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Secretary of the Commission
USNRC
Washington, DC 20555

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PROPOSED RULE PR-Misc Notice
Reg Guide

Dear Sir:

Enclosed are comments on the Draft Reg. Guide "Instruction Concerning Risk from Occupational Radiation Exposure". Clarification for each comment follows below:

① Add this statement for transition and clarity.

② Add footnote to explain "additional". Delete the word "excess".

③ Add the word "generally". Evidence exists to support body repair, especially at low levels of exposure and for large numbers of people exposed.

④ Not necessary to go into specific paragraph of 10CFR20, much less 10CFR20 itself.

⑤ Response is too lengthy, therefore, break it into 3 parts.

⑥ Revise for clarity. Also, the question as worded implies a definite direction and possible causes. One such cause, revising the RBE or QF for neutrons, should not affect dose limits, only calculation of dose.

⑦ Revise for clarity.

⑧ List should be ordered.

⑨ Add for completeness.

Yours truly,
James J. Drasler

Acknowledged by card. 6/10/80. mdv.

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Radiation is like most substances that cause cancer in that the effects can be seen clearly only at high doses. Still, it is prudent to assume that smaller doses also have some chance of causing cancer. This is as true for natural cancer-causers such as sunlight and natural radiation as it is for those that are man made such as cigarette smoke, smog, and man-made radiation. As even very small doses may entail some small risk, it follows that no dose should be taken without a reason. Thus, a time-honored principle of radiation protection is to do more than merely meet the allowed regulatory limits; doses should be kept as low as is reasonably achievable (ALARA).

We don't know exactly what the chances are of getting cancer from a radiation dose, but we do have good estimates. The estimates of radiation risks are at least as reliable as estimates for the effects from any other important hazard. Being exposed to typical occupational radiation doses is taking a chance, but that chance is small and reasonably well understood.

It is important to understand the probability factors here. A similar question would be: if you select one card from a full deck, will you get the ace of spades? This question cannot be answered with a simple yes or no. The best answer is that your chances are 1 in 52. However, if 1000 people each select one card from full decks, we can predict that about 20 of them will get an ace of spades. Each person will have 1 chance in 52 of drawing the ace of spades, but there is no way that we can predict which individuals will get the right card. The issue is further complicated by the fact that in 1 drawing by 1000 people, we might get only 15 successes and in another perhaps 25 correct cards in 1000 draws. We can say that if you receive a radiation dose, you will have increased your statistical chances of eventually developing cancer or some other radiation-related injury. The more radiation exposure you get, the more you increase your chances of cancer. The only question now is, by how much?

(1)

Clearly, there is no simple answer to this question. The best we can do is provide estimates, for large groups, of the increased chances of cancer or other radiation injury resulting from exposure to radiation.

A reasonable comparison involves exposure to the sun's rays. Frequent short exposures provide time for the skin to repair. An acute exposure to the sun can result in painful burning, and excessive exposure has been shown to cause skin cancer. Whether exposure to the sun's rays is short term or spread over time, some of the injury is not repaired and may eventually result in skin cancer.

The effect upon a group of exposed workers may be an increased incidence of cancer over and above the number of cancers that would be expected in that population. Each exposed individual has an increased probability of incurring subsequent cancer. We can say that if 10,000 workers each receive an additional 1 rem in a year, that group is more likely to have a larger incidence of cancer than 10,000 people who do not receive the additional radiation. An estimate of the increased probability of cancer from low radiation doses delivered to large groups is one measure of occupational risk.

8. What are the estimates of the risk of cancer from radiation exposure?

The cancer risk estimates (developed by the organizations identified in Question 9) are presented in Table 1.

TABLE 1

CANCER RISK ESTIMATES FROM EXPOSURE TO LOW-LEVEL RADIATION

Source	Number of Additional** Cancers Estimated to Occur in 1 Million People After Exposure of Each to 1 Rem of Radiation
BEIR 1979	268-399
ICRP 1977	300*
UNSCEAR 1977	300*

(2) Delete the word 'excess'.

