Commentary

What's Holding Back A Nuclear Renaissance?

by Jim Muckerheide

Mr. Muckerheide is the State Nuclear Engineer for the Commonwealth of Massachusetts, and a founder and President of Radiation, Science, and Health, an international organization of independent scientists and policy experts knowledgeable about low-level radiation health effects. He is also Director of the Center for Nuclear Technology and Society at Worcester Polytechnic Institute in Massachusetts.

This article is adapted from a commentary the author circulated in response to comments by Sen. Max Baucus (D-Mont.) on the need to include support for nuclear power in the current energy bill.

In a letter to constituents in August 2003, Sen. Max Baucus supported his vote to eliminate the Federal loan guarantees to the nuclear industry from the Energy Bill, claiming that nuclear power is "a mature industry" that did not need or deserve "government subsidies." At the same time, Senator Baucus acknowledged that the industry has no relevant experience on which to base costs.

We will answer Senator Baucus's allegations point-by-point, shortly. But first, let's frame the question as it should be framed: Nuclear power is needed to meet the essential energy and economic realities facing the United States and the world, which will have a population of about 9 billion people by mid-century, with growing aspirations and energy demands in the developing world. The major U.S. corporate and financial institutions must be recruited to lead the effort to construct the cost-effective nuclear power plants that the United States, and the world, need to provide for the future that our grandchildren will inherit. This mission is essential to avoid the potential international conflict and wars over oil supplies, economic strangulation, and environmental degradation.

How do we accomplish that? Senator Baucus's arguments amount to excuses and failure to tackle the real issue. A response to the arguments in his letter can help us to see what needs to be done and how we can do it.

The Most Efficient Energy Source

Argument One: "Too Expensive, Not Competitive."

Senator Baucus referred to the failed effort of the WPPSS [the Washington Public Power Supply System in Washington state], and said it showed that "the nuclear industry" piled "cost overrun on top of cost overrun." He said that "in the past, construction costs for many existing nuclear power plants have totalled substantially above the levels that would have made them competitive with coal and natural gas fired plants."

The truth is that even the older generations of nuclear plants produce back *all* of the energy that was used to build them in less than two years. By mass, uranium fuel has 30,000 times the energy in coal. The High Temperature Gas Reactor will improve this energy efficiency by about 50%. And there is even greater potential in the "Advanced High Temperature Reactor," which proposes to use the ceramic fuel and helium turbines of the gas reactor, with a liquid [salt] primary circuit, to reduce reactor/vessel sizes—using current materials and technology.

Senator Baucus fails to recognize that the costs of electricity from coal, oil, and gas power plants were substantially reduced, because of the competition from the 100 nuclear power plants that were being built in the 1960s and 1970s; and that the low costs of power from those nuclear plants today—providing 20% of U.S. electricity—are a major constraint on the cost of electricity from fossil fuels.

Further, Senator Baucus's claim that there would be large government subsidies is also wrong. Loan guarantees are not subsidies, except as an insurance premium. But that insurance premium is being taken out against the risk (real or perceived) of a significant possibility that the government will fail to be responsible, that politics would intervene to fail to allow approved designs to be built on approved sites in a timely fashion. Price-Anderson insurance is, similarly, a trivial actual subsidy.

Argument Two: "It's a 'mature industry' that doesn't need government help."

Senator Baucus argues that the industry does not produce accurate cost estimates, and on the other hand that it is a "mature industry," that doesn't need government help. You can't have it both ways. Even if his statements about the lack of a basis to produce accurate cost estimates were valid, such factors would be the very hallmark of an immature industry. A "mature industry" is substantially defined by its ability to produce its product with firm costs and schedules.

We are not defending the nuclear industry's behavior. It is short-sighted and self-serving in many ways. But that does not argue for the industry's "maturity." The nuclear industry itself is continually telling the Congress that it has no confidence in its ability to build nuclear power plants on a fixed budget and schedule. The very basis of the industry's nuclear power campaign is to get government handouts, in order to justify "testing the licensing process," and to build "first-of-a-kind" nuclear power plants.

Senator Baucus's comparisons with U.S. cost/schedule experience are not valid, because that's long-past experience

Muckerheide answers the arguments of Sen. Max Baucus, left, who, among other Senators, sought to knock loan guarantees for the nuclear industry's revival, out of the Energy Legislation now before Congress.

with one-of-a-kind plants. It does not reflect the recent, successful experience of building the two-unit 1,356 megawatt-electric General Electric Advanced Boiling Water Reactors (ABWRs) in Japan. These reactors became operational in 1996 and 1997 in just 51 months—with future plants projected to be built in less than 48 months, with firm costs.

