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A Viewpoint on Proposed Radiation-Protection Standards

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I have strongly-mixed emotions concerning this presentation. As an individual who believes strongly that a major role of government is to regulate and prevent chaos, it disturbs me to find in the following discussion that our regulatory agencies serve in many instances as the antithesis of their intended purpose. There is indeed chaos in the regulatory arena and in no area is it more rampant than for the specific case of radiation standards and guides.

The involvement of the Federal Government in radiation protection standards was minimal until after the controversy generated by claims of damage from the fallout from weapons' testing and subsequent Congressional hearings. The Atomic Energy Commission had had the most need for standards and the greatest involvement, but the fallout controversy forced a broader Federal participation. Additional stimulus was provided by the concern about radiation from consumer products, notably color television sets, and by the emergence of nuclear intervenors.

Prior to 1959, guidance had been almost entirely from the national and international councils and committees operating as semi-autonomous, semi-

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official bodies providing "consensus" opinions; the uniformity of their opinions was extraordinary even though there was often overlapping membership.

In response to mounting concern about the effects of low levels of radiation on humans, the Federal Radiation Council (FRC) was formed in 1959 by Public Law 86-373. It was the first body with legislated responsibility to "advise the President with respect to radiation matters, directly or indirectly affecting health, including guidance for all federal agencies in the formulation of radiation standards and in the establishment and execution of programs of cooperation with States...."

Over a period of about ten years, a small staff with the help of volunteer scientists wrote reports giving guidance in essentially all major areas of radiation protection. These scholarly reports, used in conjunction with extensive reports of the various traditional councils and committees, provided the professional health physicist with the guidance necessary for protecting the human being and the environment from radiation (FRC reports 1-8, U. S. Government Printing Office).

In 1969, the Environmental Protection Agency (EPA) was established by the National Environmental Protection Act (NEPA), and the responsibilities of the FRC were transferred to the Office of Radiation Programs of EPA. In 1974 the Nuclear Regulatory Commission (NRC) was made independent of the old Atomic Energy Commission and expanded. By 1976, the EPA annual report on radiation protection activities listed eleven federal agencies with a role in radiation protection functions, with thousands of people employed. The number of people with some role in these activities has continued to grow. One ramification of this huge expansion of effort has been the evolvement of a type of "Regulatory Person." Many of the people in this category came into a regulatory role

directly from college or university. Many brought the advantages of youth, bright minds, and high ideals. They brought the disadvantages of a lack of field experience, training relevant to their jobs, and poorly defined objectives. Being bright however, they soon perceived one piece of an objective. They had to prepare new or revised standards or guides to demonstrate to management that they had a mission so that management could, in turn, justify budgets to the Office of Management and Budget (OMB) and to Congress. However, it was equally clear that the national climate was not right for changing radiation control limits and guides upward so that, effectively, their reason for being was reduced to revising standards downward. Coincident with this type of institutional environment, the "Regulatory Persons" were obligated, of course, to defend the levels and limits which they promulgated. Such repeated defense of a position, however unconvinced they were originally, soon resulted in a firm "mind set." This well known phenomenon has worked so well that some of the older staff who, in their intellectual minds know better, now espouse the premise that they would not want their wives or children to be exposed to 10 mrem/yr, for a return of a more abundant electrical energy production. I am convinced that they are now truly concerned about 10 mrem/yr, which is about one half of the root mean square of the variation in the natural background in the United States.

As a consequence of the above and the obvious extension of it, Regulatory People are convinced that the overall risk of cancer resulting from one rem is greater than one in 10^{-4} and that the linear extrapolation is valid even for low LET chronic exposures. The obvious extension of their conclusions to actual exposed populations shows that something must be wrong. Though the epidemiology for such groups as the most highly exposed people in Kerala,

India, can be faulted, it still provides some bounds to the risks of radiation at levels much higher than normal natural background. In one small but well delineated and stable population of 70,000 people who receive, and have received for many generations, annual exposures ranging from about 500 to 2000 mrem/year, the risk coefficient used in the proposed revision of 10CFR20, i.e. 1.6×10^{-4}, results in 400-2000 added cancer deaths per 70 years. The studies conducted in Kerala during the past twenty-five years do not show an increase in cancer risk in the people (see e.g., Gopal-Ayengar et al. in Proceedings of Fourth International Conference on Peaceful Uses of Atomic Energy, Volume II).

With regard to the proposed revision of 10CFR20, I want to add two comments. First, the current draft is an enormous improvement over previous drafts, and it demonstrates a willingness by the NRC staff to incorporate changes in response to both internal and external suggestions. I believe that in all areas except one the staff is progressing toward a useful regulatory document.

