SZÉKELY ENGINEERING
EXPLANATIONS & EXAMPLES

Temperature, Ovens, and Radiation, *or*, The Chicken Little Method of Decision Making

Shortly after the Three Mile Island accident in 1979, I spent several months at Indian Point 3 designing systems to implement changes dictated by the Nuclear Regulatory Commission to preclude similar mishaps in the future. While at Indian Point, I was *inside* the reactor's containment building twice *while the unit was generating power*, each time for about 30 minutes, and received less total radiation than I would have while undergoing a chest x-ray.

With the movie The China Syndrome having been in theatres 12 days before the accident, permits for U.S. nukes slowed to a trickle. In the 25 years since the subsequent Chernobyl disaster in 1986, permits have begun to slowly rebound but Fukushima has become the crisis du jour, allowing hysteria to once again rear its ignorant head and threaten to squash permitting of new nuclear plants.

What with so much of what the lay public "knows" being based upon the fuzzy reality we live in, where science is a matter of consensus rather than independent experimental confirmation of hypotheses, I sometimes become a bit put out when discussing current issues with friends and acquaintances who have no idea that how little of what they "know" is based upon fact. The Legacy Media, in its breathless "reporting" of the day-by-day events at Japan's Fukushima nuclear reactor complex, has done nothing to help dispel the ignorance of the lay public with regard to the world as it is, rather than the world as they see it through the badly distorted lenses they've donned courtesy of a largely failed system of higher education.

When the Fukushima event began, I thought I might have to spread my thoughts among two newsletters, first to explain how to understand nuclear radiation, and then to discuss the risks associated with different types of nuclear power plants.

Thankfully, the former has been done for me by Charlie Martin at Pajamas Media (see previous link), so I'm going to limit myself here to the differences between virtually all nuclear plants truly designed to generate electricity, and those like Chernobyl where electricity is a byproduct in the manufacture of weapons grade Plutonium, and why neither can explode like an atomic bomb.

Having said I'll not discuss how to understand nuclear radiation, I'm gratified that Mr. Martin makes the same point about the lay public having difficulty understanding the difference between temperature and heat in his piece on radiation, as did I in Volume 6 Number 5 of this publication in May of 2006.

What I *will* discuss, is how to understand radioactive contamination, and the huge differences between Chernobyl and every other accident that has happened, and every other accident that ever *will* happen to reactors of U.S. design.

With regard to the last statement, National Geographic did a TV special entitled Inside the Nuclear Threat which, in its last 15 minutes or so, explains everything you need to know about containment vessels and buildings of U.S. reactors, and the ineffectiveness of jerry-rigged dirty bombs. It also explains that a nuclear powerplant can't turn into an a-bomb because the fuel in the former is enriched to between 3 and 6 percent of the explosively fissionable Uranium 235 (U-235) isotope while a bomb requires 85-90% U-235, and extracting such from the much more plentiful normally non-fissionable U-238 requires the resources of a national government – Osama can't do it in a cave.

But to start with radioactive contamination, the concept to internalize is that of *half-life* or natural decay. That is, radioactive Iodine 131, for instance, has a half-life of about 8 days, which means, that after 8 days go by, only half the original amount remains radioactive, with the other half having decayed to the non-radioactive Iodine 127 we use as a disinfectant. Half of the remainder continues to decay every 8 days with the result that after 8 such cycles, or 64 days, 1/256 of the original amount, or about .039% remains radioactive. There are, however, heavy elements like U-235 which are ferociously radioactive for an extremely long time (700 million year half-life), and it's those which constitute the reasons for containment buildings. Containment buildings and vessels, by the way, are the reason the line in the China Syndrome movie that a meltdown "would render an area the size of Pennsylvania" permanently uninhabitable, is so much Hollywood tripe, as proven by actual events at Chernobyl, a reactor which had no containment building, and which did no such thing – the exclusion zone (which is presently a wildlife refuge) is 2/3 the size of New York City, or about 1/240th the size of the State of Pennsylvania (see link above).

The penetration of the different kinds of radioactivity described in the link in the previous column on how to understand radiation, by the way, varies greatly with type; alpha particle radiation is unable to penetrate ordinary clothing, and beta particles are unable to penetrate an automobile or a dwelling. The really nasty stuff is the gamma radiation of x-rays, and is why x-ray techs and radiologists run and hide when operating stuff like CAT scanners and x-ray machines, and the fact that they do it all day, every day, is *why* they have to run and hide in the first place.

This is part of why the radiation levels reported in the Legacy Media are so meaningless. First, because the dose, like heat required when baking, is cumulative (*only* to an extent; see next link), and second, because the intensity follows the inverse square law, which is the reason a page will have 1/100 of the amount of light falling on it when it's 10 feet from a lamp as it would when only a foot away.

That is, if a Geiger counter measures a potentially lethal radiation level of, say, 5 Sieverts per hour 6" away from a radiation source, at about 25 miles away, the intensity is lower than the natural background radiation of 3.6 microSieverts per hour. There are high-altitude places on earth where the natural background radiation levels are 200 times as high, and with regard to this last, the linear model of radiation exposure would expect 200 times as many cancers in such locations, which is *not* the case. In fact, there were actually fewer cancers reported at such high-altitude elevations than at sea level.

Finally, radioactive half-life is the reason that irradiated foods pose no health risk associated with radiation. For radiation to pose a biological hazard you really need to have ingested radioactive heavy metals or stuff like Strontium-90 which replaces the calcium in bone and goes through its 28.8 year half-life raising hell inside your body like a continuous internal x-ray or CAT scan. To do that, however, you'd have to be ingesting *heavily* contaminated food or water, but it's not like this stuff hides and no one knows it's there, nor, if you're particularly paranoid, is it hard to get hold of a Geiger counter and check your food before you eat it.

Me, I'm more worried about stuff like salmonella.

Since the Russians have quit building Chernobyl-style reactors and all others have containment structures, what we're left with as a worry is spent nuclear fuel sitting in pools while it cools off in both temperature and radioactivity. About 8 feet of water above the topmost spent elements pretty much contains the radioactivity so the object is to keep the pool full of water. The spent fuel pools at Indian Point, 35 miles from NYC, by the way, are cut into the bedrock, so they're not going anywhere anytime soon.

Until recently, the cooled spent fuel was supposed to have been moved from on-site pools to Yucca Mountain, but political considerations have taken that off the table (again). In what looks to me like a poster-boy example of the Chicken Little method of decision making, if you read the Yucca Mountain piece linked to above, you'll find that the EPA's original Yucca Mountain Disposal standards were to apply to maximum expected annual exposure for 10,000 years after the closing of the facility, but was then extended by the EPA to 1,000,000 years after the closing of the facility.

It seems to me that if it took us 10,000 years to go from living in caves and wearing animal skins to landing on the moon, we should be able to figure out how to make 10,000 year-old nuclear waste a non-issue within the next 10,000 years – if we're not here in another 10,000 years, it won't be because of spent nuclear fuel cooling off in Yucca Mountain.

France, which gets about 75% of all its electricity from nuclear power, relies (among other nations) on reprocessing of nuclear fuel but mostly because of nuclear proliferation considerations such had been prohibited here in the United States. This reprocessing, however, allows the fuel to be re-used and makes the final waste product much less dangerous, so we may get back into that business here.

Now that you're good (I hope) with regard to nuclear plant radioactivity, however, consider the fact coal-fired power plants are no better.

Smile.