The United States has not started construction on a new nuclear plant for 25 years! And it was often incompetent when it did—with WPPSS only being the worst. But there were some significant exceptions, proving that competence counts. A few utilities succeeded dramatically in achieving cost-effective construction: Duke Power under Bill Lee, which built the Catawba and McGuire reactors; and Florida Power and Light which built the St. Lucie plant, under leadership of Marshall McDonald, who was brought in from the oil industry, where he was building offshore oil platforms. And this was even while weathering the Nuclear Regulatory Commission-led plethora of design change requirements in the wake of the accident at the Three Mile Island plant in Pennsylvania. This so-called lessons-learned" engineering produced out-of-control costs and schedules in most of the industry, in a period when interest rates were at their highest.

But even though nuclear is not a "mature" industry, the actual cost of subsidies to build new nuclear power plants is very small, compared to what is given to the so-called "alternative energy sources," and even to the handouts which the oil, gas, and coal giants receive. For example, the Federal government takes out 1.7¢ per kilowatt hour from your utility bill, and gives it to the people who are building/operating windmills—even though in most cases a windmill won't produce enough energy *in its entire lifetime* to build another windmill. Billions more dollars are channeled to subsidize methanol production.

Beyond the relatively minor significance of the experience of operating existing plants, the only thing "mature" about the nuclear industry could be claimed to be a substantial political presence; but again, the industry is generally and regularly beaten by the wind industry and renewables, not to mention the oil, gas, and coal industries that have, and use, real political clout in their own self interest to aggressively promote their own industries. (For example, the gas industry's self-promotion as "the clean energy.")

The Nuclear Energy Institute (NEI, the nuclear industry lobbying group) has been unable to develop the ability to articulate the clear advantages of nuclear power, and it is seen from all quarters to simply be looking for government handouts, without even being able to articulate the necessity and public advantages of supporting the development of nuclear power, and developing a mature nuclear power industry! The nuclear industry misrepresents its own technology as being unduly hazardous because that produces billions of dollars in funds (and profits) from taxpayers and ratepayers and insurance companies for the industry. By going along with the myth that radiation is dangerous at any level, the industry then gets government contracts to clean up old nuclear production sites, and to treat and dispose of radioactive wastes—to levels of radioactivity that are far below naturally occurring radioactivity.

NEI appropriately reflects the timid and immature nature of the industry it represents, and the profits which public fears produce. Even if the nuclear industry could be considered "mature," in any sense of the technology, clearly the current industry leaders are mostly timid people who must maximize current profits while shunning all risks. Such "leaders" cannot be expected to propose to build anything without hand-holding and direction from Washington.

We have also to recognize that there is now no established regulatory capability in place, which is a further hallmark of an immature industry.

What Needs To Be Done?

What could be done to take the current weak nuclear industry—and no leadership from government—and turn it around? Some of the steps include improving the current certified plant designs to be more cost-effective; implementing new generation plants, especially gas-cooled reactors based on the inherently safe 40-year-old ceramic fuels; and establishing a government-led effort to engage the major energy-using and producing industries to create the economic framework to devrelop the nuclear power plants, and other energy facilities, required to meet the economic and environmental needs of te public.

• **Certified plant designs.** We now have the experience to improve existing certified plant designs and develop new certified plant designs, to be built on pre-approved licensed sites. This could be done even now, despite the enormous unnecessary costs and delays that have been undertaken to certify current plant designs. (It is indicative of the immaturity of the industry that it takes more than a year to file for approval for an existing site; that is, a site that already has an operating nuclear power plant; and then a year for NRC review). Even

the current certified plant designs should contribute to our confidence that we can produce accurate nuclear power plant cost/schedule estimates; for example, the recent successful construction experience of the two General Electric certified Advanced Boiling Water Reactors (ABWRs) in Japan, which is now being repeated in Taiwan.

However, although there was substantial emphasis on optimizing constructibility, the design effort for the ALWRs (Advanced Light Water Reactors) did not address the unnecessarily high costs of the Light Water Reactor (LWR) designs. The design bases of these plants still implement the early plant design basis concepts that reflect great science and engineering uncertainties. They do not substantially factor in experience and knowledge that has been developed since.

