

HLWYM HEmails

From: Brittain Hill [bhill@cnwra.swri.edu]
Sent: Thursday, February 05, 2004 7:13 PM
To: McCartin, Timothy; Leslie, Bret
Cc: Gordon Wittmeyer; Paul Bertetti; McKenney, Christopher; Grossman, Christopher; Esh, David; Danna, James; Firth, James; John Trapp; Rubenstone, James; Compton, Keith; Codell, Richard; Bradbury, John; Arlt, Hans; Michael Smith; Patrick Laplante; Roland Benke; Donald Hooper
Subject: RMEI discussion item for Status Meeting on IA Consequences
Attachments: rmei_sum.wpd

In preparation for our discussions next week, I have been working on a short write-up on the basis for defining RMEI characteristics for volcanic risk calculations. I've circulated the first draft within the core IA-PA-BIO technical group earlier this week, and have made some revisions to the draft based on that feedback.

I conclude that, in order to be compliant with 10CFR63 requirements for a RMEI, we should be using airborne particle concentrations and exposure times that are representative of an outdoor worker, not a population average for Amargosa Valley. I realize that this may sound contradictory to past practice, but I believe I have a solid technical and regulatory basis behind that conclusion.

While I don't expect rousing agreement to this conclusion, I believe the arguments have sufficient merit to warrant discussion in our group telecon next week. We need to air this issue out, as it directly affects upcoming review of BIO-IA KTI agreements. Regardless of the outcome, I think we need to develop a more transparent regulatory basis for these inhalation parameters, which are driving the total-system risk calculation.

If you would like to discuss this individually before the meeting, please give me a call. I would prefer not to get into several semi-parallel group email discussions before the meeting, though.

Thanks-
Britt

Timothy McCartin wrote:

> All:

>

> DUE TO A CONFLICT I NEED TO DELAY THE MEETING TILL THE WEEK OF February 9 - HOW ABOUT 9:30 ON February 10TH? In the interim I have done some analyses to understand the difference between TSPA and TPA regarding the intrusive calculation (attached a set of tables) - a lot probably needs to be explained in a meeting however there are some very large differences in the source term as well as some interesting differences in the Kds - food for thought and discussion. I can do a simple hand calculation and get the DOE results (based on the mean value realization) - doesn't mean it is correct but at least we can discuss how DOE gets the 200 mrem dose (within 10,000 years). Quite interesting - I may discuss this a bit with Peter Swift when I am in Las Vegas this week.

>

> Tim

>

> Remembering back to September when we had an initial meeting to re-evaluate the consequence calculations for IA (meeting summary sent out in September is provided below as a reminder) - it seems we need to get back together and go over what we have accomplished.

>

> As a bit of an update I will have some sensitivity analyses regarding mass loading and remobilization for the meeting on the 29th.

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- > Brit: can you please forward this to Don Hopper - he still is not on our email list.
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- > Tim
- >
- > Summary of initial meeting:
- >
- > (1) We agreed to form some teams of IA and PA staff to develop a better understanding of the basis for the parameters and models used in the TPA code for estimating consequences. The topic areas and teams (currently) are:
- >
- > A. How can/should variability in wind speed and direction be incorporated into the performance assessment [Dick Codell and Ralph Cady]
- >
- > B. How should remobilization be incorporated into the performance assessment and what are the results of TPA5.0 telling us [Don Hooper, Tim McCartin, Mike Smith, Dave Esh (volunteered by Dick Codell)]
- >
- > C. What are appropriate values for mass loading at different time periods (e.g., shortly after the event) and for different activities (e.g., high disturbance) [Brit Hill (volunteered by John Trapp), Pat LaPlante, Roland Benke, Chris McKenney]
- >
- > D. What are appropriate exposure times for time spent by the RMEI in each mass loading category (e.g., high disturbance, indoors, outdoors etc.) [Roland Benke, Pat Laplante, Chris McKenney]
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- > The results will be shared and discussed by the group at future meetings. Also, others are welcome to join a group - the first meeting got things going and lets keep everyone in the loop on meetings and information.

