How big should the evacuation zone be for the Daya Bay Contingency Plan?

A number of recent newspaper articles argued that the 20 km evacuation zone is not enough and should be extended to 30km. I do not agree with such a suggestion since evacuation process does carry risk. Unnecessary evacuation can often do more harm than good, especially for the sick and the old . So unless it is absolutely necessay (i.e. if we do not evacuate the residents immediately, they will have immediate danger.), we should not take the step of evacuating the residents.

In the Daya Bay Contingency Plan, this so-called evacuation zone is in fact the Emergency Planning Zone (EPZ) 1 which is for planning countermeasures against plume exposure. There is also the Emergency Planning Zone (EPZ) 2 in the contingency plan for planning countermeasures against ingestion of contaminated food and water. The exact size and shape of each EPZ is a result of detailed analysis, which includes consideration of types of nuclear reactors, geographical features and demographic information specific at each site. The countermeasures are designed to protect the population from receiving high doses of radiation. These countermeasures include evacuation, sheltering and use of stabile iodine-isotope tablets in the short term (first two weeks after the severe accident). Food control, water supply interventions and decontamination could be carried out in the longer term. Before answering the question whether 20 km EPZ 1 is sufficient or not, we can first examine how France plans their emergency planning zones since reactors in Daya Bay and Ling Ao Nuclear Power Station are of French origin. In France, around each Nuclear Power Plant (NPP), there are two zones defined. The emergency planning zone of 5 km radius around a NPP is the zone where evacuation is pre-planned and prepared in detail. The emergency planning zone of 10 km radius around a NPP is the zone where sheltering is pre-planned. The two emergency planning zones around a NPP provide reasonable assurance that the doses to the population in the short term would be below the different intervention levels for a spectrum of accidents and radionuclide releases, in particular for most core melt accidents. The French Government also recognizes that protective actions could be extended beyond 10 km if conditions worsen. So, the countermeasures are not restricted to these zones and can be extended when the accident progresses. The Institute for Radiological Protection and Nuclear Safety (IRSN) is actually providing technical information and evaluation to the French Government to make scientifically-based decision. It is generally recognized that much more time would be available for emergency response beyond the 10km distance.

On 10 March 2012, Dr Jean-Christophe Gariel, the Director in charge of the Environment of IRSN presented their work on the Fukushima nuclear accident in a nuclear safety related symposium organized by Hong Kong Nuclear Society and City University of Hong Kong. In his presentation, he showed how IRSN used various atmospheric and seawater dispersion modeling software to estimate the impact of radioactive pollutants to France and also French citizens in Japan due to Fukushima. In another occasion, Dr Gariel also discussed the use of SOFIA and ASTEC simulation software for nuclear safety evaluations and severe accident simulation.

Besides France, we can also examine the emergency preparedness in USA since she is the biggest nuclear electricity producer in the world. In the US, it also makes use of two zones - the plume exposure pathway EPZ (10 miles in radius around a NPP) and the ingestion pathway EPZ (50 miles in radius around a NPP). Evacuation does not always call for completely emptying the 10-mile zone. In most cases, the release of radioactive material from

a plant during a major incident would move with the wind, not in all directions surrounding the plant. The release would also expand and become less concentrated as it travels away from a plant. Therefore, evacuations are conducted to anticipate the path of the release. Generally as a minimum, in the event of a general emergency, a two-mile ring around the plant is evacuated, along with people living in the 5-mile zone directly downwind and slightly to either side of the projected path of the release. The US Government, supported by research centres and universities, also uses simulation software such as MAAP5, MELCOR and RELAP to carry out probabilistic safety assessment of their nuclear plants and also estimate the potential release and dispersion of radionuclide in the atmosphere in order to optimize the emergency planning process.

After examining the emergency planning of both countries, the EPZ 1 in Hong Kong is already bigger than that for France and USA. Also, Hong Kong Observatory performs the technical role of estimating and monitoring the dispersion of radioactive materials released from a nuclear accident. The estimated and measured data provided by HKO can be used by the HKSAR Government to extend the countermeasures beyond the emergency planning zones as the accident progresses. It is generally recognized that the release is strongly affected by the wind direction. So, blindly extending the evacuation zone to 30 km does not necessary increase the overall safety for the population since this may cause unnecessary chaos and hazard to the evacuees. However, one thing the HKSAR Government could do more is to have more collaboration with universities in Hong Kong in order to establish expertise in severe accident simulation and also localized air flow patterns caused by high rise buildings in Hong Kong. The research collaboration with the universities could improve the understanding of the phenomenon and impact of severe nuclear accidents. This approach is far better than blindly extending the evacuation zone to beyond 20km.

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