AUSTRALIAN NUCLEAR FORUM

Low-Level Radiation Dose Standards

Policy

Radiation protection standards for low doses should be based on accepted scientific evidence. (Adopted 27/9/01)

Summary and conclusions

The whole body dose-effect relationship currently recommended by the ICRP and adopted by most countries includes the Linear No Threshold (LNT) hypothesis that says the risk of cancer is proportional to dose. An extension of this concept is to use the LNT relationship to estimate statistical effects of small incremental doses to large populations. However, neither concept is supported by experimental evidence for doses below 50 mSv/yr.

Natural background radiation around the world ranges from about 1 to 100 mSv/yr with no observed differences to local populations. Further, for various reasons the real low-dose health effect relationship is likely to be much more complex than reflected by the LNT hypothesis. Consequently the use of the LNT hypothesis at low doses is scientifically questionable.

It is generally granted that use of the LNT model at low doses causes adverse effects to be somewhat over-estimated. Thus in a majority of applications unquantified conservatism is required in design and operation leading possibly to excessive economic and social costs.

The ANS position statement raises many questions about the LNT hypothesis and most are summarised here with a few minor additions. In response to the concerns of the ANS and many other reputable scientific/technical societies the world over, the ICRP is currently reexamining its recommended standard based on the LNT hypothesis.

Considerations

1. Historical Development of Dose Limits

Early dose standards were based on directly observed effects and were expressed as fixed limits. Analysis of the atomic bomb survivors in Japan however, showed decreasing probability of adverse effects proportional with lower acute doses down to about 20 mSv. This led to the International Commission on Radiological Protection (ICRP) to recommend the Linear No Threshold (LNT) hypothesis for low-dose effects, with the corollary that no dose above background could be regarded as absolutely safe.

2. Consequences of the Application of the LNT

Since there is currently little experimental evidence of the effects of low-level radiation, the LNT relationship remains unproven. It is convenient to use on the local scale, and by extension with larger groups (Le. collective dose). However, application of the latter to the Chernobyl accident fallout resulted in undue public alarm. Moreover it is in the low-level exposure region where most resources are spent in radiation protection - expenditures probably excessive since the fundamental dose-effect relationship is generally recognised as conservative, but to an unknown extent.

3. Additional Low-Level Effects

A basic problem with the LNT hypothesis is that it does not acknowledge that background levels vary significantly without observed ill effects. This prima facie evidence indicates that the linear relationship should be terminated somewhere above the higher background levels, i.e. above about 100 mSv/yr. Also, the practise of only considering doses above background in calculating risk is illogical since, for example, an added exposure of 100 times normal in

one location may require public evacuation, but the same total exposure in another location is regarded there as normal.

Additional complications arise in accommodating exposure history, age, gender, kind of radiation, volumes and organs of the body involved and the complex mechanism of cell repair is still the subject of much research. Also, there is evidence that low levels of radiation are necessary for the good health of some organisms - a phenomenon called hormesis. All such factors indicate that the true low dose-effect relationship is unlikely to be simple in form.

4. Contribution of Australia

Like most other countries, Australia has added little to the fundamental understanding of low-level radiation effects. This country's major interest lies in the use of existing international standards in industry and scientific research. Should any changes be made in these standards, they will no doubt be adopted here.

5. Possible Formulation of Dose-Effect Relationship

Current radiation protection standards are based on the LNT hypothesis which is simple to apply. However, if the true low-level dose effect relationship is more complex it may be, as UNSCEAR suggests, that computer modelling could be used for estimating radiation risk at low doses and dose rates.

6. Positions of Other Nuclear Organisations

The ANS issued the following: "It is the position of the American Nuclear Society" that there is insufficient scientific evidence to support the use of the Linear No Threshold Hypothesis (LNTH) in the projection of the health effects of low-level radiation." It went on to recommend a re-examination of the hypothesis with the aim of developing a science-based model that would reduce the misuse of resources and provide for better public understanding.

The ICRP itself recently initiated a review of the biological and epidemiological information with a view toward possible revision of the currently recommended standards, but in relation to low-level effects the ICRP says "for the present, no change is considered".

7. References.

1. "Health Effects of Low-Level Radiation," American Nuclear Society Position Statement, June 2001.

2. "A Report on Progress Towards New Recommendations: A Communication from the International Commission on Radiological Protection", Journal of Radiological Protection (vol 21, p 113, 2001).

3. UN Scientific Committee on the Effects of Atomic Radiation, 2000 Report.