

The Sea to Land Transfer of Man Made Radioactivity (2018/2019 BRIEFING)

Tim Deere-Jones was educated at the Cardiff University (Wales): Dept' of Maritime Studies, where his research dissertation was on the Sea to Land Transfer of Marine Pollutants. He has been working as a "non-aligned" marine pollution researcher and consultant since 1983 and has worked with major NGOs and campaign groups in the UK, Europe, the US and Australia. Tim has a particular field and research interest in the behaviour and fate of anthropogenic radioactivity released/spilled into marine environments.

It is clear from the available empirical data that coastal populations impacted by prevailing onshore winds and living next to sea areas contaminated with liquid radioactive effluents from nuclear sites, are annually exposed to dietary and inhalation doses of man-made marine radioactivity, discharged to sea from nuclear power stations, fuel fabrication sites and re-processors, and transferring from the sea to the land in airborne sea spray and marine aerosols (micro-droplets) and during episodes of coastal flooding.

I have no doubt that this is a global phenomenon and that the various mechanisms of sea to land transfer are not unique to the UK, however, I have observed that the scientific literature on the subject appears to be restricted to the output of UK official (pro-nuclear) and independent (non-aligned) researchers and that, to date, no other sources of such research have been identified. The UK research itself was terminated within a few years of its inception and, coupled with the absence of any similar research in other "nuclear states", it is my assumption that the international nuclear community has no interest in promoting such work and is happy to see the whole issue sidelined and downplayed.

In the UK, the early research was initiated by the nuclear industry and pro nuclear governments, acting through the UKAEA, which in the late 1970' & early 80's researched the sea to land transfer of the alpha emitting Plutonium's (Pu) 238, 239, 240 and Americium (Am) 241 and the beta emitting Caesium (Cs) 134 & 137, across the Cumbrian coast near Sellafield. (REF 1).

The UKAEA work confirmed that all five radio nuclides studied, transferred readily from the sea to the land in onshore winds. In wind speeds of less than 10metres per sec (22 mph) Cs was enriched in spray and marine aerosols with enrichment factors [EFs] of around 2; however, the alpha emitting Pu and Am were shown to have EFs, relative to filtered ambient seawater, of up to 800. The alpha emitters were found to be associated (*by Ad-sorbition*) with micro particles of sedimentary and organic material suspended in the marine water column and ejected into the atmosphere, as aerosols, by bursting bubbles at sea and at the surf line.

However, once the sea to land transfer of alpha emitters with massive enrichments was confirmed, such studies were rapidly abandoned and virtually no empirical field work on the extent of the inland penetration of spray and aerosols and human doses and exposure pathways has been completed by "official" sources. As a result all of their assessments have been "modelled", based on assumptions derived from deeply inadequate historical data. It is also noteworthy that, of the 70 + radio nuclides known to be discharged to sea from UK nuclear sites, only the five named radio nuclides have ever been researched for their sea to land transfer potential.

30 year wind data from the UK's west coast indicates that onshore winds (SSW to NNW), in excess of 3 mph, occur for around 5,150 hours per year. (REF 2) Thus it may be proposed that sea discharged gamma emitting Cs 137, and the alpha emitters Pu 238, Pu 239, Pu 240 and Am 241 are transferring from the sea to UK west coast terrestrial coastal zones in sea spray and marine aerosols, generated in both the offshore zone and the inshore zone, for approximately 60% of the time during an average year. (Such figures are a generalization, and specific individual sites along the UK's west coast will be subject to regionally and locally variable conditions and may receive more or less hours per year of onshore wind.)