However, the second comment relates to my chief concern, i.e., the approach to a much-needed de minimis level and the particular choice. I have not yet begun to understand why NRC would choose EPA for guidance or why they chose to compare the risks of radiation to that guessed at for a single food additive when there are so many common food additives that are potentially carcinogenic. For our present U. S. population, their chosen de minimis risk is one in a million/lifetime. This corresponds to about 225 added cancer deaths per lifetime, which is a vanishingly small fraction of the risks from any other energy source. If we discard all modern energy technologies and use mules and horses as the power source for food production, there will be far more than 225 people expire per year from being kicked by these animals. For

a seventy-year period this corresponds to over 15,000 deaths or fifteen billion times the risk from the proposed de minimis level which is, in turn, based upon an ultra-conservative extrapolation from the high dose range. This is also an indication that the "soft path" approach to energy represents an enormous risk to health and safety. Reemphasizing the risks relative to the proposed revision of 10CFR20, or to EPA's food additive limits, a risk of one in a million in a lifetime is so small as to be meaningless on any real scale, certainly meaningless in comparison to the 150,000 chances per million of fatal cancer which we all face at present.

Lest you gather that I concentrate too strongly on NRC and EPA, let me add that these agencies are entirely typical. DOE's operational safety staff has been supporting the development of guides on which to audit and appraise DOE programs. Consider, for example, the values given in PNL-4139D figure 2.1. There, a proposed de minimis value of 0.1 mrem/year is indicated for a "maximum exposed individual in an unrestricted area" (figures 1 and 2).

I can not give an optimistic prognostication for the near future. Restrictions, guides, and limits for radiation will continue at levels ranging from 1/10 to 1/1000 of any realistic values based on risk/benefit analyses. At present, the benefit part of the analysis is getting little attention with the exception of medical applications where, at least implicitly, the benefits are perceived by regulators to exceed the risks. There is pressure from some members of the Health Physics Society to change the prospectus to remove the implication that health physicists support beneficial uses of radiation and/or nuclear power.

Figure 3 shows the objective of the Health Physics Society as of about 20 years ago. Figure 4 shows a proposed revision of the prospectus which is on

the current annual ballot of the Health Physics Society. Some few members would delete everything after the word radiation. I would point out to them and to regulatory personnel that the easiest way to protect everyone from technological sources of radiation would be to eliminate them a la Jane Fonda. The consequences would extend beyond the adverse health, safety, and economic impacts on the nation; it would obviate the need for regulators or further regulation.

In summary, I would remind everyone to keep in mind that we have a world average natural radiation environment of 125 mrem/year. Further, and more important, it varies from about 70 to about 5000 mrem/year. For many generations millions of people have lived with more than twice the average level with no detectable harm (see e.g., Gopal-Ayengar et al. in Proceedings of Fourth International Conference on Peaceful Uses of Atomic Energy, Volume II). Figure 5 shows graphically the relationship of some radiation sources. Finally, figure 6 depicts one of several familiar analogies between common substances and radiation, in this case alcohol. Clearly, either 1 liter of vodka or 1000 rems of radiation, in an acute dose, is lethal. Doses of 100 rem of radiation or 100 milliliters of vodka will produce symptoms, and for radiation, a potential for long term effects, including a specific probability of leukemia of about 1%. For smaller doses no signs or symptoms will be seen except for a slight increase in cancer risks from the radiation which would require a large population for detection of the risks. For both agents, there is no evidence for effects in people for doses less than 10 rem or 10 ml though some medical authorities believe that 10 ml of alcohol with meals is beneficial. A radiation dose of 1 mrem/year can best be compared to the alcohol clinging to a fault in the skin of a single well-ripened grape.

Until regulatory personnel stop playing with 10^8 times 10^{-6} and begin to exhibit some cognizance of the natural world and its variance, I can predict only gloom and dispair, enormous waste of national resources, an ever-widening technological gap between the U. S. and other more rapidly-advancing countries, and a steady decline in our national standard of living due to expensive energy.

