Responses to specific comments and reviews of Chernobyl paper.

Responses to review by Dr. Albert Lee

Source model – Quantifications on conservatisms-. Used 95th percentile values for concentration factors. The mode could be further refined by running it through Monte Carlo style simulation and conducting a more thorough sensitivity analysis. This was beyond the scope of the present report, but is an area for future work..

Transport model – We could provide calculations based on using a broad swath model. However, this was beyond the scope of this report. Basically, this will dilute the isotopes further – meaning a lower concentration and health impact to any individual person exposed. While it would be more consistent with a realistic scenario, it should not change our major conclusions.

Results – He is correct that we are probably overestimating the additional cancer risk. There is some debate about the best way to estimate the lifetime cancer risk associated with low level radiation exposure. The models were parameterized using people exposed to higher levels of radiation. When using the models to assess cancer risk in people exposed to low levels of radiation, we are actually extrapolating outside of the data. The question is whether it is reasonable to use a linear model. The BEIR-VI report recommends using the linear model because it is more conservative (i.e., will probably over-predict the cancer risk associated with low levels of exposure). As the BIER report points out, it is potentially more realistic to assume that below a certain level of exposure the additional risk of cancer falls precipitously (or approached the other way, it rises precipitously once you have passed some threshold), but this will be less conservative.

Discussion – Given the complexities involved in estimating an "average background dose rate for Ukraine", we were unable to this figure. Howev er, we have offered an estimate of the effective dose received by populations in areas contaminated by the Chernobyl disaster.

Responses to review by Dr. Akira Osawa

Osawa offers three major critiques and a list of minor points. The minor point were rectified. Additionally, in response to his three major critiques. 1) The model has been adjusted to take into account 95th percentile values for concentration factors and variability in many of the various components. The mode could be further refined by running it through Monte Carlo style simulation and conducting a more thorough sensitivity analysis. This was beyond the scope of the present report, but is an area for future work. This can be done, but will require some additional work, especially if we are going to get variance estimates for all of the parameters in the model (not just the radioisotope concentrations). 2) Discussion has been adjusted and no longer includes problematic elements noted by Osawa. 3) Figures developed as suggested. Discussion of results has been expanded.

Responses to review by Dr. Jerome Puskin

Pushkin offered a very thorough and helpful review. Individual points were worked through and incorporated into the final draft. In most cases recommended wording changes were incorporated into the final draft. In addition, some of the changes made to the content of the report as a result of this review include:

1) Differentiated more clearly between 'dose' and 'committed effective dose.' Changed units as appropriate.
2) Clarified that calculations were based on child of 1 yr.
3) Incorporated a resusupension pathway.
4) Recalculated concentration ratios and radionuclide inventory based on upper 95^{th} percentile values
5) Changed assumption about wind direction throughout the event (from 90% of the time toward Kiev to 100% of the time).
6) Incorporated the dose coefficients recommended by Pushkin.
7) Tables and results section were revised to take into account changes in model assumptions. These changes resulted in higher estimated doses.

For this report, we chose not to make the following changes, but they are areas in which further research is probably warranted

1) Including forests and grasslands on both sides of the border.
2) Need to address possibility of water from Kiev reservoir being consumed following a wildfire event.

Responses to review by Dr. Chris Whipple

1) Source Model
2) Adjusting concentration factors for different biota would make the model more realistic and would be important if a more realistic model of fire on the landscape (rather than a worst case model) were used. Given the assumptions that the fire consumes all vegetation, a more refined model was not pursued for this paper. Similarly, the effects of a thinner soil mixing layer were not pursued for this report.
3) Transport model
4) A resuspension model – similar to what was recommended by Whipple - was incorporated into the final paper.
5) As noted in the final report, a more refined model (e.g.lagrangian puff model) was beyond the scope of this report, but could be incorporated in future work.
6) Exposure model
7) Duration was taken into account, but the original text was confusing. Text has been clarified.
8) Cancer incidence and mortality model

9) According to WHO statistics, proportion of deaths in Ukraine due to cancer is much lower than in the U.S.

Responses to review by Dr. D.J. Winfield

Winfield provided a detailed list of 34 comments mostly associated with specific lines. I went through line by line and corrected as appropriate. Notably (among other improvement made to the report based on this critique) we 1) clarified issue associated with dose and dose rate 2) outlined the major assumptions that make the model conservative 3) offered a more thorough discussion of the issues associated with using the Gaussian plume model for this work, 4) incorporated propagation of error 5) adjusted precision of estimates, and 6) rephrased description of initial event.

Winfield is correct that the fire fighters in the CEZ will receive the highest dose from a real fire. However, that would require a very different analysis – some of that work has been done by Kashparov. Point about there never being a truly "worst case" is well taken.