. Administrative procedures to limit worker cumulative exposure

_____

10218 66

Yes

_____

No

_____

Describe if response is Yes

D. Assuming a lifetime exposure limit of age in years times 1 rem were implemented, identify the implementation of the following at your facility

Projected yearly increase in facility exposure (man-rem)

_____

Projected number and costs of increased staff by

Number of personnel-

_____

Annual costs-

_____

Additional projected costs of annual personnel training

_____

Costs of additional personnel dosimetry record keeping

One time-

_____

Annual-

_____

V. - FETAL EXPOSURE

A. Number of occupationally monitored female workers for

1987

1021867 _____

1988

B. Number of occupationally monitored female workers with measurable exposure within the following age categories

<20 _____

20-24 _____

25-29 _____

30-34 _____

35-39 _____

40-44 _____

45-49 _____

50-54 _____

55-59 _____

60-64 _____

65+ _____

C. Number of declared pregnant female workers during

1987 _____

1988 _____

D. Using 1988 exposure data, identify the number of female workers with annual exposure in the following ranges (in rem)

0-<0.1 _____

1021868 0.1-<0.2 _____

0.2-<0.3

0.3-<0.4 _____

0.4-<0.5 _____

0.5-<1.0 _____

1.0-<1.5 _____

1.5-<2.0 _____

2.0-<3.0 _____

3.0 _____

E. Identify if current policies at your facility restrict the declared pregnant female worker from all radiological work and radiological areas

Yes _____

No _____

F. Do you have a current policy to limit the monthly exposure accrual rate for declared pregnant female radiation workers

Yes _____

No _____

If Yes, describe -

1021869

G. Will adopting a requirement for maintaining exposure <0.05 rem/month during the gestation period necessitate changes or increase costs

Yes

_____

No

_____

If Yes -

One time costs

_____

Annual costs

_____

Identify changes-

H. Using 1989 exposure data, list the number of declared pregnant female workers with gestation period total occupational exposure in the following ranges (in rem)

- <0.1

_____

0.1 - <0.2

_____

0.2 - <0.3

_____

0.3 - <0.4

_____

0.4 - <0.5

_____

0.5 or greater

_____

VI - ALI AND DAC VALUES

A. Identify the one time and annual costs associated with reducing the 5480.11 ALI and DAC values by a factor of 2.5, 5 and 10

Factor of 2.5 reduction

One time-

_____

Annual-

_____

Costs to be spent on the following changes-

102 1870

Factor of 5 reduction

One time- _____

Annual- _____

Costs to be spent on the following changes-

Factor of 10 reduction

One time- _____

Annual- _____

Costs to be spent on the following changes-

VII - DESIGN LIMITS

A. Identify costs and changes necessary to implement a change in the F480.11 paragraph 9.j.(1)(b) external exposure continuous occupancy design limits to 0.25, 0.1 mrem/hr

0.25 mrem/hr limit

Costs- _____

Changes -

0.1 mrem/hr limit

Costs- _____

Changes -

102187

VIII - ENVIRONMENTAL LIMITS

A. Costs and modifications to implement a strict 100 mrem/yr environmental dose (no exception up to 500 mrem/yr) limit to members of the public

One time costs-

_____

Annual costs-

_____

Modifications-

B. Identify the total cancer risk factor used by your facility in Safety Analysis Reports, NEPA documents, etc.

Risk Factor-

_____

Identify costs associated with adoption of a 4E-4/rem cancer risk factor

One time costs-

_____

Annual costs-

_____

Implementation time (months)-

_____

1021872

Facility Questionnaire

Note - This version of the questionnaire duplicates and provides additional written guidance that may prove useful in filling out the Lotus 123 spreadsheet questionnaire. Your responses should be directly entered onto the diskette or entered onto the hardcopy of the computer questionnaire. Do not enter your responses onto this version of the questionnaire.

Facility Name _____

Operating Contractor _____

Facility Type (use 5484.1 designations)_____ - A separate questionnaire should be filled out for each of the Contractor's facility types.