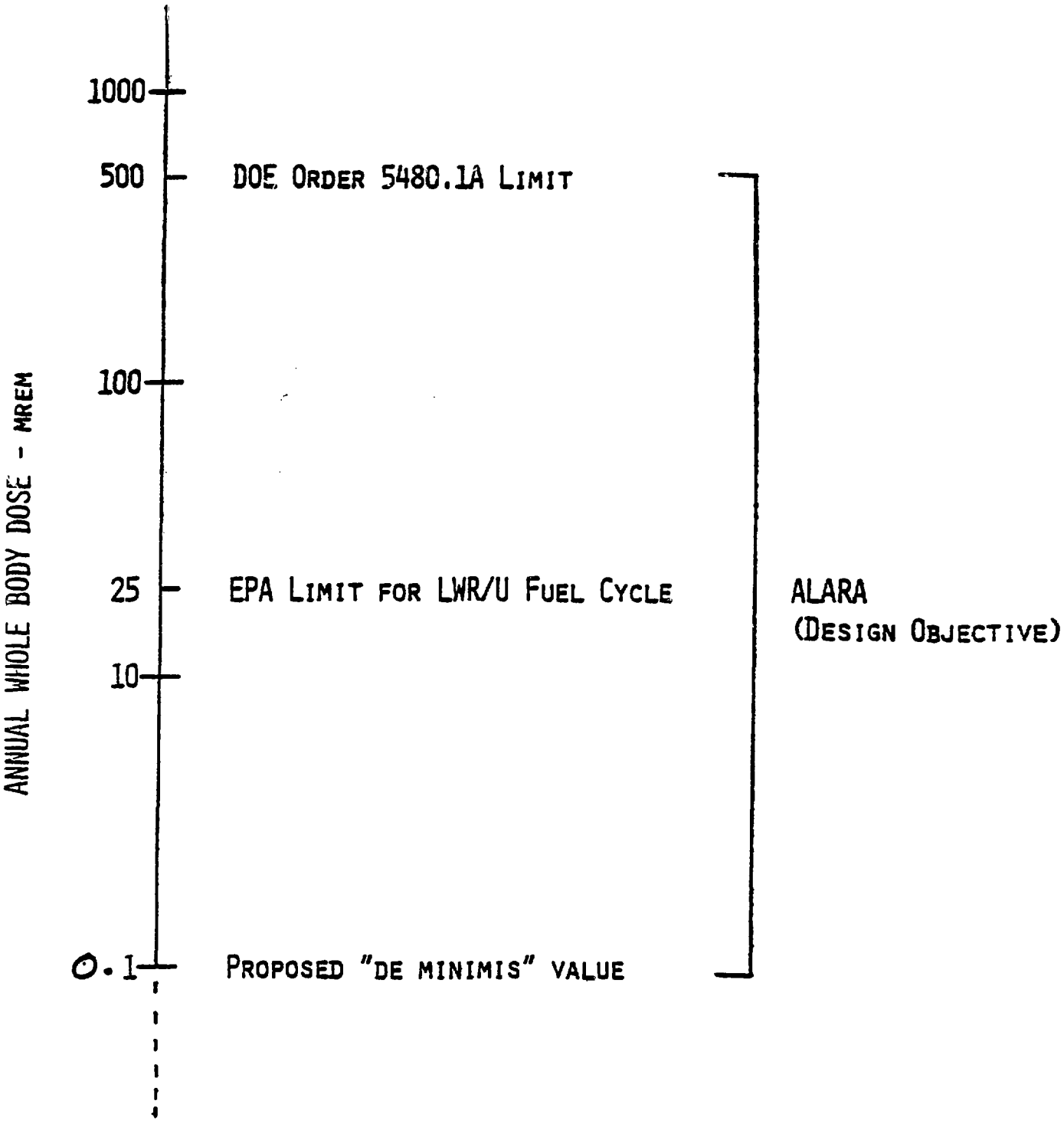

FIGURE 2.1 Dose Criteria Relationships For A Maximum Exposed Individual IN AN UNRESTRICTED AREA

Figure 1

Annual release data should be obtained and reported for each effluent stream and radionuclide which has a reasonable probability (P>0.01) of exceeding or causing to exceed any of the following:

a) An annual whole body dose or dose commitment to any individual in the uncontrolled environment of 0.1 mrem

b) An annual whole body dose or dose commitment to the general population within an 80 km radius of 1 man-rem

c) A temporary (less than one minute) concentration in the effluent at the point of discharge of 10% of the applicable Concentration Guide (CG) for uncontrolled areas

Figure 2

OBJECTIVE

THE PRIMARY OBJECTIVE OF THE SOCIETY IS TO DEVELOP SCIENTIFIC KNOWLEDGE AND A PRACTICAL MEANS WHEREBY MAN AND THE ENVIRONMENT IN WHICH HE LIVES ARE PROTECTED AGAINST THE HARMFUL EFFECTS OF RADIATION THEREBY FACILITATING IN FACT THE EXPLOITATION OF RADIATION AND ATOMIC ENERGY FOR THE BENEFIT OF ALL MANKIND.

