Gaia and the 7th
III
Fuel and Waste

by Tom Kinney
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Bulletin Quote:

"We have become, by the power of glorious evolutionary accident called intelligence, the stewards of life's continuity on earth. We did not ask for this role, but we cannot abjure it. We may not be suited to it, but here we are." Steven Jay Gould

When I was little, my Dad was a clerk in the storeroom of the local utility company. Besides accuracy, the only way he could distinguish himself was by good handwriting, which he practiced endlessly. That's not a high paying job thus I grew up in a family where we didn't have much but were determined to get as much benefit out of what we did have as possible. One of the best ways of doing that is to not waste anything.

My toy boat was a scrap 2 x 4 cut with a point at one end. My bike was one that someone else outgrew. My Mom was a meat and potatoes and casserole lady. And very little was thrown out. We ate the leftovers. But, in part because we ate the leftovers, my parents were able to save enough money to buy a lot and materials to build a house and a pretty nice house at that. Of course the upstairs wasn't finished, just plywood on the floor, and my bed was really just a porch swing—leftover. Not much was wasted.

When we don't use everything we possibly can, we end up with a problem—what do you do with the stuff you didn't use? We end up paying someone to carry it away and stow it someplace. In some places they make things out of what we throw away. See this turtle shell and the aluminum trim? That's just leftovers. And isn't that what pollution is—just leftovers? Fertilizer that got away and into the water—chemicals that escaped capture and got into the air—pesticides that ends up where there are no pests to control. Sometimes we don't do things we should because we are afraid of the pollution it may cause. Well, if we consider the pollution as leftovers, maybe we should figure out how to gather all that stuff we are afraid of and make use of it. When it comes to nuclear power, we have swimming pools all around our country full of not much more than leftovers. My Mom's casseroles were sometimes made with leftovers. Now I don't think we should start making radioactive casseroles, but we certainly have better things to do with those leftover nuclear fuel rods than have them taking up space in all those swimming pools or digging a hole in a mountain to put them in.

Main Talk—

Our Seventh Principle states: We, the members of the Unitarian Universalist Association, covenant to affirm and promote respect for the interdependent web of existence of which we are a part. If there is a common focus that UU's "worship," maybe it is that interdependent web, our natural world. In the first of this three part series, we explored Lovelock's concept of Gaia, the earth mother, who supernaturally, if you so choose, or through natural forces within its independent web of existence keeps itself in reasonable balance while simultaneously being in the process of continual change. For example, scientists tell us that millions of years ago, the earth's atmosphere contained three times today's CO2. The temperature rise was balanced by increased humidity and cloud cover reflecting much of the solar energy keeping temperatures in the range for the interdependent web of existence <u>of that time</u>. The plants grew huge on the extra CO2, converting the earth's air to a more oxygen rich atmosphere. Oxygen breathing creatures evolved as the monster plants receded. Life continued on its long, ever-changing march toward our snapshot in time with a now different environment that is **our** interdependent web.

Gaia has two energy sources, one outside the earth and one internal to the planet. The external one, of course, is the burning of the sun. The debris from those ancient photosynthesizing plants fell to the forest floor and with no yet-to-evolve earthworms, termites, or rot, became buried under tremendous pressures to become our coal, oil, and gas of today. Think of it as tapping a millions year old solar battery that will eventually go flat. This form of old solar has an energy density a hundredfold that of the new solar energy that we tap by wind, hydroelectric, photovoltaic, and the burning of wood and other recent plant matter. Gathering the new, less dense energy takes lots of land which is why a hundred square miles of land of new solar is required to produce what happens on one square mile of the old solar coal-burning facilities.

The second source of energy Gaia owns. It's part of our earth. The interconnected web doesn't have to wait for it to arrive from elsewhere. It was part of the planet's formation when a nearby star exploded 3.5 billion years ago. It is not hundreds more dense, but 2 million times as dense as new solar and is spread all over the planet. It provides about 60% of the heat in the molten magma eighty miles below us helping to keep earth from becoming just a rocky iceball. This mother earth terrestrial energy is the binding energy within the nucleus of the atom that we tap within a nuclear reactor providing 20% of America's electricity and 80% of France's.

In part two, we addressed how science and engineering learned, with increasing safety, to recover and apply this energy such that modern facilities have achieved a world-wide recognized confidence and security, at least among the countries whose populations understand and have adopted nuclear power. Our population falls short in that understanding. This summer, 69 workers were killed in a Russian hydroelectric plant—that is 69 more than have been killed by nuclear reactors in the U.S. over the last 50 years.