DOE Operations Office _____

Name of Respondent_____ Phone _____

I - GENERAL INFORMATION

A. Provide Total Facility Collective Exposure for 1988 (Person-Rem)

B. Provide (if available) Collective Internal Exposure for 1988-(Person-Rem)

C. Provide total number of personnel monitored during 1988 for external and internal exposure

D. Provide total number of personnel with measurable external exposure for 1988

E. Provide value (in Rem) for highest exposed male and female worker for 1988

F. For 1988, provide total collective neutron exposure (in person-rem) and average neutron quality factor used. Identify the number of workers with neutron exposures in the following ranges: 0 to <0.2 Rem, 0.2 to <0.5 Rem, 0.5 to <1.0 Rem, 1.0 to <1.5 Rem, 1.5 to <2.0 Rem, 2.0 to <3.0 Rem, >3.0 Rem.

G. Identify the number of your monitored workers routinely exposed to low energy (< 100 kev) photon radiation.

H. Identify the number of your monitored workers who received an exposure to low energy photons in excess of 0.5, 1.0, and 2.0 Rem in 1988.

I. Identify the number of monitored workers exposed to both low energy photons and neutrons in 1988.

II - RADIOLOGICAL SOURCE TERM

A. Identify the radiation types (i.e., alpha, beta, gamma, neutron, muon, etc.) and associated range of energies which contribute to personnel exposure at your facilities. For beta, give the nuclides involved.

III -REDUCTION OF OCCUPATIONAL WHOLE BODY LIMITS

Questions A - J of this section should be answered in their entirety assuming the postulated three reductions in annual Effective Dose Equivalent (EDE) to 2.0 rem, 1.0 rem, and 0.5 rem versus the current limit of 5.0 Rem.

A. Identify the total number of your monitored workers exceeding 2.0, 1.0, and 0.5 Rem in 1988.

B. For the population identified in III-A above, list the three dominant occupational categories (using 5484.1 occupational codes as given in DOE 5484.1 Chg 3 Att. 8 Table 3) in descending order (i.e. from highest to lowest) of percent contribution to the total.

C. Based on your knowledge of the magnitude of your facilities' internal exposures, would the responses given to A and B above be significantly (>5%) altered assuming an internal EDE was added to the external EDE to calculate total exposure? If yes, provide revised responses for questions asked in A and B.

D. In recognition that the operational status or production level at your facility during 1988 may not have been routine, identify if your answers to A - C above would be significantly different assuming your facility returned to a routine operational/production status (Y/N). (Note - "significantly" equates to a change in >30% of total facility exposure or >15% in number of workers above the limits in A or results in a new occupational category or prioritization in B). If yes, provide revised responses for questions asked in A - C, based on data from a more typical year. Also identify the data year used.

E. Identify increased numbers of workers (total number and by the top ten 5484.1 occupational code categories) necessary to implement an annual EDE (including internal dose) of 2.0, 1.0, and 0.5 Rem. For each EDE level, specify the anticipated increase in yearly cost (in thousands of dollars).

F. Would control of the annual EDE to a 2.0, 1.0, and 0.5 Rem limit increase or decrease the total person-rem exposure to your work force? Estimate increase or decrease (using + and - codes) in person-rem by affected occupational categories (using 5484.1 occupational codes).

G. Would facility modifications (i.e., shielding, decontamination, ventilation upgrades, use of remote tooling, etc) be required to comply with an annual EDE of 2.0, 1.0, and 0.5 Rem? If yes, specifically identify these modifications (list in order from higher to lower significance, using modification codes provided) and provide estimated costs (in thousands of dollars). Identify if costs are one-time or annual.

H. What changes to your radiation protection program, including corresponding costs (in thousands - identify one time versus annual), would be required in the following areas to comply with an annual EDE of 2.0, 1.0, and 0.5 Rem? (Your response to this question should include any costs associated with a commensurate reduction in the ALI/DAC values.)

- instrumentation
- record keeping
- dosimeters(passive, active*)
- general controls (posting, storage, etc)
- staffing
- training.

*Note - passive dosimeters are used for record-keeping purposes (TLDs), active are used for real-time exposure control (alarming dosimetry, pocket dosimeters).

