

Statement of Chan Chee Khoon

Witness for the Defence

Public Prosecutor *vs.* Phua Kia Yaw & 14 Others

*in the Kuantan Sessions Court
State of Pahang, Malaysia*

Kes Tangkapan No: 62-(64-78)-07/2014

Presiding Judge: Puan Hakim Unaizah bt Mohd

Date of Hearing: March 9, 2018

Brief biography

My name is Chan Chee Khoon. I was a professor at Universiti Sains Malaysia until my retirement in 2010. I subsequently served as academic consultant and senior research fellow at Universiti Malaya from 2011-2016 (Dept Social & Preventive Medicine, Faculty of Medicine, and Centre for Poverty and Development Studies). Currently I am a member of international research consortiums based at University of Bremen (Germany), and the London School of Hygiene & Tropical Medicine respectively.

I graduated with bachelor and master's degrees in life sciences from the Massachusetts Institute of Technology (1975), and I also earned a Doctor of Science degree in epidemiology from Harvard University (1990) with a thesis on the epidemiology of nasopharyngeal carcinoma. In the summer of 1986, I worked at the Massachusetts Cancer Registry in Boston where I helped to analyse childhood leukaemia clusters in the vicinity of the Pilgrim nuclear power plant at Plymouth, Massachusetts. I was a founding member of the Penang Cancer Registry (technical advisory committee), and also a founding executive board member of the International Society for Equity in Health. In the last 15 years, I have served on the editorial advisory boards of the *International Journal for Equity in Health*, *Global Social Policy*, *Global Health Promotion* and *Oxford Bibliographies in Public Health*.

My interest in Lynas

Lynas is a public interest issue. As a public health professional, I have a duty to contribute towards an informed public discussion of the technical, policy and operational aspects of the refinery's processes and its social, environmental, and health implications. As a Malaysian citizen, I also expect a transparent and accountable process in the governance of public health matters, with meaningful consultation and engagement of all stakeholders. I am honoured to be called upon to testify in the case of Public Prosecutor *vs.* Phua Kia Yaw & 14 Others.

Background documents reviewed and my professional view

Aside from the International Atomic Energy Agency's report on Lynas (2011) and the Radiological Impact Assessment (2010) and the Radioactive Waste Management Plan (2011) submitted by Lynas itself, I have also read the pertinent literature and key documents on radiation risk from internal emitters (radioactive particles that end up in the human body through inhalation, or ingestion via food and water) (CERRIE 2004, ECRR 2010; Chen et al 2005, P Day 2006, among others), and I have come to the following conclusions:

1. The 'safe thresholds' of 1 mSv/yr (public) and 20 mSv/yr (occupational) that Dr Looi Hoong Wah (Kuantan physician), Dr Che Rosli Che Mat (MP, Hulu Langat), Lynas, AELB, and IAEA repeatedly invoke are derived from the International Commission on Radiological Protection's quantitative risk models which are currently under critical scrutiny and challenge¹, in the wake of excess childhood leukaemia near nuclear power plants that cannot be explained by radiation exposures which are two to three orders of magnitude below the 'safe thresholds'. Most recently, two large epidemiological studies in Germany (KiKK, 2008) and in France (Geocap, 2012) have reported statistically robust findings of a doubling of leukaemia risk among children living within a 5km radius of a nuclear power plant, where radiation exposures were much below 1 mSv/yr. Could the excess leukaemia be due to inhaled or ingested radioactive particulates not satisfactorily accounted for in ICRP's risk models?² A UK expert panel (2004, www.cerrie.org) could not arrive at a consensus regarding the health risks of low level exposure to these internal emitters. Opinions among the UK panel members ranged from negligible adverse effects to an underestimation of risk by at least a 100-fold. Could the excess leukaemia be due to electromagnetic fields associated with high voltage power cables linked to the nuclear power stations? or to population mixing and vulnerability to infectious agents suspected of causing leukaemia? (Kinlen hypothesis). No one can be sure.
2. In other words, nobody really knows at this point how safe (or hazardous) the Lynas refinery may be (for human and environmental health), given that much of the radioactive solid wastes are in powdery form, i.e. respirable when dry as suspended particulates, or ingestible from contaminated surfaces. In a situation of uncertainty such as this, the

¹ It is quite contentious whether these existing ICRP risk models - largely calibrated against *external* sources of *instantaneous* irradiation of large human populations, most importantly, the long-term follow-up studies of survivors of the Hiroshima and Nagasaki atomic bomb blasts - are adequate for assessing the health risks of *chronic* exposure to low-level ionizing radiation from ingested or inhaled *internal* emitters (see references cited below).

