+POPULATION DOSE EQUIVALENT FROM NATURALLY OCCURRING RADIONUCLIDES IN BUILDING MATERIALS

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A significant component of natural background is that arising through the presence of naturally occurring radionuclides in building materials. Estimates are that the average contribution from this source to the external whole body dose equivalent rate in brick and masonry houses is 10 to 20 mrem/yr. For critical population groups, values reported in the literature range up to a hundred mrem/yr (1,2). Dose equivalent rates to the lungs can be even higher and, in a number of situations, it would appear that control measures should be considered. A listing of several such measures, with information on the advantages and disadvantages of each, is given in Table 1.

In order to quantify the benefits of control measures, the authors have developed a Fortran IV computer program for estimating whole body and lung dose equivalent rates due to naturally occurring radionuclides in building materials. Two of the inputs to this program are the effects of wall thickness and the effects of a surface sealant on the external gamma exposure rate due to the increased quantity of radon daughter nuclides trapped within a wall. As illustrated in Figure 1, the presence of such a sealant can appreciably increase external dose rates, an effect that must be considered if impervious paints are added to surfaces to block radon diffusion into a room.

Estimates show that the use of surface sealants (in the form of epoxy paints) in basement areas could result in lung dose equivalent rate reductions (assuming 75% occupancy) at a cost as low as $20 to $40 per person-rem. This estimate was based on the assumption that the entire cost of the painting operation was attributable to dose reduction. If it is assumed that the basement walls would have been painted for aesthetic purposes in any case, and that the added cost for dose reduction was only the marginal difference between a non-permeable epoxy paint and a permeable paint, the cost per person-lung-rem dose equivalent reduction could be as low as $5 to $10. This finding shows that some presently available control measures for population dose equivalents from naturally occurring radionuclides appear to be well justified on the basis of the $1,000 per person-rem value currently used by the U.S. Nuclear Regulatory Commission in determining the cost-effectiveness of techniques for reducing routine radionuclide releases from commercial nuclear power plants (3).

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References

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Table 1

COMPARISON OF CONTROL MEASURES

Control Measure	Advantages	Disadvantages
Material substitution	Can control both external and internal exposure Passive control Only marginal costs incurred when applied to new construction	Impractical for existing structures Potentially high cost
Manufacturing standards	Preventive measure Passive control	Not applicable to existing structures Potentially high cost
Building design changes	Areas of highest exposure can be eliminated	Lifestyle/behavioral changes may be required Not applicable to existing structures
Increased ventilation	Retrofit possible Relative low cost	Does not reduce external gamma exposure rate Increases heating and cooling costs
Adsorption, filtration and/or chemical reactions	Retrofit possible Potentially high effectiveness for reducing internal D.E.	Technologies not yet fully developed Cost estimates are uncertain Does not reduce external gamma exposure rate
Surface sealants	Retrofit possible Passive control Can provide aesthetic improvements Relatively low cost	May cause increase in external gamma exposure rate

FIGURE 1

GAMMA FLUX FROM RADON DAUGHTERS IN CONCRETE OF MEDIUM PERMEABILITY TO RADON