LSNReviews

From:	Brittain Hill [bhill@cnwra.swri.edu]
Sent:	Wednesday, March 30, 2005 3:59 PM
To:	Roland Benke
Cc:	Michael Waters; Keith Compton; Donald Hooper; 'Razvan Nes'; Gary Walter; Patrick Laplante; Timothy McCartin; Sitakanta Mohanty; John Trapp; Paul Bertetti; Tina Ghosh; Bret Leslie
Subject:	Re: ICRP inhalation dose coefficient selection for the direct releasescenario in the TPA code, particle size considerations
Attachments:	CN_Mass Loads.jpg

Roland - I think your proposed approach for an AMAD of 10 um is reasonable and supportable by available information.

For reference, I've attached a graph of the Cerro Negro data we collected in 1999, at deposits of the 1995 eruption that were located 1-4 km away from the vent. These deposits has 2-5 wt% of the tephra as particles <100 um diameter.
Legend: Inhalable = 100 um, Thoracic = 10 um, and Respirable = 4 um MAD.

Strength of these data are that they were collected at basaltic tephra fall deposit 4 yrs after the eruption, using activity levels that recorded ~2-6 hours of average activity (i.e., "walking" included periods of rest and inactivity while taking notes etc.). Limitation is shown by error bars, in that short duration measurements (2-6 hours) resulted in large relative errors for low abundance particulates. Nevertheless, the general scaling relationships appear supported by other literature values, and basic physics: expect greater abundance of larger particles for high kinetic energy disturbances, with relatively lower abundances of larger particles when particles are entrained by wind and surface turbulence effects alone.

For high disturbance activity, much of the airborne mass is represented by 10-100 um particles. However, the relative abundance of 4 um particles also is equivalent to 10 um particles, whereas other activity levels show a more expected 5x reduction in 4 um particles. The AMAD of 10 um is somewhat conservative, but does not appear grossly conservative, for this activity level.
Light disturbance and static deposits appear well represented by the AMAD of 10 um. Thus, the very limited data support the 10 um AMAD proposed by Roland.

A quick look at the Mt St Helens and Montserrat data shows a focus on 10 um measurements, with a bit of Total Suspended Particulate (<100 um) data. No PM4 data are obvious in my references, but I'll keep looking. The PM10 to TSP relationships for high and light disturbance, though, appear similar to relationships we measured at Cerro Negro.

Thanks, Roland - I'm sure Ruth Weiner will want to discuss this in a couple of weeks.

Britt

Roland Benke wrote:

> Background
>
> ICRP72 inhalation dose coefficients are based on the newer ICRP
> respiratory tract model, described in ICRP Publication 66 (ICRP66).
> The LUDEP computer code, licensed from the UK, applies the ICRP66
> respiratory tract model and was used by the ICRP during the development of the ICRP72 dose coefficients.
> While the LUDEP code allows for detailed investigations into the
> calculations of the ICRP dose coefficients, it does not include the
> updated biokinetic models for some radionuclides (e.g., updated
> biokinetic models for Pu and Am are described in ICRP Publications 67
> and 71 and supercede the older ICRP30 biokinetic models) and,

> therefore, the LUDEP code alone cannot recompute the ICRP72 inhalation
> dose coefficients. The updated biokinetic models tend to have a
> relatively small effect on the dose coefficients, which typically
> differ by less than about 50% compared to dose coefficients when the
> older biokinetic model is paired with the newer repiratory tract
> model. This small difference meant that the LUDEP code could be used
> to gain meaningful insights on the dependence of the inhalation dose
> coefficient to other factors, such as particle size distribution and receptor physical-activity & breathing levels.
>
> ICRP uses lognormal particle size distributions for its dose
> coefficients to the public and workers. For public environmental
> exposure, an Activity Median Aerodynamic Diameter of 1 micron is used
> with a geometric standard deviation of 2.47. For workplace exposure,
> an Activity Median Aerodynamic Diameter of 5 microns is used with a geometric standard deviation of 2.5.
> Since the two standard particle size distributions may not adequately
> cover the wide range of potential exposure scenarios and specific
> aerosol conditions, ICRP published supplemental inhalation dose
> coefficients in 2002 for several Activity Median Aerodynamic Diameters
> that ranged from 1 nm to 10 microns.
>
> Proposal
>
> To account for particle size considerations, it is recommended that
> the ICRP inhalation dose coefficients for an Activity Median
> Aerodynamic Diameter
> (AMAD) of 10 microns be used in the TPA code for the direct release
> scenario.
>
> Basis
>
> CNWRA airborne mass load measurements over the Cerro Negro tephra
> deposit
> indicate: (i) heavy disturbance, such as driving over the deposit,
> produced airborne mass loads where about 95% of the measured airborne
> particle mass was associated with the particle sizes > 10 microns and
> (ii) light disturbance, such as walking over the deposit, produced
> airborne mass loads where about 60% of the measured airborne particle
> mass was associated with the particle sizes > 10 microns (Hill, B.E., C.B. Connor, J. Weldy, N.
> Franklin. 2000. Methods for Quantifying Hazards from Basaltic
> Tephra-Fall Eruptions. Proceedings of the Cities on Volcanoes 2
> Conference, Auckland, New Zealand, February 12-14, 2001).
>
> The AMAD is a median quantity that defines the aerodynamic diameter of
> a distribution of particle sizes where 50% of the airborne activity is
> associated with particle sizes greater than the AMAD and 50% of the
> airborne activity is associated with particle sizes less than the
> AMAD. A 10-micron AMAD appears reasonable for the mass loading from
> light disturbance and a bit cautious for the mass loading from heavy
> disturbance. More detailed assessments using insights from the LUDEP
> code suggest that use of the single particle size distribution with a
> 10-micron AMAD, as better representation the particle size
> distribution for the direct release scenario than the default 1-micron
> AMAD, would not lead to underestimations of the inhalation dose.
> Overall, the shift from the default 1-micron AMAD in favor of a
> 10-micron AMAD will generally reduce the ICRP inhalation dose coefficients by about a factor of 2 for the key
radionuclides.