Today we will discuss handling the leftovers from nuclear energy facilities.

In the last twenty-five years, we all needed to gain a general understanding of computers as the internet completely changed communications and learning. On nuclear waste, we Americans got stuck in the past while the rest of the developed world educated themselves and moved on. Most consider there is <u>almost</u> no such thing as nuclear waste.

So let's begin with the help from Tucker's *Terrestrial Energy* and the technical review and contributions, thank you, by Reed Johnson, who spoke here last Spring. There is likely some uranium in each shovel-full of dirt in your backyard, but not at concentration levels that would pay you to buy a Geiger counter and a pair a magic tweezers to start picking out the uranium atoms. Originally, our uranium source was a by-product of vanadium and silver mines in the rocky parts of the U.S. Increasing uranium demand motivated mining companies toward areas where uranium was more abundant and knowledge grew on how to do cleanly. Twenty-five percent of the world's current production of uranium now comes from three mines in the most remote parts of Saskatchewan, on the edge of the Northwest Territories. I sometimes worked around the 50^{th} parallel in western Ontario where it was ungodly cold and buried deep in snow in the winter. The Wallston Lake mine is 600 miles further north at the 60^{th} parallel near the uninhabitable muskeg country that makes up most of northern Canada. Sufficient world-wide supplies for many centuries are known, some in more populated areas including a huge lode right here in Virginia. Uranium has also been extracted from sea water, potentially another 6,500 years of Gaia fuel.

The uranium is made into fuel rods that are safely handled with gloves. Two semi-trailers will deliver a reactor's fuel for 3 years. Compare that to a mile long train every three days for a coal-fired electrical plant of half the output and you can see the value of this high density energy. Reducing coal usage saves lives in both cleaner air and in mining. China averages 5,000 killed per year mining coal. Even Australia, one tenth our population, lost 112 lives to coal mining in one recent year. We've shared West Virginia's pain more than once.

What comes out of a power plant other than electricity? Coal plants produce CO2 and all manner of sulfur, mercury, and other elements inherent in the burning of coal including mildly radioactive flyash. Oil and gas are somewhat less polluting. **Nothing** airborne comes out of the nuclear plant other than water vapor. As to solids, coal every day produces ash, clinkers, sulfur, and other such residues. What can not be used by industry goes to landfills. What comes out of the nuclear fuel plant daily is **<u>nothing</u>** other than the highly trained operators at the end of each shift. Every 18 months to 3 years, the fuel rods are replaced because the heat-producing nuclear reaction can no longer be sustained.

And here is where we deviate from the rest of the world. We label these rods “nuclear waste” and worry about how we store them. Much of the rest of the world labels it “nuclear fuel” and burns almost all of it up in their nuclear plants after extracting some special elements for other uses. Think of a 12 foot long rod, actually a zirconium tube full of pellets, like this one I’ll pass around. The diameter varies with reactor design between that of a pen to about twice that size. We label all 12 feet of that rod as nuclear waste and worry about where to store it long term. The rest of the world turns almost all of it into more nuclear fuel to make more electricity and stores a ball-point pen size piece for future use.

I’m going to ask the science haters among us to bear with me a few minutes while I flush out the understanding of what’s in these rods that we Americans have labeled nuclear waste. If the words “radioactive” and “plutonium” make you queasy, you may find this knowledge moves you toward the everyday comfort others have with these terms.

About 95 percent of the fuel rod is just plain old uranium 238, the same kind that is harmlessly laying around in your back yard. It could easily go back from whence it came. Yet, because we treat it as “radioactive,” a scary word to some, we Americans create a huge, intractable and essentially unnecessary problem. Consider your shovel full of dirt. According to U.S. federal regulations, you have a "nuclear waste problem." You cannot legally put it back in the ground. You must take it to a nuclear waste repository. Needless to say, this is likely to add some expense to tilling your garden. U-238 is radioactive, but that does not make it poisonous or deadly. A Texas friend of mine with nuclear expertise, a guy who has been inside the sarcophagus at Chernobyl and helped deal with our border security challenges, tells me that among the items that regularly set off the radiation alarms monitoring border traffic are certain brands of kitty litter, Fiestaware dishes and bowls, World War II hand compasses, motorcycle speedometers, and a myriad of other such everyday products. By the way, if you have the yellow/orange Fiestaware, that surface is the same stuff that was called "yellowcake" that Sadam Hussein was trying to get from Niger. Radiation is all around us, all the time.

