



Optimizing Radiation Protection of the Public and the Environment at the Department of Energy

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Background



- Assist implementation of ALARA provisions of DOE O 458.1.
- Identifies goals, requirements and issues when developing ALARA analyses for optimization of various programs.

DOE-HDBK-XXXX-YR

DOE HANDBOOK

OPTIMIZING RADIATION PROTECTION
OF THE PUBLIC AND THE
ENVIRONMENT FOR USE WITH
DOE O 458.1, ALARA REQUIREMENTS



U.S. Department of Energy
Washington, D.C. 20585

AREA ENVR



ALARA Process



- “A **graded process** for evaluating alternative operations, processes, and other measures, for **optimizing** releases of radioactive material to the environment, and exposure to the work force and to members of the public taking into account societal, environmental, technical, economic and public policy considerations to make a decision concerning the optimum level of public health and environmental protection.”



ALARA is Optimization



- Optimization is not minimization.
- Optimization carefully balances the benefits from dose reduction with costs.
- Optimization considers the collective dose to the exposed population.
 - It is necessary to comply with the appropriate individual dose limit whatever the cost.
 - It is the collective dose that is used in the ALARA analysis to select a radiation protection alternative
- **The best option is not necessarily the one with the lowest dose.**



ALARA Analyses



- Level of analysis should be commensurate with the estimated collective dose to the exposed population.
- Types of analysis:
 - Qualitative Analysis
 - Semi-Quantitative Analysis
 - Quantitative Analysis



Factors to Consider



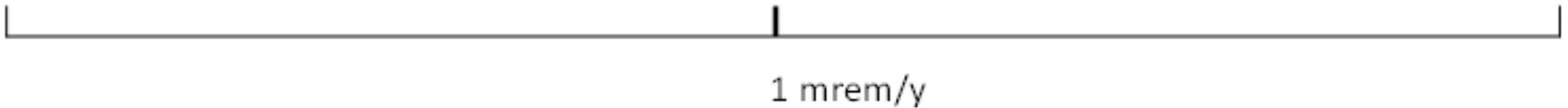
- Collective dose to the exposed population
- Maximum dose to MEI or representative person of the critical group
- Dose to workers
- Applicable alternative processes
- Doses for each alternative evaluated
- Cost for each alternative evaluated
- Examination of the changes in cost among alternatives
- Societal and environmental (positive and negative) impacts associated with alternatives



General Guidance



MEI or Representative Person of the Critical Group dose



Collective dose



ALARA analysis type

Qualitative.....Semi-quantitative.....Quantitative



Qualitative ALARA Analysis



• Pros vs Cons

– Issue: determine dose rates in areas adjacent to a DOE facility

– Options:

- TLDs/EPDs
- Surveys
- Modeling

TLDs/EPDs	
<u>Pro</u>	<u>Con</u>
Easy to perform	Delayed results (TLDs)
Minimum time to employ	Tampering of TLDs/EPDs
DOECAP accredited	Environmental Issues (e.g. weathering)
Longer dwell time	

Instrumentation	
<u>Pro</u>	<u>Con</u>
Easy to perform	Can be time intensive
Immediate results	Snap-shot in time
Calibrated equipment	

Modeling	
<u>Pro</u>	<u>Con</u>
Immediate results	Can be complex
	Model uncertainty
	Subjective



Semi-Quantitative ALARA Analysis



- Attempts to match the thoroughness of a Quantitative analysis with some of the simplicity of performing a Qualitative analysis.
- May be appropriate when estimated doses from alternative actions begin to approach or exceed “reference” dose levels.
- As compared to Quantitative, Semi-Quantitative analysis is more appropriate when number, types and complexities of alternative actions are not as substantive.



Quantitative ALARA Analysis



- Health Detriment (α)
 - \$1,000 - \$6,000 per person-rem
 - \$2M - \$12M per hypothetical cancer death averted
 - Assumes 5×10^{-4} worker risk & 6×10^{-4} public risk
- Non-Health Detriment (β)
 - Not readily expressed in monetary terms
 - Not linearly related to collective dose
- EXAMPLE: reduce 10 person-rem/yr to zero
 - Dose averted = \$60,000
 - Quantitative ALARA analysis alone may significantly exceed this value



Quantitative ALARA Analysis



- Results of a Quantitative ALARA analysis is not very sensitive to the value selected for health detriment (α)
- No limit to value(s) selected for non-health detriment (β)
- Must not combine health and non-health effects in same coefficient

$$Y = \alpha S + \beta \sum_j N_j f_j(H_j)$$

- In most cases, when the dose to the MEI, or representative person of the critical group, is well below the primary limit, no further treatment can be justified on the basis of health-risk considerations.



RevCom Comments



- It is inappropriate to extend cancer risks to small populations or individuals.
 - ICRP 103 suggests the time period and number of individuals making up collective dose should always be specified to prevent estimates being quoted out of context
- “Occupational” ALARA and “Environmental” ALARA should be combined
 - AU-22 works closely with AU-11 to ensure policy and guidance continue to be complementary
- The Handbook should consider the use of ANSI N13.12-2013 and its screening values
 - Come back at 5:00



QUESTIONS?