>
> Roland

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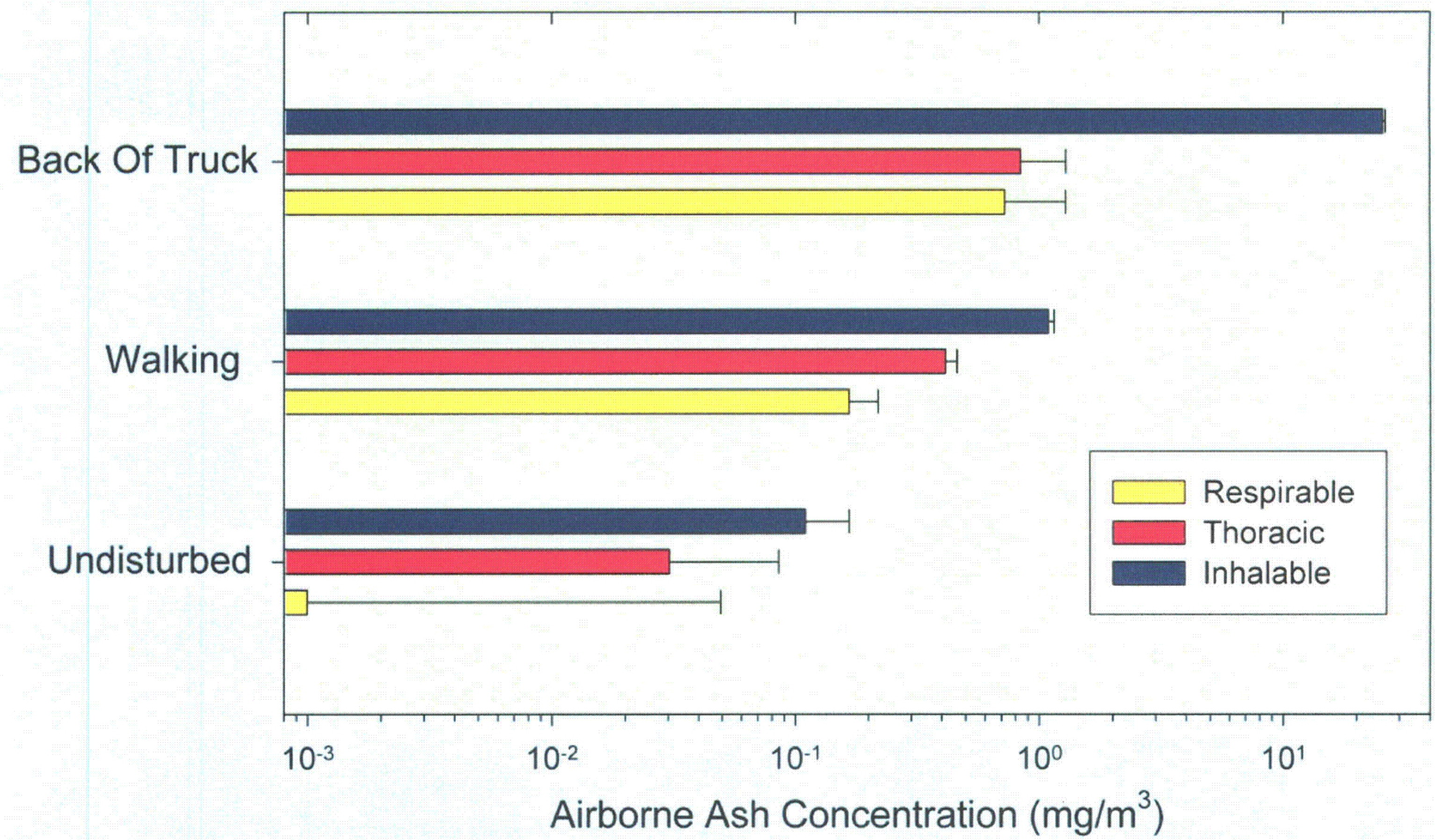

Back Of Truck
Walking
Undisturbed
Respirable
Thoracic
Inhalable
10-3
10-2
10-1
100
101
Airborne Ash Concentration (mg/m3)