President Carter decided we would **not** reprocess spent nuclear fuel rods. France, Russia, England, and Japan do and have reprocessed over 55,000 tons of nuclear fuel. Canada, Holland, Belgium, and others do as well from small reactors to extract medical and industrial isotopes. Where there is such a recycling industry, there is very little storage problem. If we had not abandoned reprocessing, only 1-2 percent of what was scheduled for Yucca Mountain would have to be stored for later use.

So what do other countries do? That plain old 95% plus U-238 is blended into a new fuel rod. The remaining 5 percent of a spent fuel rod is more highly radioactive whose energy is actually too intense to be used in a reactor as is.

Fission products make up 1.5 percent of the spent rods. These are the radioactive isotopes of atoms **far down** the periodic table and first recognized by Lise Meitner working in her seaside cottage; Barium, strontium, cesium and zirconium are the most common of the two dozen or so. Fermi had done the experiments in Italy. These isotopes have important industrial uses and are among those we currently have to buy from Canada. We label them "waste" and would move them from Meitner's seaside cottage to Yucca Mountain where they will continue to shed their radioactivity until they reach stability, usually as lead. Cesium 137 and strontium 90 require the most caution as they mimic calcium and potassium and can be taken up biologically in the food chain where they can accumulate internally. The good news is that they are short-lived as they have a half life of only 30 years.

Some of the U-238 will absorb neutrons and **move up** the periodic table, forming the "transuranic elements" making up 1 percent of the spent rod. Plutonium is the most common. Along with the U-235 remaining, the plutonium and similar isotopes are enriched back up to 3.3 % to make what is called "mixed oxide fuels" or MOX to be burned as more fuel for the reactors.

"Plutonium" is one of those shiver words. The Hiroshima bomb was enriched uranium. The Nagasaki bomb and most weapons manufactured since then are made from a certain plutonium isotope. What is **not** commonly recognized is that the plutonium in spent fuel rods is not "bomb-grade material." Only P-239 and P-241, two of four or five isotopes, has the right fissionable qualities to make nuclear weapons. The other plutonium isotopes in spent rods "pollute" the P-239 and P-241 making it "fizzle" instead of "fissile." Purifying <u>commercial</u> reactor plutonium to bomb grade doesn't work. The British, the Russians, and the French have all tried and failed. Bomb grade plutonium is made in either a heavy water reactors or a reactor with a graphite moderator. The latter is what the Soviets were doing at Chernobyl when things went awry. Graphite is also how North Korea built its crude homemade weapon. If all this had been clearly spelled out in 1976, we probably would have understood that plutonium from our commercial reactors cannot reasonably be made into nuclear bombs. Our "noble" abstinence from recycling could have been forestalled and we would have no "nuclear waste" problem today. When asked if the U.S. created this nuclear waste problem in the minds of our people based upon a false premise, Pierre Guelfe, chief engineer of France's reprocessing facility, gave a little Gallic shrug and smiled responding, "That's right."

Fortunately, the mixture of P-239 thru P-242 that comes out of our reactors is good for one thing—running nuclear reactors. When combined at a small ratio of reactor plutonium with mostly U-238, as mixed oxide fuel, MOX, it can be plugged into existing reactors. Thirty reactors in France, Belgium, Switzerland, and Germany are using MOX and twenty more have been licensed to do so. Japan targets 35% MOX by 2010 and has licensed one reactor at 100% MOX fuel rather than the typical 30-50 %. I have not found anyone more sensitive to constructive discussions of nuclear energy than my Japanese friends, and sensitive with good reason, nor anyone more reactionary than some of my American acquaintances expressing reasons that are technically incomprehensible.

After the collapse of the Soviet Union, Pete Domenici and Sam Nunn negotiated a remarkable deal with the Russians whereby we buy enriched uranium and plutonium from their stockpile of weapons to fuel American power plants. *One out of every ten light bulbs here is now lit by a former Soviet weapon.* (That cute phrase comes from twenty percent of our electricity is nuclear and half our fuel is from recycled missiles.) If ever the world has beaten swords into plowshares, this is it. We had to ask France to convert that Russian material for us because we can't do it for ourselves—remember President Carter and no reprocessing.

The remaining 1.7 percent of the spent fuel rods are "minor actinides" with funny names like americium, neptunium, californium, curium, einsteinium, and fermium—all of which are above uranium on the periodic table. They may have been present at the birth of the solar system but have long since disappeared due to their short lives. Some take about 1000 years to reach background levels but some have a half-life of merely hours. Those short-lived ones are used mainly in medicine. But we haven't yet figured out how to get them out of the spent rods as the rods have to go into a cooling bath for months before they can be reprocessed. By that time, those short-lived isotopes have lost their radioactivity.

