Thank you for the opportunity to comment on *Analysis of Cancer Risk in Populations near Nuclear Facilities: Phase I*. Although we do not agree with some of the report recommendations, we do want to commend you for what seems to be a well-researched and thoughtful approach toward the subject tasked to the committee. We are gratified to see some long-standing concerns of the public being recognized in this report. Likewise, we feel that there are some recommendations within the report that may serve to unnecessarily complicate the issue or obscure rigorous scientific investigation and outcomes.

Also please see a special section on a Beyond Nuclear collaboration with meteorologist Sam Miller. Dr. Miller's investigation could be of special use to Phase II.

Use of industry-collected data for reconstructing doses to the public from nuclear power effluent has many shortcomings.

Effluent releases.

- The report recognizes effluent release and meteorology data from licensees are not intended to be used for dose reconstruction. They were collected to ensure compliance with USNRC regulatory limits. We agree.

- The report recognizes C-14 could result in fairly large public doses but until 2010, licensees were not required to report it in release numbers. We think it is about time that carbon-14 is recognized as the long-term threat it is. Unfortunately, it has been ignored to such a degree in the past that attempting to account for the health impact from those releases in any detail now would cost a good deal and not necessarily paint an accurate picture.

- The report says that effluent releases are only useable at the population level and only then if more detailed information is available. Some plants have provided more detailed information to the NRC, but even so, Phase I seems to suggest that this will not support detailed reconstruction doses to *individuals without the help of computer models*. These models, however, could still rely on industry-measured data. These limitations guided the committee to recommend certain pilot sites highlighted in the report. However, decoupling dose reconstruction, effluent pathways, and other potentially helpful but unnecessary, study areas, could make more study sites available. Areas of study other than epidemiology could be examined *separately,* perhaps in parallel.

- Not only would it be expensive to make industry effluent data useable, but also any result would be untrustworthy because the data were not collected for health studies and the data are incomplete and unreliable -- something which the committee seems to recognize. While examining additional areas of study could enhance the

findings of an epidemiology examination, bad or untrustworthy data could actually hinder a truthful result. No epidemiology study should be curtailed or abandoned because effluent data is incomplete, or unavailable. This would be like rewarding the industry and regulator for poor planning and shoddy data collection. If it turns out that this data is unavailable, health studies can, and should, go ahead anyhow.

Environmental contamination.

- The report recognizes that environmental contamination, like effluent data measurements, are for regulatory compliance, not for health impact assessment. However, The report also says that environmental measurements of radiological contamination can be used to set an upper bound for doses around nuclear facilities.

- Using industry environmental monitoring measurements to set an upper dose bound around the plant vicinity is unacceptable to the public since this data is unreliable, fails to account for all radionuclides, catch all contaminated foodstuffs or account for full bioaccumulation (witness how surprised researchers were upon discovering that blue fin tuna not only collected Fukushima cesium very quickly in their bodies but also did not shed this contamination during their travel across the Pacific.)

- It appears the utilities, although they examine a number of foodstuffs, don't examine for beta (H2 and C-14 give off beta) and monitoring programs don't/cant measure every single bit of food we eat. Since radionuclide deposition can be very spotty, due to localized weather patterns, or can vary in unexpected ways by other natural processes, food monitoring is very unreliable.

- Utility measurements of contamination cannot completely account for certain short-lived biological residence time or half-life, or what exposures *might have been*, by measuring what is *currently* there. Therefore, if environmental contamination measurements were not established at the time the reactors started operating, they will not be complete. Any study attempting to use this data would have to carefully account for this shortcoming.

Other concerns with effluent and environmental contamination.

- Not only are dose estimates based on bad/incomplete, industry gathered effluent data, this unreliable data is put through dose formulas riddled with uncertainties. Actual effects on children and women, internal impacts of beta emitters such as carbon 14, tritium, and strontium 90, and how each of these radionuclides may bioaccumulate in humans and animals, are some of the potential impacts not fully accounted for in exposure scenarios.

