

Cite this: DOI: 10.1039/c2ee22659f

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COMMENT

Reply to the ‘Opinion on “Worldwide health effects of the Fukushima Daiichi nuclear accident”’ by B. Richter, *Energy Environ. Sci.*, 2012, 5, DOI:10.1039/c2ee22658h’

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Received 22nd June 2012, Accepted 26th June 2012

DOI: 10.1039/c2ee22659f

We thank Dr Burton Richter (herein, BR) for his comments on our paper (herein TJ12). We would like to respond briefly to only a few of them.

First, BR states that TJ12 “concludes that there will eventually be 15-130-1100 fatalities from the radiation released from reactor failure in what is regarded as the second worst nuclear accident in the history of nuclear power”. However the full range of mortality estimates due to Fukushima due to radiation provided in the abstract of TJ12 was 15–1300. Additional fatalities due to the evacuation plus worker exposure were ~610 giving total estimated fatalities due to the accident of 625–1910. Additional cancer morbidities were 24–2500.

Second, BR implies that the fatalities due to Chernobyl should be 10 times higher than those due to Fukushima since Chernobyl emissions were about 10 times higher. However, as indicated in TJ12, because Chernobyl is landlocked, over 90% of Chernobyl Cs-137 deposition was over land, where people live. On the other hand, only 19% of Fukushima Cs-137 deposition and 42% of Diablo Canyon deposition were over land since both are near the ocean and radionuclides were blown mostly out to sea due to the westerly winds in the case of Fukushima and the anticyclonic Pacific high in the case of Diablo Canyon. As such, studies referenced in TJ12 have estimated that Chernobyl fatalities may have been much more than 10 times higher than our estimate for Fukushima fatalities. Landlocked nuclear facilities worldwide would disperse radiation over land like Chernobyl; others near coasts, like Fukushima.

Third, BR assumed that years of life lost could be calculated by subtracting the median age from life expectancy. However, cancer risk due to radionuclides is often higher for children than adults, so it is possible BR may have underestimated years of life lost due to Fukushima.

Finally, BR compared health effects of nuclear *versus* coal and natural gas and concluded that nuclear results in lower health impacts. We do not examine this issue in TJ12, but simply point out here that these three are not the only energy sources that should be considered in such an analysis, since other electric power options include wind, concentrated solar, geothermal, solar photovoltaics, hydroelectric, tidal, and wave power, among others. In addition, any policy decision on whether to use nuclear or any of these other sources would likely include consideration of a broader range of impacts. In the case of coal and natural gas, these include, among others, water, soil, and ecosystem damage from mining. For nuclear, they include radioactive waste disposal, nuclear weapons proliferation risk associated with nuclear energy use, emissions from the background power grid due to the time lag between planning and operation of a nuclear facility, and mining impacts. These issues and any conclusions about them are beyond the scope of TJ12.

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