America imports 90 % of our medical and industrial isotopes from Canada's Chalk River special reactor due to the noisy opposition to dong our own recycling. A side note from one of my Texas experts, when the Chalk River truck comes through the border, all kinds of lights, sirens, and alerts go off due to the variety of radioactive isotopes onboard. A rescheduling to 2 a.m. was necessary to control the excitement. A further aside, our detectors don't just identify radioactivity, they nail the exact element and even the isotope of that element. It is really rather amazing equipment and it is everywhere at border crossings and especially shipping centers checking containers. I'll put a copy of the hand held version's detection sheet among some things in the lobby for you to peruse. Chalk River had to be shut down temporarily and unexpectedly for maintenance this Spring sending the U.S. into a panic of acquiring the needed isotopes from elsewhere in the world to keep our nuclear treatments and equipment going. In the mid 1990's, a proposal was made to build our own little special highly efficient reactor specifically to reprocess for our medical needs. The administration said no—no reprocessing. Our nuclear medicine is a massive industry that treats a whole host of illnesses more than 40,000 times per day and saves tens of thousands of lives each year. Aside from antibiotics, it is probably the greatest medical advance of the twentieth century. Glenn Seaborg, who won the Nobel Prize for discovering plutonium, always considered his discovery of now medically preferred technium-99 to be his greatest accomplishment. You may not recognize many procedures and equipment as being "nuclear" due to the American public's odd nervousness over those "nuclear" and "radiation" words. MRI's were originally called nuclear magnetic resonance imaging machines. Another example, non-radioactive boron-10 concentrates in brain tumors. The patient is then taken to a nuclear reactor to be exposed to neutrons. The boron absorbs neutrons and emits alpha particles, killing the tumor cells. When activists recently tried to close down Australia's nuclear reactors, the nation's doctors rose up in protest that it would ruin nuclear medicine. This stuff we call nuclear “waste” even helps clean coal plant exhaust by continually measuring incoming coal and adjusting the process.   Getting right down to the basics, isotope-driven instruments control toilet paper thickness and sewer pipe quality as well as inspecting the very pipes used in nuclear reactors.

When we think of nuclear materials waiting to be recycled, remember the ratio of energy density is 2 million to one compared to fossil fuels making the volume of material stunningly small. All the high-level by-products from fifty years of nuclear fission in this country could be assembled ten feet high on a single football field. The French store all the high-level wastes from 30 years of providing 75-80 percent of their electricity in one room in the seaside town of La Hague.

What is the ultimate safe storage of the really long term isoptopes? The ability of natural geologic barriers to isolate radioactive left-overs is demonstrated by the natural nuclear fission reactors at Oklo, Africa. These were self-starting nuclear reactions of many millions of years ago in an area that just happened to have the right density of uranium isotopes. During their long reaction period about 5.4 tonnes of fission products as well as 1.5 tonnes of plutonium together with other transuranic elements were generated in the uranium ore body. This plutonium and the other transuranics remained immobile through the present day, a span of almost 2 billion years.[12] This is quite remarkable in view of the fact that ground water had ready access to the deposits and they were not in a chemically inert form, such as the fused glass in which we embed our waste materials.

So, what's going on with Yucca Mountain? The EPA set an annual radiation requirement for the site that should not exceed 15 millirems/year for <u>10,000</u> years. Remember, average ambient all around us is 350 millirems/year with Denver nearly double that, frequent flyers and pilots even more. In general, rocky areas like New England have higher background radiation as well. Another natural example is NE Washington state where residents receive an average of 1700 millirems per year due to radon levels in the rock and soil. Certain populations of the earth receive as much as 10 times the average with evidence of <u>improved</u> health and longevity. At 15 millirems/ year, the activists still complained.

I don't intend to pick on Greenpeace but only use it as an example. Greenpeace has done wonderful work in many environmental areas and deserves high praise. Protection of whales is only one. However, Greenpeace is also known for having "stretched" the truth to the point that some of the more conscientious of their leadership have actually quit the organization based upon disgust over integrity issues. They lack an accountability / responsibility system, no checks and balances. Greenpeace takes the position that any radiation exposure is bad, simple as that. U.S. regulatory agencies yielded to that pressure. The anti-nuclear folks got the D.C. Court of Appeals to agree to a million years for Yucca Mountain so the EPA set 350 millerems/year for a million years. After only 1,000 years, the materials from which the plutonium has been turned into MOX and burned will have fallen below the original uranium ore. Why a million? That's how long it will take every radioactive isotope to disintegrate to zero radioactivity, below that certain brand of kitty litter. Some nuclear opponents say that's still not good enough and are eyeing your shovel full of dirt. Let's try for a rational understanding of the word "radiation."