Figure 3

PROPOSED AMENDMENT

"THE PRIMARY OBJECTIVE OF THE SOCIETY IS THE DEVELOPMENT OF SCIENTIFIC KNOWLEDGE AND PRACTICAL MEANS FOR PROTECTION OF MAN AND HIS ENVIRONMENT FROM THE HARMFUL EFFECTS OF RADIATION, THUS PROVIDING FOR ITS UTILIZATION FOR THE BENEFIT OF MANKIND."

Figure 4

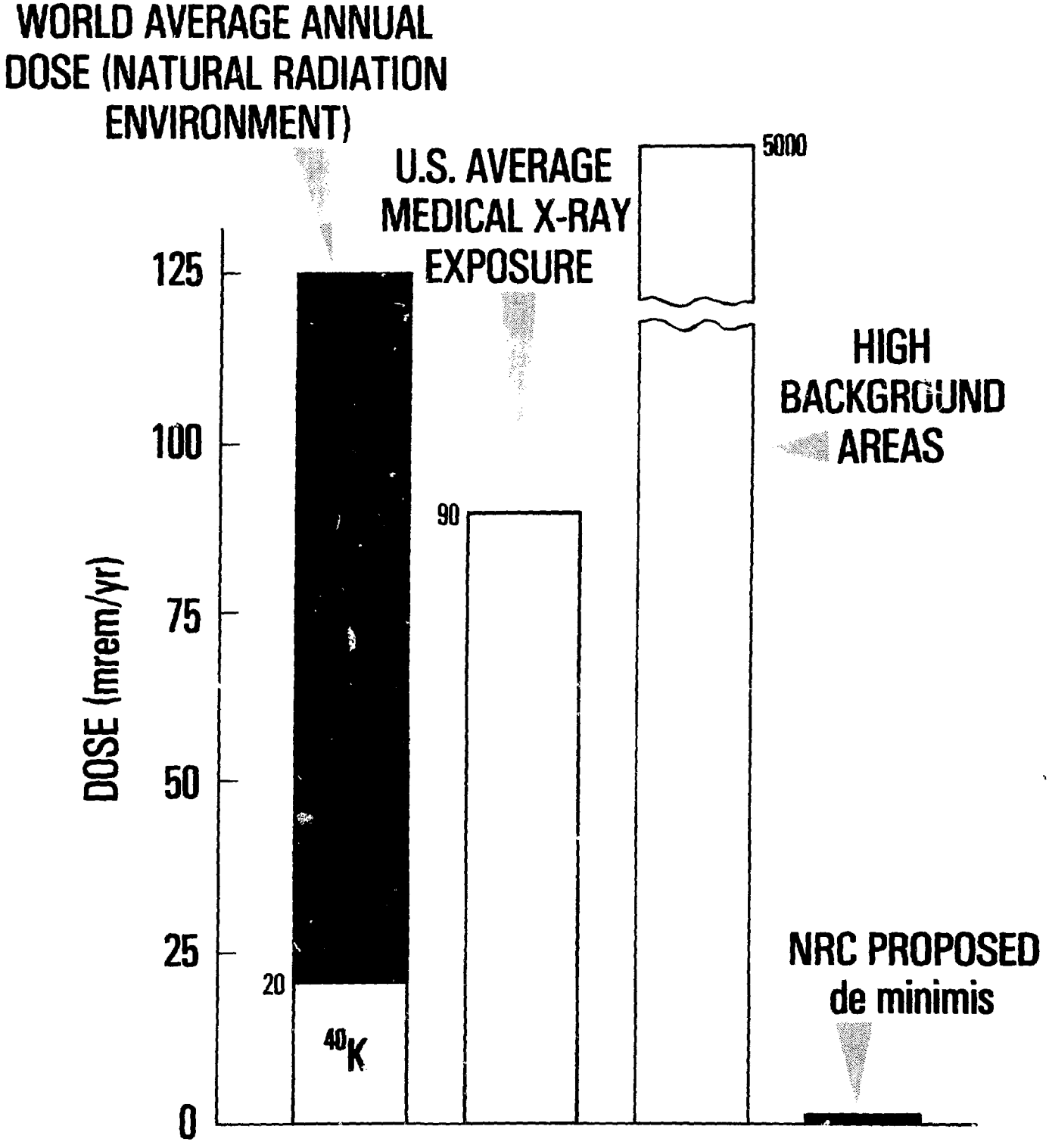
WORLD AVERAGE ANNUAL DOSE (NATURAL RADIATION ENVIRONMENT)
U.S. AVERAGE MEDICAL X-RAY EXPOSURE
5000
HIGH BACKGROUND AREAS
125
100
75
50
25
0
DOSE (mrem/yr)
90
20
40K
NRC PROPOSED de minimis