I. Identify any phase of or current operations that would have to be abandoned because of high cost factors associated with modifications necessary to comply with an annual EDE of 2.0, 1.0, and 0.5 Rem.

J. What time frame (in months) would be necessary to permit transition to a reduced annual EDE of 2.0, 1.0, and 0.5 Rem?

K. Identify any changes in your response to questions III A-J above if a neutron QF of 20 were adopted <u>in addition to</u> the reduced annual EDE of 2.0, 1.0, and 0.5 Rem.

L. Identify what percentage of the current EDE (i.e. 5 Rem) is the basis for your facility administrative exposure limit.

IV -LIFETIME EXPOSURE LIMIT

A. For your current radiation worker population, identify the number of individuals that have exceeded or have the potential to exceed (i.e., are within 10% of) a lifetime cumulative exposure limit of age in years x 1 Rem. (Note - If data is not available, indicate time and cost to obtain the data).

B. For the top ten individuals with highest cumulative exposure identified in A above, specifically identify occupational code (using 5484.1 occupational category codes), age in years, and cumulative lifetime exposure in Rem.

C. Identify if your facility currently has a policy in place to administratively limit worker cumulative exposure. If yes, please describe.

D. Assuming a lifetime exposure limit of age in years x 1 Rem were implemented, identify the implementation costs (in thousands) at your facility. Specifically address the following:

- projected yearly increase in facility exposure (person-rem)
- projected number and annual costs of increased staffing
- annual costs of additional training
- costs of upgraded dosimetry record-keeping (one time and annual)

V - FETAL EXPOSURE

A. Provide number of occupationally monitored female workers for 1987 and 1988

B. For 1988, identify the number of occupationally monitored female workers with measurable exposure within the following age categories:

<20, 20-24, 25-29, 30-34, 35-39, 40-44, 45-49, 50-54, 55-59, 60-64, >64.

C. Provide number of declared pregnant female workers in the occupationally monitored group during 1987 and 1988

D. Using 1988 exposure data, identify the number of female workers at your facility with annual exposure in the following ranges (given in Rem):

0 to<0.1, 0.1 to <0.2, 0.2 to <0.3, 0.3 to <0.4, 0.4 to <0.5, 0.5 to <1.0, 1.0 to <1.5, 1.5 to <2.0, 2.0 to <3.0, ≥ 3.0.

E. Identify if current policies at your facility restrict the declared pregnant female worker from all radiological work and radiological areas (Y/N).

F. Identify if current policies at your facility limit the monthly exposure accrual rate for declared pregnant female radiation workers(Y/N). If yes, describe and identify the monthly limit (Rem).

G. Will adopting a requirement for maintaining exposure <0.05 Rem/month during the gestation period necessitate changes or increase costs to your current radiation protection program? If yes, specifically identify changes and give estimated cost impact (one time and annual as applicable).

H. Using 1988 exposure data, identify the number of declared pregnant female workers with gestation period total occupational exposure in the following ranges (in Rem):

0 to <0.1, 0.1 to <0.2, 0.2 to <0.3, 0.3 to <0.4, 0.4 to <0.5, 0.5 and greater

VI- ALI AND DAC VALUES

A. Specifically identify the one time and recurring costs and changes associated with reducing the 5480.11 ALI and DAC values by a factor of 2.5, 5 and 10. Your estimates should address additional posting and area control costs and any additional analytical or sampling upgrades necessary to meet more restrictive MDAs.

VII- DESIGN LIMITS

A. Identify changes and costs necessary to implement a change in the 5480.11 paragraph 9.j.(1)(b) external exposure continuous occupancy design limits to 0.25 and 0.1 mrem/hour.

VIII - ENVIRONMENTAL LIMITS

A. Identify the impact of the elimination of the short term 500 mrem EDE exception to the 100 mrem EDE annual limit to members of the public. Specify any costs (in thousands of dollars)

or facility modifications necessary to comply with this change.

B. Identify the total cancer risk factor used by your facilities in Safety Analysis Reports, NEPA documents, and CERCLA or RCRA corrective action analyses. Identify costs (thousands) and time schedule (months) associated with adoption of a 4E-4/Rem cancer risk coefficient.