Some lab and field studies indicate mild increases in radiation above background levels is beneficial to health and longevity. T.D. Luckey, University of Missouri, 35 years of data on early atomic bomb workers and blast observers provides 13 million person-years of experience with low-dose radiation shows conclusively that low doses of ionizing radiation reduces premature cancer mortality to only 65 per cent that of unexposed controls. A seven-year Johns Hopkins study compared 28,000 nuclear shipyard workers continually exposed to gamma radiation from cobalt-60, the steel-reinforcing isotope, and worked close to nuclear reactors vs. 32,500 who had not. Cancer rates were significantly lower among the nuclear workers and death rates from all causes were 24 percent below their non-exposed cohorts. One of the Johns Hopkins authors wrote, "radiation stimulates the immune system…as a study to find radiation risks, (this one) was an abysmal failure. If our study's aim had been to look for health benefits of ionizing radiation, it would have been a huge success."   Not so remarkably, this data supports what lab animal testing had implied for years that extra radiation in low doses is beneficial.

Natural occurrences don't support Greenpeace's position either: Yangjiang, China—triple the U.S. national average from thorium in the nearby mountains with a population enjoying exceptional health. Guarapari, Brazil--sixty times the U.S. average from natural sources where people bury themselves in the “hot” beach sand supposedly for their health. Ramsar, Iran—85 times the average from the natural surroundings and mineral springs with no increased incidence of cancer or other abnormalities in the local population. Bernard Cohen compared radon levels, county by county, throughout the U.S. vs a million lung cancer deaths and 20 million deaths from other causes. The highest radon counties have lung cancer rates 30 percent below the lowest radon counties.

The anxieties and tremendous construction expenditures to achieve zero radiation seem emotionally driven, lacking scientific support. Radiation exposure actually increases when one steps outside a U.S. nuclear facility into our normal surrounds.

Transport is also not a technical issue as it moves in special containers: Europe--70,000 metric tons through densely populated areas; U.S.--1.6 million miles including 8 traffic accidents; U.S. Navy--790 containers over a million miles since 1957, all with a perfect safety record. Yet that perfect safety record was eclipsed when Greenpeace toured the Yucca Mountain region with a van proclaiming the incoming shipments would be a “Mobile Chernobyl.” Catchy phrases make the news but don’t enlighten.   A retired Nevada science teacher, a Japanese prison camp survivor, says, “I went to a couple public hearings and it was impossible to talk rationally. Every time I tried to speak (to the science), people there shouted me down.” Yucca Mountain workers say the press has people scared to death.

A final and persistent fear of nuclear energy is based upon a vision of a terrorist attack crashing a plane into a nuclear reactor. The Air Force has run that test. A thin aluminum tube makes a very poor battering ram against a concrete and steel containment structure. If the 9/11 hijackers had tried to take out Indian Point nuclear plant in New York, it would have been a blessing. The results would have been a spectacular plane crash and nothing else.

What happened that the American public missed getting a good sense of the technical side of utilizing this Gaia energy? Social scientists point to a transition period at the time of the nuclear test ban treaty. Activist organizations that contributed much to communicating public concern regarding nuclear warfare found themselves having accomplished their goals, experienced a precipitous drop in funding, but were still riding a wave of passion not fully spent. Many applied their accomplishments of having made into nightmare words “nuclear” and “radiation” at a new target, nuclear power generation, possibly not understanding the differences explained above. Their well-honed sensational attention grabbing tactics kept the media in partnership as activists laid on railroad tracks in Southern California, blocked construction access in my neighboring Midland, Michigan construction project subsequently canceled, and otherwise harassed many other nuclear power generation sites around the country. The activists grabbed the spotlight at the Three Mile Island industrial accident submerging the fact that no one was hurt and containment functioned as intended. Concurrently, the scientifically impossible movie, “China Syndrome,” spurred the imagination, fed the fear mongers, inspiring the politicians to action. The activist’s skepticism against the technical community and the failure of that community to effectively tap the media to help share their rational knowledge resulted in a virtual shut down of progress in providing nuclear energy to America. We live with the residual mythologies and the consequences of that time in our history. We have lost the technological lead. France's Areva nuclear company is finally and quietly moving toward building us a reprocessing plant in South Carolina, proposing two new reactors at Calvert Cliffs, and a uranium enrichment facility at Idaho Falls.