- The report recommends that NRC review effluent release monitoring and reporting requirements to see if they can be improved for future dose reconstructions and made

completely freely available to the public. The public approves this recommendation with a qualified "yes". The public would welcome truly independent monitoring, but the public would need to be involved in this process from the outset to blunt the mistrust engendered in the public by the NRC and industry. The report seems to recognize this lack of public trust in the regulatory agency.

Conclusion.

The committee judges that, if release data are available, they are sufficient for developing accurate dose estimates, under certain conditions, but significant uncertainties could remain and both the money and time needed would be great. We contend that while this data can be used for certain health investigations it would not only be expensive, it would be unnecessary for an epidemiological study. Additionally, because of the uncertainties involved, use of these data might actually obscure a more truthful health investigation.

A health study should not be held up or shelved because this data is unavailable or inadequate. Beyond Nuclear has a grave concern that C-14 effluent, tritium effluent, and beta emitters in general, are poorly measured or accounted for. Additionally, it appears from the Phase I report that noble gas decay products may not be accounted for. Abnormal or inadvertent releases may be averaged and the impact of this would have to be considered. Questions of subsurface contamination and tracing it over time, old releases, which have scant data or poorer measuring techniques or equipment, would also have to be resolved. This would be necessary for both nuclear power and fuel cycle facilities.

NRC licensees and the NRC, as regulator, should not be allowed, through their inability to adequately account for effluent or its health impacts, delay or block health studies. Further, they should not be able to capitalize on any uncertainties stemming from their inability or unwillingness to collect the effluent or monitoring data needed to make determinations about health impacts. Nor should the incomplete data they have collected be the basis of studies that are used to obscure what could be actual health impacts found in a pure epidemiological investigation.

Epidemiology.

The report considered four types of studies and chose two: ecologic and case/control.The ecologic would examine multiple cancer types in population living near nuclear facilities. The case/control would look at cancers in children born near nuclear facilities. We support the case control but think that the ecologic would be a waste of time and money for reasons given below.

Most importantly, the report recognizes that, "as a standalone study, a risk projection model (one study model considered but rejected) would provide less information than

the other study designs considered by the committee...A serious problem with such a study is one of public credibility: the calculated dose distribution by necessity must be based on the reported release data--which if drastically wrong, would provide misleading results. Simply said, the accuracy of the risk projection models is entirely dependent on the accuracy of the reporting of the releases." We appreciate and agree with the conclusion that a risk projection study could be less reliable, and is less acceptable to the public, than the study types that the committee chose.

-We agree with the report that childhood leukemia is a sentinel cancer for radiation exposure. Therefore, an investigation that focuses on children has good study potential because health impacts could affect a significant proportion of the potential study population and therefore, be more easily teased out.

-The report appears to be proposing to study adults as part of the ecologic study model. We contend, however, it makes little sense to study cancer incidence among *adults* because migration to and from areas around nuclear facilities would muddy the data.

-Any attempt to collect individual exposure information for childhood leukemia should be disconnected from a case-control study. (see our reasoning above) If raw data were more reliable, connecting these research areas with an epidemiological study would produce the most solid evidence, but, and as recognized by the report, using effluent or monitoring data to assess individual doses, where possible, would be daunting. In general, such research might be reasonable for estimating population dose averages or ratios of dose difference between populations based on geographic location or weather patterns. But for small area populations or case control studies, which require classification of individuals and sometimes ordering, these dose estimates would prove expensive and distracting, even to the point of introducing false information into the study.

-We do not recommend using mortality data because elapsed time between incidence and death and competing causes of death, could make this an inappropriate indicator. Uncertainties in effluent measurement or health data should be recognized, but don't need to be made more complicated than they actually are or worse yet, act as roadblocks to studies that we *can* do.

-The report states, "ecologic studies are considered as "hypothesis generating" investigations and a finding with possible public health impact will require more rigorous testing using a different study design." However, a hypothesis has already been generated in this instance and therefore, ecologic studies as proposed by the report are not needed because the case control study the report proposes should be enough and can provide more rigorous investigation.