*ICRP and UNSCEAR both estimated 100 ~~excess~~ delayed deaths from these 300 radiation-induced cancers. Only about one-third of cancer cases are fatal. Note that the three independent groups are in close agreement on the risk of radiation-induced cancer.

** Above normal incidence of cancer

To put these estimates (of Table 1) into perspective, we will use an average of 300 excess cancer cases per million people, each exposed to 1 rem of ionizing radiation. (Most scientists would agree that 300 is a high estimate of risk and may be considered an upper limit.) This means that if in a group of 10,000 workers each receives 1 rem, three would be predicted to develop cancer because of that exposure, although the actual number could be more or less than three (including none). ~~Introduce the concept of manrem here. It could be and is very misleading and confusing seeing the reference to "1 rem" all the time.~~

The American Cancer Society has reported that approximately 25 percent of all adults in the 20-65 year age bracket will develop cancer at some time from to the worker population. A job that involves exposure to radiation should be done only when it is clear that the benefit justifies the risks assumed. All design, construction, and operating procedures should be reviewed with the objective of reducing unnecessary exposures.

14. Has the ALARA concept been applied if, instead of reaching dose limits during the first week of a quarter, the worker's dose is spread out over the whole quarter?

3a No. At low doses the health effects do not seem to be affected by dose rate. The risk of cancer from low doses is considered to be proportional to the amount of exposure, not the rate at which it is received. Spreading the dose out over time or over larger numbers of people does not generally reduce the overall risk. The ALARA concept has been followed only when the collective dose is reduced by reducing the time of exposure or decreasing radiation levels in the working environment.

15. What is meant by <u>collective dose</u> and why should it be maintained ALARA?

Nuclear industry activities expose an increasing number of people to occupational radiation in addition to the radiation doses they receive from natural background radiation and medical radiation exposures. The collective occupational dose (man-rems) is the sum of all occupational radiation exposure received by all the workers in an entire worker population. For example, if 100 workers each receive 2 rems, the individual dose is 2 rems and the collective dose is 200 man-rems. The total additional risk of cancer and genetic effects in an exposed population is assumed to depend on the collective dose.

3b It should be noted that, from the viewpoint of risk to a total population, it is the collective dose that must be controlled. For a given collective dose, the number of health effects is believed to be the same even if a larger number of people share the dose. Therefore, spreading the dose out may reduce the individual risk, but generally not that of the population.

Efforts should be made to maintain the collective dose ALARA so as not to unnecessarily increase the overall population incidence of cancer and genetic effects.

16. Is the use of extra workers a good way to reduce risks?

There is a "yes" answer to this question and a "no" answer. For a given job involving exposure to radiation, the more people who share the work, the lower the average dose to an individual. The lower the dose, the lower the risk. So, for you as an <u>individual</u>, the answer is "yes."

But how about the risk to the entire group of workers? The risk of cancer depends on the total amount of radiation energy absorbed by human tissue, not on the number of people to whom this tissue belongs. Therefore, if 30 workers are used to do a job instead of 10, and if both groups get the same collective dose (man-rems), the total cancer risk is generally the same, and nothing was gained <u>for the group</u> by using 30 workers. From this viewpoint the answer is "no." The risk was not generally reduced but simply spread around among a larger number of individuals.

Unfortunately, spreading the risk around often results in a larger collective dose for the job. Workers are exposed as they approach a job, while they are getting oriented to do the job, and as they withdraw from the job. The dose received during these actions is called nonproductive. If several crew changes are required, the nonproductive dose can become very large. Thus it can be seen that the use of extra workers may actually increase the total occupational dose and the resulting risks.

The use of extra workers to comply with NRC dose limits is not the way to reduce the risk of radiation-induced cancer for the worker population. At best, the total risk remains the same, and it may even be increased. The only way to reduce the risk is to reduce the collective dose; that can be done only by reducing the radiation levels, the working times, or both.