Figure 5

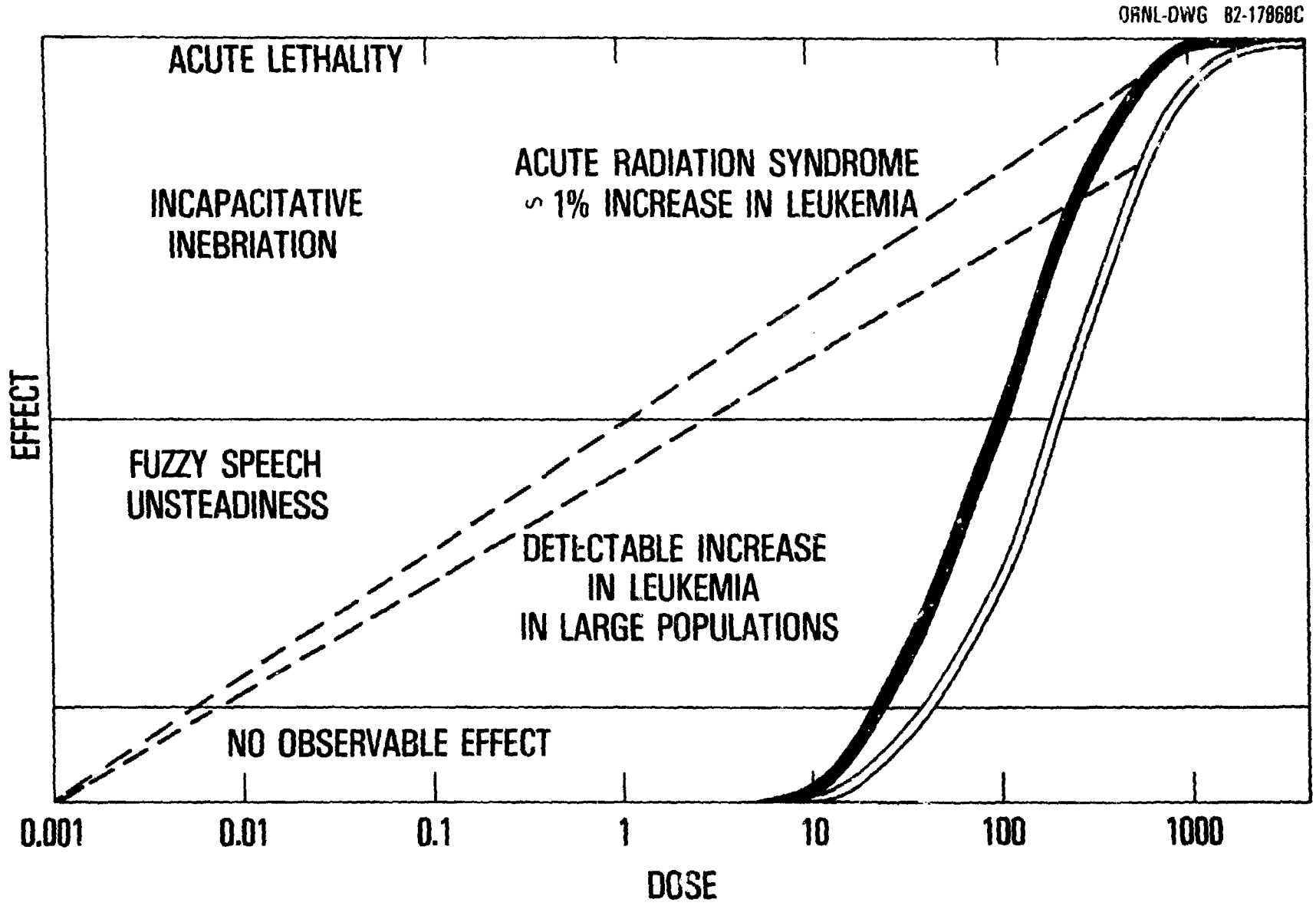
ORNL-DWG 82-17868C
ACUTE LETHALITY
ACUTE RADIATION SYNDROME
≤ 1% INCREASE IN LEUKEMIA
INCAPACITATIVE
INEBRIATION
FUZZY SPEECH
UNSTEADINESS
DETECTABLE INCREASE
IN LEUKEMIA
IN LARGE POPULATIONS
NO OBSERVABLE EFFECT
EFFECT
0.001
0.01
0.1
1
10
100
1000
DOSE

Figure 6