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After the meltdown

By Richard Vaughan

The safety of nuclear power stations has been defended and attacked on the basis of how likely it is that a major disaster will occur. Those who support nuclear power say that the probability is vanishingly small, while nuclear opponents dispute this, and quite often add that even if the probability were low, the consequences of an uncontained meltdown would be so terrible that the risk should not be taken at all. Thus, the dialogue has revolved around the likelihood of a major nuclear accident, and neither side has made serious efforts to bound the *size* of the public risk from the worst release that could really happen: that it would be a major public catastrophe has always been assumed.

Fortunately, there is a mounting body of evidence to suggest that this is not the case. The central error of opponents in particular has been to equate the lethal *content* of the fission products in a reactor with its potential danger. It is true that there is sufficient radiotoxic material in a reactor to kill many hundreds of thousands, but by the same criterion there is enough water in the Serpentine to kill millions. Obviously, both assertions, while true in themselves, are absurdly misleading, since no dispersal mechanism exists whereby either material could be so lethally distributed.

One of the few pleasant surprises to arise from the Three Mile Island accident in the U.S. was the fact that very little radioactive iodine was released into the environment, despite the severe damage suffered by the reactor core. Iodine is the most dangerous fission product likely to be released in the event of a serious nuclear accident, because it concentrates in the thyroid. Most other gaseous fission products are noble gases which can be breathed in and out, but are not retained in the body since they are chemically inert. Early in the investigation of the *President's Commission on the Accident at Three Mile Island*, the crucial matter was quickly recognised to be the enormous disparity in radioactive release between iodine and the inert fission products. The total estimated release of the noble gases was around 10 million curies, while that of the iodine was a mere 18 curies, although the core inventories were comparable.

This remarkably high retention of iodine has rekindled efforts to improve our understanding of the release mechanism of fission products from damaged fuel elements. Nuclear safety inspectorates have always based their estimates of the consequences of an uncontained meltdown on the deliberately pessimistic assumption that iodine is released into the atmosphere just as easily as the noble gases. However, there is now a mounting body of evidence to suggest that it is more likely to combine with caesium, another abundant fission product, to form caesium iodide. This has a tendency to plate out on any metal surface, or alternatively dissolve if there is water or steam present.

The evidence for a high degree of iodine retention is not confined to Three Mile Island. In a paper presented at an international conference in Washington last November, eleven different cases of either accidental or deliberate melting of nuclear fuel were reviewed, and in all cases in which there was water, steam or hydrogen present, the release of iodine was very much lower than would be predicted under existing models. In the light of all this, Dr Chancey Starr, The Vice-President of the Electric Power Research Institute, recently led a team of nuclear scientists in making a strong submission to the U.S. Nuclear Regulatory Commission, calling upon them to reduce greatly the iodine release source term that they have been using in safety assessments for the past eighteen years. If accepted, this could have a significant effect on emergency planning around nuclear power plants, and would reduce greatly the need to consider such drastic measures as evacuation of the public in the event of a core melt.

The good news is not limited to American water-cooled reactors. Iodine, apart from reacting with caesium and dissolving in any water present, is known to react chemically and physically in other areas, and since nearly all the surfaces inside any reactor containment are covered with paint, plastic or organic films, iodine retention is bound to be high, even in the British gas-cooled designs. Nevertheless, this new development has strongest implications for the American water-cooled reactor: it is widely believed that the consequences of the worst conceivable accident may be ten to one hundred times less severe than previously assumed. In other words, the idea first intimated shortly after the war, and exaggerated by most anti-nuclear groups, that thousands of somatic and genetic effects would automatically ensue from an uncontained meltdown is seriously mistaken. The point is elegantly made by M. Levenson and F. Rahn in their recent analysis of reactor safety (*Realistic Estimates of the Consequences of Nuclear Accidents*, Electric Power Research Institute, Pain Alto, Ca 94303, USA):

> *"Now, in the aftermath of TMI, people are perhaps more open to asking the questions: Why weren't the public health effects greater? Was it but for the grace of God? No! But it was due to the grace of Nature. Engineered barriers, after all, are always subject to failure. Not so with natural phenomena. Our experience has shown natural phenomena to be very effective in containing radioactivity. These same natural barriers will also act in future accidents. The inherent safety of nuclear reactors rests on the demonstrable phenomena - not on theoretical arguments or hypothetical scenarios. Whether an accident does or does not occur depends on our skill, although some like to think of it in terms of luck or probability. But the consequence of such an accident is not a question of skill, or luck, or probability: natural processes will limit the dispersal of significant radioactivity to the near vicinity of the accident. As a result, a public catastrophe will not occur."*

It would be nice to think that even the most rabid opponent of nuclear power would regard all this as good news. Unfortunately, human nature does not work that way, and nor do journalists. For most readers, this is probably the first they will have heard of one of the most fundamental shake-ups in nuclear safety analysis to have occurred in recent years. Suppose that, after TMI and a myriad of smaller accidents and experiments, the error was suggested to be in the other direction; you would probably have heard about it on the radio, read it in the papers, or seen it reported in ominous tones on TV. As it is, the media have greeted the news with a resounding silence which one could be forgiven for believing was deliberate.

This is not, of course, any great surprise. Exactly the same thing happened to the findings of the Kemeny Report, (that no immediate danger threatened the public at TMI), the findings of the LJS Congress OTA's Brookhaven Report (that coal combustion may be responsible for 48,000 premature deaths per annum in America), and half a dozen non-nuclear industrial accidents which have necessitated the evacuation of (and in one case killed) thousands of people since TMI took place. To date, there has not been a single fatal accident in the operation of a commercial nuclear power plant anywhere in the Western world. The fact that the worst *hypothetical* nuclear "disaster" has been grossly exaggerated looks like remaining a well kept secret.

But then, the superior safety of nuclear power over that from fossil fuels is arguably one of the best kept secrets of our age.