17. Why doesn't the NRC impose collective dose limits?

Compliance with individual dose limits can be achieved simply by using extra workers. However, compliance with a collective dose limit (such as 100 man-rems per year for a licensee) would require reduction of radiation levels, working times, or both. But there are many problems associated with setting appropriate collective dose limits.

21. Why do some facilities establish administrative limits that are below the NRC limits?

(4)

There are two reasons. First, paragraph 20.1(c) of the NRC regulations states that licensees should keep exposures to radiation ALARA. By requiring specific approval for worker doses in excess of set levels, more careful risk-benefit analysis can be made as each additional increment of dose is approved for a worker. Secondly, a facility administrative limit that is set lower than the quarterly NRC limit provides a safety margin designed to help the licensee avoid overexposures.

22. Several scientists have recently suggested that NRC limits are too high and should be lowered. What are the arguments for lowering the limits?

In general, those critical of present dose limits say that the individual risk is higher than estimated by the BEIR Committee and the ICRP. A few studies have indicated that a given dose of radiation may be more likely to cause biological effects than previously thought. The controversy is focused on studies involving groups of exposed individuals. Opinions differ on the validity of the research methods used and the methods of statistical analysis. The chief problem is that, with small groups, the incidence of effects such as leukemia is small. It cannot be shown without question that these effects were more frequent in the exposed study group than in the unexposed group used for comparison or that any observed effects were caused by the exposure to radiation.

The current BEIR committee concluded that claims of higher risk had "no substance," and nearly one-half of the committee members were convinced that the BEIR risk estimates were actually too high. The NRC staff is committed to a continuing review of research on radiation risk and is funding a study to design new research on human effects from exposure to radiation.

23. What are the arguments against lowering the NRC dose limits?

There are 3 reasons:

(5a) a. Health risks are already low

The estimated health risks associated with current average occupational radiation doses (e.g., 0.5 rem/yr for 50 years) are comparable to or less than risk levels in other occupational areas considered to be among the safest.

exposure to 5 rems/yr for 50 years, which virtually never occurs, would increase the estimated risk to levels comparable to risks in mining and heavy construction. If the dose limits were lowered significantly, the number of people required to complete many jobs would increase. The collective dose would then increase since more individuals would be receiving nonproductive exposure while entering and leaving the work area and preparing for the job. The total number of health effects might go up as the collective dose increased.

5b b. Current regulations are technically sound

The regulatory standards for dose limits are based on the recommendations of the Federal Radiation Council, the NCRP, and the ICRP. At the time these standards were developed, about 1960, it was considered unlikely that exposure of these levels during a working lifetime would result in clinical evidence of injury or disease different from that occurring in the unexposed population. The scientific data base for the standards consisted primarily of human experience (X-ray exposures to medical practitioners and patients, ingestion of radium by watch dial painters, early effects observed in Japanese atomic bomb survivors, radon exposures of uranium miners, occupational radiation accidents) involving very large doses delivered at very high dose rates. The data base also included the results of a large number of animal experiments involving high doses and dose rates. The animal experiments were particularly useful in the evaluation of genetic effects. The observed effects were related to low-level radiation through a linear, nonthreshold extrapolation procedure. Based on this approach, the NRC regulations were formed. in 10 CFR Part 20, "Standards for Protection Against Radiation," also state that licensees should maintain all radiation exposures, and releases of radioactive materials in effluents, as low as is reasonably achievable. (4)

5c c. Very little to gain

Reducing the dose limits, for example, by a factor of 10 (that is, from 5.0 rems/yr to 0.5 rem/yr) has been analyzed by the NRC staff. An estimated 2.6 million man-rems could be saved from 1980 through the year 2000 by nuclear power plant licensees if compliance with the new limit was achieved by lowering the radiation levels, working times, or both, rather than by using extra workers. It is estimated that something like $23 billion would be spent toward this purpose. Spending $23 billion to save 2.6 million man-rems would amount to spending $30 to $90 million to prevent each potential radiation-induced cancer death. Society may consider this cost unacceptably high for individual protection.