> Tim

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Definition of RMEI characteristics for inhalation risk calculations
Brittain Hill, February 5, 2004

The current approach for calculating risk from volcanism does not appear consistent with the requirements in 10 CFR 63 for the characteristics of a reasonably maximally exposed individual (RMEI). Using the requirements and underlying concepts for a RMEI in 10 CFR 63 and 40 CFR 197, airborne particle concentrations and exposure rates that are representative of an Outdoor Worker, who works within the potential exposure plume of airborne contaminants, appear most consistent with these regulations. In contrast, the DOE and potential NRC approach of using only the average outdoor exposure time, for the entire population of the unincorporated township of Amargosa Valley, does not appear consistent with regulatory requirements for a RMEI. I am not questioning the basis for defining the RMEI in the regulations or suggesting that changes are needed in the regulations. Instead, I am concluding that the Outdoor Worker inhalation characteristics are more consistent with existing regulations than the average population approach currently used by DOE. The basis for this conclusion is as follows:

- Based on NRC and DOE current understandings, the probability-weighted dose (i.e., risk) from potential volcanic disruption is at least an order of magnitude higher than the risk from nominal repository performance during the 10,000 post-closure period. This understanding appears different from the technical basis used to develop current regulations: [EPA, 40CFR197, p. 45]

“Our initial evaluation of potential exposure pathways from the disposal system to the RMEI suggests that the dominant fraction of the dose incurred by the RMEI likely will be from ingestion of food irrigated with contaminated water (see Chapter 8 of the BID). It is possible, however, that DOE and NRC will determine that another exposure pathway is more significant. Consequently, DOE and NRC must consider and evaluate all potentially significant exposure pathways in the dose assessments.”

I have searched the documentation for 40CFR197 and 10CFR63 and can find no reference to the consideration of the possible risk or dose significance from a volcanic exposure pathway. This scenario is neither supported nor denied. I also cannot find reference to not considering risks from low probability events, except for human intrusion discussions. I conclude there is no regulatory basis to exclude volcanic events from consideration in RMEI characteristics. I don't think this current understanding of total-system risk questions the basis for the RMEI definitions in 10CFR63 and 40CFR197. However, I believe this risk understanding provides sufficient basis to consider the RMEI concepts in the regulations when defining the most important parameters for the higher-risk volcanic exposure pathway.

- The RMEI concept in 10CFR63 and 40CFR197 is based on “..estimating the dose to a person assumed to be at greatest risk based on reasonable (i.e., not overly or insufficiently conservative) assumptions. [e.g., EPA, 40CFR197 BID, 8.3.3]. The statement “greatest risk” gives due consideration to both the likelihood of receiving a dose and dose magnitude into the RMEI definition; I cannot find any reference to the RMEI being an individual considered most likely to receive a dose. The reasonableness criterion can be interpreted within 10CFR63 as the 1 in 10,000 in 10,000 year events that can affect performance are credible, thus, volcanism appears a reasonable scenario. It does not appear overly or insufficiently conservative to use risks from volcanism as a basis for RMEI parameters. Although there are conservatism and nonconservatism in the volcanic risk calculations, the level of conservatism appears equal to that included in nominal performance calculations.

- The RMEI concept clearly applies to the near-maximum exposure received by any member of

the exposed population, not to the population in general [e.g., EPA, 40CFR197 BID, 8.3.3]

“The basic approach for estimating doses to the RMEI is to identify and characterize the most important exposure pathway(s) and input parameters. By using maximum or near-maximum (i.e., 95th percentile) values for one or a few of the most sensitive parameters, while assuming average values for others, it can reasonably be assumed that the resulting dose estimates correspond to the near-maximum exposures that could be received by any member of the exposed population. The ultimate objective of the approach is to define an exposure that is well above average exposures, but within the upper range of possible exposures.”