The proposition is supported by the data. In 1982 a study by UK nuclear agency workers found that Sellafield derived (sea discharged) Pu 239 and Pu 240 in soil, to a depth of 15cm and up to 1 km inland of the Cumbrian coast, was nearly 4 times higher than the Pu from weapons test fallout. (Ref 3)

In 1988, independent empirical research commissioned by a west Wales local authority reported that Sellafield derived, sea discharged, Cs had been found in pasture grass up to 10 miles inland of the Ceredigion coast. Clearly, this contributes to human dietary doses via the dairy and beef food chain. The research also implies the inevitability of further dietary doses via arable and horticultural crops. Given that airborne radioactivity is driven at least 10 miles inland, it should be assumed that coastal populations are exposed, on a repeated annual basis, to inhalation doses. (Ref 4)

Independent, empirical field research by a team of GPs in the Hebrides, has shown broadly similar, but more detailed results and demonstrated that island and coastal environments are saturated with sea borne Cs from distant sources. The GP's research demonstrated that those who ate more "local" terrestrial produce had higher doses of Sellafield sea discharged Caesium 137 than those who ate "non-local" produce. Some island residents received higher doses of Sellafield derived, *sea discharged Cs*, from their locally grown *terrestrial* produce, than from sea foods. The same residents received higher doses from their terrestrial produce than some sea food eating populations living adjacent to nuclear pipelines discharging liquid waste to sea. Given the available evidence of the West Wales study, it is logical to propose that the same would apply in that case. (Ref 5)

Given that the UKAEA study has unequivocally demonstrated that Cs transfers across the surf line of the Cumbrian coast in association with highly enriched concentrations of Pu and Am, it is legitimate to propose that similar outcomes will occur in West Wales and the Hebrides, where both sea areas are known to hold Pu and Am. However, despite the worrying empirical data on the fate and behaviour of sea discharged radioactivity generated by independent studies at sites distant from marine discharge point sources, UK Governments, their regulating and environmental protection agencies and the nuclear industry have not only refused to undertake follow up research but have drastically reduced their radiological monitoring of marine and coastal sites distant from discharge points.

Although "official" research has demonstrated the significance of sea to land transfer, it was not able to provide any Useful quantitative empirical data. The UKAEA authors admitted that their field work had used highly inefficient "muslin screen" collectors in wind speeds up to only 10 metres/sec (Beaufort Scale Force 5, "fresh breeze"). The authors "estimated" that, under those conditions, the muslin screens were only 20% efficient in absolute terms and warned that their data should be used only for "qualitative" studies and not for quantitative calculations. Wind speeds greater than Force 5, would be expected to further reduce the efficiency as the porosity of the screens increased as the muslin stretched. Since those UKAEA studies of the late 1970's and early 80's, virtually nothing has been done by well funded nuclear industry bodies and pro nuclear governments, to follow up the implications of those early observations of sea to land transfer of Pu, Am and Cs.

Yet the nuclear industry insists that any such doses are merely a small fraction of the official "permitted" dose endorsed by both the industry and government who clearly have no interest in acquiring the necessary empirical data. But from the available empirical evidence, and in the absence of any contra-indication, it can be proposed that repeated long term exposures of coastal zone populations to doses of seas to land transferred radioactivity, via multiple pathways, represent a significant potential public health impact risk.

The UK Government and a number of its departments and it's environmental regulatory agencies are aware of the concerns discussed above, but appear to prefer a cover up, rather than an open discussion. An example has been the long term attempt to access a copy of one of the most potentially informative UK Government/Regulating Agency reviews of Sea to Land Transfer issues entitled "*Sea to land transfer of radio nuclides. How much do we know?*" which has been referenced in annual marine monitoring reports as support for the official argument that sea to land transfer is of low radiological and public health significance. However, applications for a copy of this paper, made to the libraries of DETR, CEFAS, DEFRA, DECC and even to the author himself, have been met with the consistent reply that there are no copies available. (Ref 6)

Without the advantage of a set of empirical research outcomes, based on a thorough understanding of the way radio activity behaves in coastal and coastal zone environments, successive UK government regulators and environmental protection agencies lack any relevant knowledge of the public health impacts of the radio active wastes that have been discharged into UK sea since the 1950s. As a result coastal zone populations are left both un-informed and un-protected in the face of chronic long term exposures. This applies equally well to other populations around the world who live within coastal zones adjacent to radioactively contaminated sea areas.