(6) 24. Does that mean that the dose limits are not subject to change? adapt to

~~24. Are there any areas of concern about radiation risks that might result in lowering the NRC dose limits?~~

Not necessarily.

Three areas of concern to the NRC staff are specifically identified below:

a. An independent study has indicated that a given dose of neutron radiation is more likely to cause biological effects than previously thought. Although the scientific community has not yet agreed with the results of this study, workers should be advised of the possibility of higher risk when entering areas where exposure to neutrons will occur.

b. It has been known for some time that rapidly growing living tissue is more sensitive to injury from radiation than tissue in which the cells are not reproducing rapidly. Thus the unborn embryo or fetus is more sensitive to radiation injury than an adult. The NCRP recommended in Report No. 39 that special precautions be taken for ~~when an~~ occupationally exposed pregnant women ~~could be pregnant~~ in order to protect the embryo or fetus. In 1975, the NRC issued Regulatory Guide 8.13, "Instruction Concerning Prenatal Radiation Exposure," in which it is recommended that licensees instruct all workers concerning this special risk. The guide recommends that all workers be advised that the NCRP recommended the maximum permissible dose to the embryo or fetus from occupational exposure of the mother should not exceed 0.5 rem for the full 9-month pregnancy period. In addition, the guide suggests options available to the female employee who chooses not to expose her unborn child to this additional risk. (7)

c. Also of special interest is the indication that female workers are subject to more risk than male workers. In terms of all types of cancer except leukemia, the 1979 BEIR analysis indicates that female workers have a risk of developing radiation-induced cancer that is approximately one and one-half times that for males. Incidence of radiation-induced leukemia is about the same for both sexes. Female workers should consider carefully this difference in the risks of radiation-induced cancer in deciding whether or not to seek work involving exposure to radiation.

25. How much radiation does the average person who does not work in the nuclear industry receive?

We are all exposed from the moment of conception to ionizing radiation from several sources. Our environment, and even the human body, contains naturally scientific groups that have studied them. Thus, your employer is not obligated to guarantee you a transfer if you decide not to accept an assignment requiring exposure to radiation.

You also have the option of seeking other employment in a nonradiation occupation. However, the studies that have compared occupational risks in the nuclear industry to those in other job areas indicate that nuclear work is relatively safe. Thus, you will not necessarily find significantly lower risks in another job.

A third option would be to practice the most effective work procedures so as to keep your exposure ALARA. Be aware that reducing time of exposure, maintaining distance from radiation sources, and using shielding can all lower your exposure. Plan radiation jobs carefully to increase efficiency while in the radiation area. Learn the most effective methods of using protective clothing to avoid contamination. Discuss your job with the radiation protection personnel who can suggest additional ways to reduce your exposure.

32. Where can I get additional information on radiation risk?

The following list suggests sources of useful information on radiation risk:

a. <u>Your Employer</u>
The radiation protection or health physics office in the facility where you are employed.

b. <u>Nuclear Regulatory Commission</u>
Address: Occupational Health Standards Branch
Office of Standards Development
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Phone: 301-443-5970

c. <u>NRC Regional Offices</u>

King of Prussia, PA 19406	215-337-5000
Atlanta, GA 30303	404-221-4503
Glen Ellyn, IL 60137	312-932-2500
Arlington, TX 76012	817-334-2841
Walnut Creek, CA 94596	415-943-3700

8 d. Department of Health, Education, and Welfare

Address: Office of Public Affair
Bureau of Radiologi... Health
Department of Health, Education, and Welfare
Room 15-B-42, HF1-40
5600 Fishers Lane
Rockville, MD 20857

Phone: 301-443-3285

e. Environmental Protection Agency

Address: Office of Radiation Programs
U.S. Environmental Protection Agency
401 M Street, SW
Washington, D.C. 20460

Phone: 703-557-9710

9 f. ~~local~~ public libraries

g. School libraries
Colleges, Universities, JC's, Community colleges