Exposure time to airborne ash, along with airborne particle concentrations, are the most sensitive parameters in the inhalation exposure pathway, which constitutes ~90% of the volcanism risk. Setting these parameters to 95th percentile values appears consistent with the RMEI concept. The 95th percentile approach is the basis for setting drinking water consumption at 2 liters/day, which is at the upper range of drinking rates, using the prior perspective of the groundwater pathway being the dominant risk pathway (EPA, 40CFR197, p. 45).

- 10CFR63 and 40CFR197 do not specifically require that the average member of the Town of Amargosa Valley is the basis for a RMEI:

[NRC 10CFR63.102] “The reasonably maximally exposed individual, as a hypothetical person living in a community with characteristics of the Town of Amargosa Valley, is a representative person using water with average concentrations of radionuclides as described at §63.312.”

The hypothetical person is representative of the characteristics in the Town of Amargosa Valley. I cannot find a definition of “representative” that means “average,” and I cannot find reference to the RMEI being the average member of the Town of Amargosa Valley. I interpret this section to mean that we must use characteristics (i.e., habits and lifestyles) that are representative (i.e., commonly occur) in this area. Based on 2000 Census data cited by DOE (Characteristics of the Receptor for the Biosphere Model AMR, ANL-MGR-MD-000005 REV 02, 2003) an Outdoor Worker is a representative characteristic of the people in this area.

- This interpretation for an Outdoor Worker RMEI also appears consistent with wording in 10CFR63.312:

“The reasonably maximally exposed individual is a hypothetical person who meets the following criteria:

(a) Lives in the accessible environment above the highest concentration of radionuclides in the plume of contamination;

*(b) Has a diet and living style **representative** of the people who now reside in the Town of Amargosa Valley, Nevada. DOE must use **projections** based upon surveys of the people residing in the Town of Amargosa Valley, Nevada, to determine their current diets and living styles and use the mean values of these factors in the assessments conducted for §§63.311 and 63.321;”*

Note that living style is “representative” of the people, and that DOE must use “projections” based on people residing in the Town of Amargosa Valley to derive mean values. I interpret this to allow our hypothetical RMEI to have the characteristics of an Outdoor Worker in the Town of Amargosa Valley, with inhalation parameters possibly derived from the mean values of Outdoor Worker survey data. Use of mean values for Outdoor Worker airborne particle concentrations and exposure times is not, however, consistent with the RMEI concept in which these values (being the most sensitive to risk) are set to 95th percentile values. This is an area for additional discussion.

- Outdoor Workers consist of residents who make the majority of their income from jobs

involving outdoor activities. Representative occupations within the unincorporated township of Amargosa Valley include aggregate miners, farmers, ranchers, delivery drivers, and some public service positions (police, utility workers, etc). Information in DOE (2003, Characteristics of the Receptor for the Biosphere Model AMR, ANL-MGR-MD-000005 REV 02) provides a general basis for characterizing an Outdoor Worker. This AMR, however, makes a number of assumptions that may not be supportable or consistent with the RMEI concept in 10CFR63:

- *“It is assumed that local outdoor workers include all agricultural works, 25% of construction workers, 10% of utility workers, and 10% of workers in the mining industry [DOE, 2003]”* Although not all workers in these industries will be outdoor workers, the basis for these percentages is poorly supported. In addition, a resident who is a miner at a mine outside the exposure plume is not characteristic of a RMEI; only those aggregate miners (cinders, alluvium) who work in the exposure plume have characteristics of a RMEI (e.g., 40CFR197 SoC, p. 43). Will take some work to actually figure out what is a representative outdoor worker for RMEI characterization.

- DOE (2003) assumes “inactive outdoors” involves walking on contaminated deposits, which they interpret as a non surface-disturbing activity (i.e., low mass loads). In contrast, data from Cerro Negro clearly shows that walking on tephra deposits created a 10x increase in mass load relative to ambient conditions. Some conversion needs to be made for light activity versus inactivity while outdoors.

- DOE (2003) assumes vehicle operators remain in sealed cabs and thus are not exposed to elevated dust concentrations. I don't know where they get their trucks, but all the ones I see and have driven in this area have interiors covered with dust. This assumption does not appear supportable by assertion.

