# Can Nuclear Safety Culture be Used to Increase Public Acceptance of Nuclear Power?

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The nuclear industry prides itself on its safety culture, although it has been suggested that continued emphasis on safety may make the public feel that the nuclear power is inherently unsafe (1). The safety culture is so embedded within the industry that change may be met with some resistance. This paper explores whether, by using the principles of this cultural attitude, a strategy can be developed to increase public acceptance of nuclear power.

Safety culture is founded on a number of important tenets, namely (a) knowledge and awareness of the hazard, (b) understanding of under what circumstances the hazard poses a risk, and (c) understanding what actions can be taken to mitigate that risk. The problem comes when the public's perception of risk, which is largely based on belief, differs markedly from that of the Industry, where perception of risk is based on evidence.

The public show heightened awareness of the hazard of man-made radiation relative to radiation from natural sources or sources used in medicine. There is therefore a need to correct the misconceptions around the risk of nuclear energy to health, and a number of on-line resources are starting to recognize that nuclear energy will only become acceptable to the general public if a greater effort is made to challenge these misconceptions (2,3). It is generally accepted that exposure to high doses of radiation (in excess of several Sieverts) has the potential to cause immediate health effects. The problem comes when it comes to assessing risk at low levels of radiation (e.g. below 100 milli Sieverts). Explaining risks at low levels to the general public is not helped by the fact that attributing damage to radiation (e.g. cancer) is difficult as we have no biomarkers that enable us to be certain that the cancer in question is actually due to exposure to radiation. Our estimates predict that if 100 US citizens (used for this example because of the large Surveillance, Epidemiology and End Results database (https://seer.cancer.gov) that provides information on the incidence of cancer in a large number of US citizens) were each exposed to a dose of 100 mSv of radiation, only one would be predicted to develop cancer, whereas 42 would be predicted to develop cancer form other causes (4). The generally accepted paradigm is that there is a linear, no threshold dose response relationship to radiation (the LNT hypothesis), which immediately suggests to the general public that any exposure is dangerous, although the validity of this paradigm is questioned, particularly at low doses (5). It is often thought that this concept

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applies only to radiation in respect of carcinogenesis, but this has long been a problem in defining safe limits for chemical toxins that have been found to be carcinogenic (6). A recent review designed to introduce non specialists to the evidence relating to low dose radiation (7) demonstrates that as the dose to the individual dips below 100 mSv, the certainty (expressed statistically by 95% confidence intervals around a value) that there is any effect at all becomes vanishingly small. In other situations, it would be regarded as little or no evidence at all for any carcinogenic effect of the agent in question, and public concerns about potential risks would be minimised. Unfortunately, we seem to view radiation in a different manner. When put into context with exposure to other agents (e.g. cigarette smoke) or lifestyle factors (e.g. obesity), the effects of exposure to the dose of radiation experienced by the population either around the Chernobyl or Fukushima nuclear power plants pale into insignificance (8).

Clearly there is a disparity in the public mind between the actual risks of exposure to low dose radiation as a result of a nuclear power plant accident and the actual risks. So how we can start to solve this issue? Firstly, we tend to regard the risks of radiation differently from health risks from other toxic substances to which we are exposed. It is perhaps here we need to start. The advice given to local communities regarding what to do in the event of a nuclear accident is very similar to that provided in the event of a release of a volatile toxic chemical in the event of an accident – shelter indoors, with windows and doors shut, don't panic, evacuate in an orderly manner for the short term and minimize the consumption of locally produced food that could potentially be contaminated. It should be noted that the only volatile radioactive isotope that has been demonstrated to pose a health risk to the exposed population following a nuclear accident, 131-I, only poses a risk to the young, and contaminates the environment for a short period of 3 months only, due to its short physical half-life. Much of the increase in thyroid cancer that has been identified in Belarus, Ukraine and Russia following the Chernobyl accident could have been prevented by correct use of prophylactic stable iodine administration, or by reducing the dose significantly by restricting access to contaminated milk. Because of the known association between radiodine exposure in young children and thyroid cancer, thyroid screening programmes were implemented after both the Chernobyl and Fukushima accident. Screening for thyroid cancer in any population causes an increase in the detection of the disease, and in the case of thyroid cancer this can be considerable (9), whilst having no impact on outcome for the patient. As there is still no biomarker that can distinguish thyroid cancer caused by exposure to radiation from thyroid cancer as a result of other causes, differentiating the effects of screening and of radiation exposure can be difficult, making attribution of risk to exposure to radioiodine a subject of hot debate (10).

The isotopes that have longer physical half-lives (such as Cs-137 ) result in smaller doses to bodily tissues due to their relatively short biological half-life. For example, the average additional dose in 1986–2005 in contaminated areas in the three republics was about equivalent to that from a computed tomography (CT) scan in medicine (i.e. 10 mSv), and should not lead to substantial health effects in the general population that could be attributed to radiation exposure from the accident (11,12).

Returning to our principles of safety culture, it appears that we can address the issues around the knowledge and awareness of the risk and what to do to minimize it. It would therefore seem that what we are left with is a communication issue around the real risks of nuclear power. Can we learn anything from safety culture to address this?

The implementation of safety culture depends upon a leadership built on trust, learning from mistakes of the past and effective communication. There is no doubt that the public have lost trust in the nuclear energy as a whole, but there are lessons to be learnt from other large industries in this regard. The public need to have trust in the leadership within the power plant, and this needs to be reinforced by having a regulator that has teeth and is prepared to use them. There is evidence that local populations are more inclined to trust local plant personnel than industry or government personnel (13) , so interaction of the workforce with local people is clearly an important avenue to explore. Communicators that are trusted by the general public are more often a public figure, rather than those who are considered to be government or industry agents. One important change that has occurred post Fukushima is that number of environmentalists who most would assumed to be anti-nuclear have been forced to look again at their beliefs, when the scientific evidence suggested that nuclear power may in reality be a force for the good both in respect to climate change and to health effects of burning fossil fuels such as coal. Although historically the environmental movement and the nuclear industry would not have been perceived to make good bedfellows, perhaps there is something to be learned by the way in which these groups communicate with society at large using trusted communicators to spread their message.

The journey that we are currently undergoing with respect to nuclear energy is similar to that taken by toxicologists 15-20 years ago when concern was expressed over environmental exposure to chemical carcinogens. Eventually there was a general acceptance that the effects of carcinogenic agents at very low doses were not only indistinguishable from the background incidence, but trivial when set in the context of other health risks associated with human behaviour (e.g. smoking or obesity). This eventually resulted in an acceptance of the principle of negligible individual risk with respect to chemical carcinogen exposure. Is it too much to hope that will be able to get to this point with nuclear energy before the effects of climate change take an irreversible hold on our environment?

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Writer's Profile

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She engaged on international scientific joint research projects with Belarusian, Ukrainian, Russian Scientists after the Chernobyl accident at the Cambridge University. Dr. Thomas assumed the position of Director at the Chernobyl Tissue Bank in 1998. She is actively involved in public information on the health effects of radiation through lecture at schools and universities after the events at the Fukushima Dai-ichi Nuclear Power Plant.