BNL ALARA CENTER

Processes and Practices Related to Occupational Dose

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VALUE OF PERSON-REM IN COST-BENEFIT EVALUATIONS

Keywords: VALUE OF PERSON-REM; COST-BENEFIT EVALUATION; PERSON-REM DOLLAR; CUMULATIVE PRESENT WORTH; RADIOLOGICAL PROTECTION; PROCEDURES

Description:

The cost-benefit assessment of temporary and permanent plant modifications in support of dose reduction requires a value to convert exposure saved or expended in terms of dollars. These assessments can be rather complex and involve models with many parameters. The accuracy to justify such a high level of detail is not presently available. Most facilities use simple models, such as assigning a fixed cost per person-rem. (In 1989, the medium dollar value assigned per person-cSv at U.S. nuclear power plants was $5,000.) The dollar value of dose reduction may be calculated in a number of ways and reflects what society is willing to spend on reducing the risk of cancer induction and genetic effects. Since this involves risks, perceptions of risks and professional and societal judgments, the ICRP has decided not to recommend a precise value. However, in review of the subject, ICRP Publication 22 (published in 1973) listed a range of values between $10 and $250 per person-cSv. Due to inflation and added costs for medical care and new risk estimates, which are two to four times those employed in the earlier studies, these values are estimated as about $100 to $4,000 per person-cSv in 1990 dollars.

In order to provide a consistent basis for analysis, a minimal value of $1,000/person-cSv (1990 dollars) is recommended for both occupational and public exposures well below the dose limits. Larger values should be used to account for any costs incurred by need for additional crew changes to avoid high doses, or for impacts on outage time or other costs associated with high doses or high-dose plants.

References and Selected Abstracts:

1. "ALARA Cost-Benefit Consideration," Westinghouse Electric Corporation, 1988 Radiation Exposure Management Seminar Workshop Summaries, p. 11.

2. J.W. Baum, G.R. Matthews, "Compendium of Cost-Effectiveness Evaluations of Modifications for Dose Reduction at Nuclear Power Plants," Brookhaven National Laboratory, NUREG/CR-4375, BNL-NUREG-51915, December 1985.

Abstract: This report summarizes available information on cost effectiveness of engineering modifications potentially valuable for dose reduction at nuclear power plants. Data were gathered from several U.S. utilities, published literature, equipment and service suppliers, and recent technical meetings. Five simplified econometric models were employed to evaluate data and arrive at a value

for cost effectiveness expressed in either (a) dollars/rem, or (b) total dollar savings calculated using a nominal value of $1,000/rem. Models employed were: a basic model with no consideration given to the time value of money; two models in which discounting was used to evaluate costs and savings in terms of present values; and two models in which income taxes and revenue requirements were considered.

Results from different models varied by as much as a factor of 10 and were generally lowest for the basic model and highest for the before-tax revenue requirements model.

Results for 151 evaluations employing different assumptions concerning number of plants per site and outage impacts were tabulated in order of decreasing cost effectiveness. Twenty-five evaluations were identified as exceptionally cost effective since both costs and dose were saved. Forty evaluations indicated highly cost-effective changes based on costs below $1,000/rem saved using results of the present-worth model that included discounting of future dose savings.

3. G.D. Burholt, "Application of Cost-Benefit Analysis to Nuclear Power Reactors in Various Countries," NUREG/CP-0110, BNL-NUREG-52226, p. 97 In Proceedings of the International Workshop on New Developments in Occupational Dose Control and ALARA Implementation at Nuclear Power Plants and Similar Facilities, held at Brookhaven National Laboratory, Upton, Long Island, NY, Sept. 18-21, 1989.

Abstract: The extent of the application of cost-benefit and other analysis methods varies markedly from country to country depending on whether optimization is a regulatory requirement. Cost-benefit analysis is also used at the design stage for the choice of design options, but there is a reluctance to use the method for assessing reactor safety features involving probabilistic events. Cost-benefit analysis is also widely used in the planning of plant modifications and maintenance operations expected to involve high radiation doses. At plant level, optimization tends to be qulitative except in the USA where the utilities have developed formal procedures for the evaluation of the cost-benefit aspects of planned operations.

No international consensus exists for the value of the health detriment cost. In most European countries, the values are base don the objective detriment and, in the case of the UK and France, take into account aversion to higher radiation doses. However, in the USA, Japan, and Canada, much larger values are used by the utilities, apparently representing what they consider reasonable to pay for dose reduction.

4. G.F. Booth and D.E. Webb, "A Practical Method of Performing Cost-Benefit Analysis of Occupational and Environmental Protective Methods," NUREG/CP-0110, BNL-NUREG-52226, pp. 153-172 in Proceedings of the International Workshop on New Developments in Occupational Dose Control and ALARA Implementation at Nuclear Power Plants and Similar Facilities, held at Brookhaven National Laboratory, Upton, Long Island, NY, September 18-21, 1989, pp. 153-172.

5. R. McGrath, "ALARA Cumulative Present Worth Cost-Benefit Evaluations," NUREG/CP-0110, BNL-NUREG-52226, Proceedings of the International Workshop on New Development in Occuptional Dose Control and ALARA Implementation at Nuclear Power Plants and Similar Facilities, held at Brookhaven National Laboratory, Upton, Long Island, NY, September 18-21, 1989, p. 203.

Abstract: The ALARA economic evaluations procedure outlines a method of using Cumulative Present Worth (CPW) analysis to perform ALARA cost-benefit evaluations.

The steps are briefly: 1) collect all costs and put on an annual basis; 2) determine cost differences between present confirguration and ALARA modification for each year; 3) deflate, by the cost of funds, all yearly differences against time to see if breakeven (CPW greater than zero) occurs within company policy. This procedure provides a valid/uniform method of determining if ALARA modifications are cost justified.

6. J.W. Baum, "ALARA - Past, Present, and Future," NUREG/CP-0010, BNL-NUREG-52226, Proceedings of the International Workshop on New Developments in Occupational Dose Control and ALARA Implementation at Nuclear Power Plants and Similar Facilities, held at Brookhaven National Laboratory, Upton, Long Island, NY, September 18-21, 1989, p. 8.