- Risk Insights: Initial estimates for the risk significance of this concern are given in the following table. First block uses the current inputs for TPA5.0 rural resident, with breathing rates from DOE (2003). I was concerned that the indoor mass loads appeared very low for this type of community, and increased the mass loads in the second block to higher values in a dusty terrain.

Please recall that these mass loads are for total suspended particulates, not just respirable fractions. The 10–100 um fraction can constitute 3–9x the <10 um fraction under disturbed conditions. Dose scales directly with airborne particle concentration for Am and Pu in the inhalation pathway.

The last block shows exposure times using only the estimates in DOE (2003) for outdoor workers, which is skewed towards offsite exposures. I do not believe it is consistent with the RMEI concept to include Outdoor Workers who work outdoors in areas that have no contamination, into risk calculations for inhalation exposure. The RMEI is supposed to represent maximum risk amongst exposed individuals, not nonexposed individuals (EPA 40CFR197). Additionally, this offsite approach doesn't account for Outdoor Workers who do not reside in the “Town” of Amargosa Valley yet work in outdoor occupations within the potential contaminant plume.

Based on this information, differences in exposure time alone may result in ~5x (i.e., no change in high disturbance times, but increase low disturbance times) to 10x (shown in table) variations in dose. A better technical basis is needed to evaluate appropriate exposure times, if consideration is given to a RMEI that represents an Outdoor Worker.

Base TPA5.0	Mass Load g/m3	Time hr/d	Breath rate m3/hr	g/day
VolcHiDisturb	1.E-02	0.24	1.57	3.8E-03
VolcLowDisturb	1.E-03	0.96	1.08	1.0E-03
InHiDisturb	1.E-06	10.08	1.08	1.1E-05
InLoDisturb	1.E-07	10.32	0.39	4.0E-07
Offsite	0.E+00	2.4	1.08	0.0E+00
			Total g/day	4.8E-03
TPA 5.0 Alternative Mass Loads				
	g/m3	Time hr/d	Breath rate m3/hr	g/day
VolcHiDisturb	1.E-02	0.24	1.57	3.8E-03
VolcLowDisturb	1.E-03	0.96	1.08	1.0E-03
InHiDisturb	1.E-04	10.08	1.08	1.1E-03
InLoDisturb	1.E-05	10.32	0.39	4.0E-05
Offsite	0.E+00	2.40	1.08	0.0E+00
			Total g/day	5.9E-03
Alternative Mass Loads & Exposure				
Outdoor Worker RMEI	g/m3	Time hr/d	Breath rate	g/day
VolcHiDisturb	1.E-02	3.1	1.57	4.9E-02
VolcLowDisturb	1.E-03	4.2	1.08	4.5E-03
InHiDisturb	1.E-04	6.4	1.08	6.9E-04
InLoDisturb	1.E-05	8.3	0.39	3.2E-05
Offsite	0.E+00	2	1.08	0.0E+00
			Total g/day	5.4E-02

In summary:

- Inhalation of contaminated airborne ash is the most significant risk pathway for the postclosure period. Levels of uncertainty and conservatism for this pathway are comparable to other risk pathways. This risk insight appears different from the basis used to develop explicit RMEI characteristics in 10CFR63 and 40CFR197.
- Current DOE and potential NRC approach of using average values from the entire population in the Township of Amargosa Valley for inhalation parameters does not appear consistent with the RMEI concepts and requirements in 10CFR63 and 40CFR197.
- Consistent with 10CFR63 and 40CFR197, the RMEI can have characteristics solely of an Outdoor Worker. These characteristics are representative of the exposed population in the Town of Amargosa Valley and likely represent the highest dose and risk pathways experienced by an exposed population.
- Although a RMEI usually has the most risk-significant parameters set to 95th percentile or greater values, 10CFR63.312(b) may restrict these parameters to mean values. Additional discussion is needed on this interpretation.