² the Lynas Radiological Impact Assessment submitted by Nuklear Malaysia (dated June 2010) does attempt to estimate the risks from inhaled emitters for LAMP employees (average volume of air intake, presumed level of dust concentrates and associated radioactivity internalised by the employee) (p.56) but it then proceeds to compare the absorbed radiation dose - averaged over the whole body (or target organ?) - with existing norms of 'safe' thresholds of exposure. This is precisely what was contentious in CERRIE's deliberations on the bio-kinetics and micro-dosimetry (i. e. localised exposures down to sub-cellular components) of internal emitters including Auger emitters. By way of analogy, averaging the absorbed radiation dose over the whole body is equivalent to saying that a burning cigarette butt on your palm doesn't hurt because the heat is negligible when averaged over your whole body. Aside from cancer biology, radiation risk (from internal emitters) can also be approached from an epidemiological perspective. One of the few empirical attempts at this was a 1993-1994 study of male miners at a combined iron ore-rare earth minerals mine in Inner Mongolia which was reported in the *Journal of Radiological Protection* (Chen et al, 2005). In that study, highly dust-exposed miners had 5.15 times the age-adjusted mortality rate from lung cancer as compared to the rate among Chinese males in the general population. The less-exposed mining staff had 2.30 times the general population rate. Both groups had similar smoking rates (78%, vs. 67% for the general adult male population). On this basis, the authors concluded that the excess lung cancer risk among the less-exposed was largely due to above-average smoking, and the further difference between the two miner groups was due to high exposure to airborne crystalline silica particulates (mainly) and to thorium-containing dusts and its radioactive daughter nuclides such as thoron gas. This partitioning of attributable risk and ensuing conclusions are highly debatable, and it should also be noted that the ores that the Chinese miners were exposed to contained 400 ppm of thorium. The rare earth oxide concentrates that arrive as raw materials at Kuantan port have 1600 ppm of thorium. The US Public Health Service (1990) reports that the natural background level in North American soil is typically ~ 6 ppm of thorium.

Precautionary Principle becomes even more important in public health practice (let's recall that obstetric X-rays were considered safe by the medical and scientific community until the 1950s, when Professor Alice Stewart (Oxford) raised the alarm with her findings of increased risk of childhood leukemia. These findings were initially also dismissed as a fringe minority opinion - by Sir Richard Doll, no less, doyen of cancer epidemiologists and Regius Professor of Medicine at Oxford - but Professor Stewart's persistence eventually saw them incorporated into mainstream medical practice).

3. In asserting that the LAMP refinery is unquestionably safe, Dr Looi, Dr Che Rosli, Lynas and AELB are being cavalier with the ***Precautionary Principle***, in contrast to the State of California for instance, where Molycorp must comply with a zero liquid wastes discharge requirement despite the limited solubility of thorium compounds in most circumstances; or in Germany, where the popular will has obliged Chancellor Angela Merkel to phase out nuclear power plants even as scientists and researchers continue to lock horns over the unexplained excess of childhood leukaemia in the vicinity of nuclear power plants and nuclear reprocessing facilities.
4. Most pertinent to this case perhaps were Arafura Resources Limited's proposed rare earth operations in Australia, as an illustrative example of how the *Precautionary Principle* is operationalised in Australia. The Department of Natural Resources, Environment, the Arts and Sport of the Northern Territory Government had the following conditionality for the issuance of an operating license **item 1.3.5 RECEIPT AND STORAGE OF WASTE FROM (OFF-SITE) ORE PROCESSING. Tailings produced from the offsite processing of ore (i.e. processing waste) are proposed to be transported back to the mine-site for long term storage. The processing waste will contain radioactive material (e.g. thorium)³**. In plain language, the radioactive solid wastes produced by Arafura's mining, ore concentration, and refining processes were to be returned to the originating mine-site at Nolans Bore (near Alice Springs, NT) for secure burial. In accordance with principles of environmental justice, it was considered unfair to burden the residents of Whyalla, South Australia (location of the proposed rare earths refinery) with anxieties over their community's health.
5. Applying the same standard of *precaution* to the LAMP refinery at Gebeng would require that Lynas return its radioactive solid wastes to its originating mine-site at Mt Weld in Western Australia.

We recall that the Asian Rare Earth (ARE) refinery at Bukit Merah (Ipoh), like LAMP, had very opaque long-term waste management plans, if any. *Ad hoc* arrangements, including the aborted Papan dump-site, eventually led to a situation of indiscriminate dumping of radioactive thorium-cake wastes⁴ at Lahat, Menglembu, Pengkalan, Jelapang, Buntong, Simpang Pulai among other locations:

³ Guidelines for the Preparation of an EIS. Nolan's Project – Mine (December 2010). Department of Natural Resources, Environment, the Arts and Sport, Northern Territory Government

⁴ the Akademi Sains Malaysia reports that thorium-cake waste from ARE contained up to 36% (360,000ppm)

²³²Thorium (*Rare Earth Industries: Moving Malaysia's Green Economy Forward*, p.30, table 2.9, Akademi Sains Malaysia, August 2011). ARE's thorium cake wastes also contain 7000ppm ²³⁸Uranium which decays to ²²²Radon, a highly radioactive gas with a half-life 3.8 days (an alpha-emitter, inhaled radon is the second most important cause of lung cancer after inhaled tobacco smoke).

www.merdeka.com/bm/news_v2.php?n=11823

It would be sad if the Kuantan-Kemaman community ended up as *tikus makmal* (lab rats) in a natural experiment.

March 8, 2018

Shah Alam, Malaysia