The question will be for us to decide. Just as the Finns spent two years in national debate before deciding to go ahead with their Olkiluoto 3 Nuclear Plant to be on line in 2012 and subsequently, on February 12, 2008, submitted an application to build Olkiluoto 4, so are we becoming engaged in an almost identical discussion of our opportunity in terrestrial energy. And where do we UUs best fit as we promote respect for the interdependent web of existence by encouraging steps to reduce our human footprint and decrease our level of pollution of that interdependent web while building a better world for all?

That's a very important question because the real battle in the U.S. regarding nuclear power will be fought in the court of public opinion where knowledge does not necessarily trump mythology.

We can go to our polylog or, if you wish, I can share in less than two minutes a little more about France and what the challenges in the U.S. might look like if we proceed toward more nuclear power.

end

More information:

The French and Europe--

What do the French think? Tucker writes: "They acknowledge Americans have great power but believe we don't know what to do with it while the French have almost no power but know exactly what to do with it. In the case of nuclear energy, they have turned out to be right." When Tucker toured France's nuclear infrastructure, including their reprocessing and storage facilities, the people expressed no particular smugness saying "We're just putting into practice what you invented."

Briefly, here's what nuclear power has done for France. It provides 80 percent of the country's electricity at the lowest rates in Europe. It gives France the second lowest level of carbon emissions in Europe, behind only Sweden, which is half nuclear and half hydro. It provides France its third largest export, electricity, behind only wine and agricultural products. It allows Germany and Denmark to posture to their anti-nuclear activists but, on the side, quietly abandoned their vow to shut down their own reactors and are importing nuclear electricity from France. Italy, much less skilled at this hypocrisy, actually closed down its three reactors leaving the country with frequent blackouts. Italy now imports 70 percent of its electricity and horrified all of Europe in the spring of 2008 by announcing its intent to build several new **coal** plants. When Italy switched that decision to nuclear reactors two month later, Giuseppe Onufrio, Director of Greenpeace Italy, called it a "declaration of war."

Terrorist Threat Supplement:

In the 1990's, the Air Force attached a Phantom F4 jet to a railroad track and rammed it into a concrete barrier the thickness of a containment structure at 500 miles per hour. The jet completely vaporized while the concrete wall was barely dented. If you would want to construct a battering ram, the last thing you would use is an aluminum tube. To successfully aim to hit a nuclear plant, a passenger jet would be traveling more like 200 mph. Burning jet fuel dispersed around a containment building would come nowhere near the melting point of concrete as the heat would dissipate in a few seconds. Even then, the containment building is only the first barrier. The solid steel reactor vessel would be equally impregnable. "Well, they could aim at the spent fuel pool." True, but that would be like trying to land a jet liner in a backyard swimming pool. Besides, most storage pools are inside the containment structure anyway. Even then, the fuel would only be exposed, not burn. Remember, the Chernobyl fire burned only because it used a carbon moderator which is highly combustible.

Expectations:

The real battle will be fought in the court of public opinion. Will the public think a nuclear power plant is a bomb waiting to go off? Will it accept the scenario that a terrorist with a carving knife can set off a nuclear holocaust? Will it believe that every picocurie of radiation found in the vicinity of a nuclear reactor is the harbinger of a cancer epidemic? Will it recognize that because of its incredible energy density, the environmental footprint of this terrestrial energy is infinitely smaller than the oceans of waste products produced by fossil fuels or the vast amounts of land that must be employed to gather solar energy by either collectors or windmills?

Business Risk:

The one thing holding back investment in new nuclear facilities is the nightmare scenario that as soon as one of these new plant proposals comes out of the starting gate, it will be immediately gang-tackled by U.S. environmental organizations and nuclear opponents who will tie it up in court and regulatory proceedings for the next fifteen years. The threat of endless regulatory and legal delay is no small matter. The Sierra Club, Natural Resources Defense Council, and Environmental Defense are all lavishly funded and stocked with powerful legal staffs that can easily wage a war of attrition against any new energy proposals. Greenpeace International has a $150 million annual budget and has influence all over the world (the World Trade Organization's budget is only $100 million). Sometimes we get confused over what financial power we should really fear. To counter this attack on our emission-free future, the American public needs more knowledge about nuclear power, not just sound bites like "mobile Chernobyl."