Input to Commission Meeting on Economic Consequences of Accidents
Richard Denning and Thomas Kress

We have recognized for some time that the Quantitative Health Objective related to latent cancer fatalities, which is often referred to as a societal risk measure, does not truly represent the societal impact of reactor accidents. As calculated, it is really just another form of individual health risk (note that the total consequences are divided by the affected population). Furthermore, discussion related to extending the analyzed region to 50 miles to account for latent cancer fatalities that could result from low level exposures also misses the true character of the societal risk. The societal impacts from the Fukushima accident are evident: the cost (not just direct monetary costs) of relocating people, loss of contaminated products, loss of future land use, loss of generating capacity, and to some extent the impact on human health of low levels of radiation exposure (although our analyses indicate this provides a small contribution to the total societal impact). We also have felt that current surrogates for the safety goals (e.g. CDF and LERF) do not sufficiently capture site specific differences in risk to address all of the regulatory and licensing issues faced by the NRC.

In March 2012, Idaho National Laboratory sponsored a workshop of PRA experts at the University of Maryland to discuss the potential value of a revised safety goals and quantitative objectives. Subsequent to the meeting, Dr. Denning performed an analysis that more directly addresses the comparison of the risk of offsite contamination to the background risk of other types of event that have a disruptive societal impact. In NUREG-1150, the comparison between the individual risks of prompt fatality and latent cancer fatality satisfy the Quantitative Health Objectives with large margin (approximately five orders of magnitude difference between the background risk and the nuclear accident risk). Recently published results from the SOARCA program indicate that the margin may even be greater. No aspect of the Fukushima accident (in our opinion) brings into question this conclusion.

In order to compare societal risks from large events, the appropriate display is a complementary cumulative distribution function (showing the frequency with which a level of consequence is exceeded). The data required to plot the background societal risk for people living in the U.S. is easy to obtain today through the internet. Thus, the background curve of monetized consequences is shown that includes wars, epidemics, recessions, dam failures, explosions, hurricanes, etc (there are implied assumptions related to how to monetize these consequences that can be debated but the associated uncertainties are not large). The nuclear societal risk curve is based on release fractions and frequencies obtained from NUREG-1150 for the Zion plant. A population of 100 reactors is considered. Only cesium-134 and cesium-137 are considered. Using the RASCAL 4.0 code, the land area associated with one year dose rate exceeding 2 rem was calculated. A constant population density and cost per relocated individual were assigned. Because RASCAL 4.0 only calculates doses out to 50 miles, it was necessary to perform a hand calculation to extrapolate the results. This is a serious deficiency in these calculations (and the reason the figure is labeled PRELIMINARY), which will be corrected by a graduate student in the near future based on MACCS calculations. The frequencies of different meteorological conditions are based on one year of meteorological data at an eastern plant site. Although the Commissioners should recognize the simplifications in this analysis and the preliminary nature of the results, there are insights from the comparison that we believe are robust. The risk from land contamination does not dominate the economic risk of major disruptive events in the U.S. but, unlike the human health risks from nuclear accidents, the contribution to the background risk from other causes is not insignificant. It is our opinion that societal risk, in particular from land contamination, is the dominant risk from nuclear power plant accidents.

From a regulatory viewpoint does it matter? Certainly the control of CDF and LERF also provides control of the risk of offsite contamination. However, we suspect that a risk-informed regulatory framework that more directly addressed offsite societal impacts would better address issues like the need for vent/filter systems, the addition of multiple plants to a site, and license renewal.

It is our recommendation that the Commissioners select Option 3. The NRC is currently undertaking a new Level 3 risk study. One of the major objectives of that study should be the investigation of site specific offsite consequences and the consideration of surrogates for societal risk. It is true that the delay associated with Option 3 introduces regulatory uncertainty. However, in this post-Fukushima time period, we are in a period of regulatory uncertainty in any case.

Societal Risk of Major Disruptive Events in the United States