-European studies indicate that investigations of childhood cancer based on selection of cases and controls from birth cohorts, exposure based on distance of birthplace, and

possibly residence history, are justified. The US has yet to conduct a study like these European ones and a study like this could be very informative. One should start with the question: do we see here what they see in Europe with regard to increases of childhood cancer around nuclear facilities. One should NOT start with the question: are the (industry derived) doses high enough to cause health effects? Not only is this an engineering question rather than a health question, it builds in a number of scientifically unsupported assumptions about low doses and subpopulations. The charge question as posed to the committee must focus on health outcomes, not dose.

-A study like the ones conducted in Europe is feasible because it could be based entirely on existing records, requiring no new data or dose information generation. This keeps case-control study data as pure as possible because it can avoid recall bias and interview and questionnaire inaccuracies.

-If studies could be carried out at the state level instead of individual nuclear sites, one state could be used to conduct the study and refine the results for a multi-state study. Any additional candidate states would need adequate cancer registry quality.

Conclusion and Caution.

Phase I says "Interpretation of risk estimates is also based on uncertainties from less than perfect knowledge of the effects of low-level radiation on human health." We agree. This is why, overall, we must rely on the concept of precaution when assessing the risk of nuclear power on our health--no matter what study methods are chosen; that means not making assumptions that increased health detriment from low dose exposure will be hard to see. Using this assumption to design a sensitive study is prudent, but this assumption should not be carried through to any study results or conclusions without actually being reflected in the data of the study. This could lead to minimization of not only the cancer impacts, but of other health detriments mentioned in, yet not within the charge of, this report.

Phase I also states, "To reiterate, calculations of required sample sizes based on current knowledge of the average population exposure of the people in the US to radiation from the nuclear industry would lead to a small anticipated increase in risk that would require an enormous population size to detect with statistical precision." This *might* be true, but industry data is incomplete as stated above, and the report recognizes this several times. With incomplete or unreliable release data, saying population exposures are small may be an unsupportable assumption and should not be allowed to completely override actual data on health outcomes. Further, concluding that small doses will have small health effects may also be an unsupportable conclusion, considering the impacts of small doses of radiation are still being investigated (Phase I does recognize this--see quote above), and the full impacts on women and children are not accounted for.

Comments on "Availability of Meteorological Data"

Beyond Nuclear contracted with Dr. Sam Miller, Department of Atmospheric Science and Chemistry, Plymouth State University, Plymouth, New Hampshire to evaluate how meteorological data could be used to inform the Phase 2 portion of the NAS cancer study.

Dr. Miller's comments ("Comments on the National Academy of Sciences 'Analysis of Cancer Risks in Populations Near Nuclear Facilities: Phase 1 Methodology'") are attached in submittal to the National Academy of Sciences (NAS) to help identify meteorological contributions in determining the "maximum exposed individuals" in populations around nuclear facilities. The paper also includes comments on Section 2.4 "Availability of Meteorological Data" of the NAS Phase 1 methodology report, which dealt with the availability of meteorological data for performing numerical plume dispersion simulations. The NAS (2012) report states that:

"The committee could not determine the extent to which detailed meteorology data are readily available for all plants and years of operation. Some plant licensees report annual meteorological data in their REMP reports. More detailed meteorology data may need to be recovered directly from facility licensees or from nearby meteorological stations."

Dr. Miller's comments suggest that, in addition to the meteorological observations recorded by the nuclear licensee, the Phase 2 study can and should obtain observed meteorological data from several other sources, including discrete locations and in high-resolution gridded form. These data can be used to drive model simulations in order to validate and verify industry input.

The ongoing modeling effort by personnel at Beyond Nuclear and Plymouth State University is described. Toward this effort, the Gaussian Plume Dispersion Model was run at hourly intervals for a 10-yr period, at three different weather stations representing four civil nuclear reactor facilities. Significant ground-level radiological "hot spots" were predicted two for stations: the Grand Gulf nuclear generating station in Mississippi, and the Clinton nuclear generating station in Illinois. Both hot spots appeared south of their respective point sources, in spite of the fact that the mean wind condition at both locations was from the south. Both hot spots extended well beyond the 10-mi emergency planning zone associated with nuclear reactors. Work on the modeling project is continuing.