• **New Generation Reactors.** Inherently safe ceramic-fueled reactors, such as the General Atomics Gas-Turbine Modular Helium Reactor (GT-MHR) and the South African utility Eskom's Pebble Bed Modular Reactor (PBMR),can now be produced. These reactors can operate at higher temperature, more efficiently, and the ceramic-coated fuel pellets provide their own containment, obviating the need for large containment structures. They can be build modularly. There is also a new Canadian design, the CANDU ACR 700.

But there are significant political-economic interests blocking more cost-effective nuclear power plant designs—not the least of which are coal and gas interests, including the railroads transporting the coal. And the nuclear industry itself will work against more cost-effective nuclear power plant designs in a misbegotten effort to defend its current Advanced Light Water Reactor designs.

These political constraints will work against the interest expressed by nuclear utilities Entergy and Exelon in considering the gas-reactor technology, in order to provide pressure to bring down the cost of nuclear power plants. However, while the design effort in Japan has produced estimates of building the next ABWRs at $1,200-1,300 per kilowatt, the estimates that have surfaced with the proposition that the taxpayer would subsidize nuclear power in the energy bill, have returned to the high cost estimates of $2,000 per kilowatt.

The State of the Nuclear Industry

Consider that the current "nuclear industry" is primarily a very small group (and getting smaller) of people that have mostly spent the last 20 years getting to just being able to operate existing power plants competently. With many other factors, it is clear that Senator Baucus' claim that nuclear power is a "mature industry" is not true. Of course, we could assume that, like Taiwan, the United States would have the good sense to hire the Japanese to build the ABWR in the United States. But unless we make that a matter of national policy and include the Japanese industry in our plans and commitments to build the ABWRs, it does not substantially affect the political equation that shows the industry to be immature and unprepared to take the leadership role in implementing nuclear power in the United States.

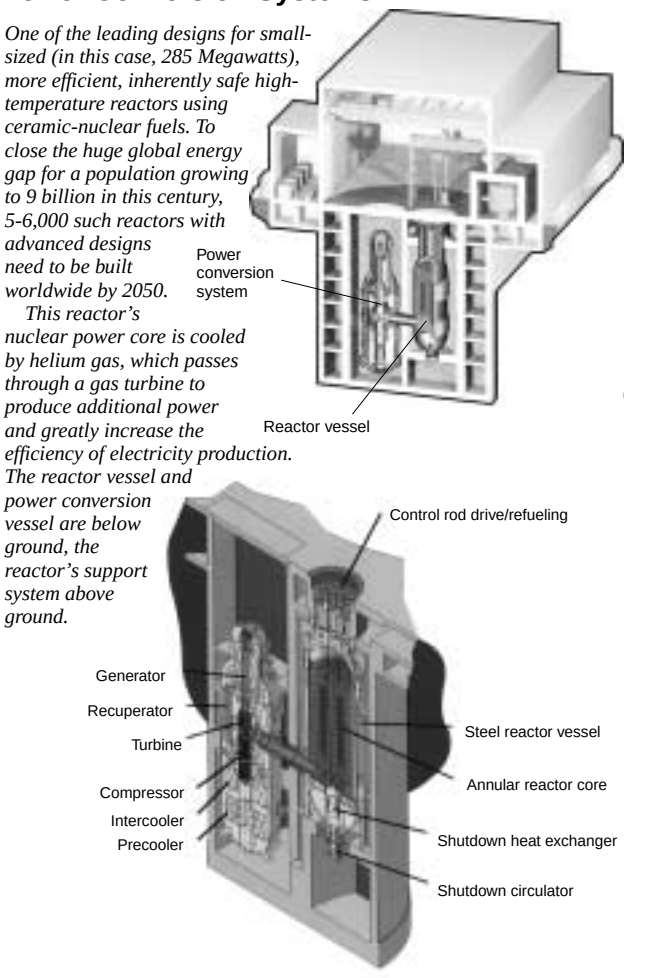
At the same time, we have to fear that Congress would give a substantive role to the Department of Energy (DOE), which no longer has the nuclear expertise, or the nuclear will, that characterized the Atomic Energy Commission that had the expertise and long-term mission to develop nuclear power!

Unfortunately, the industry is sufficiently naïve to accept such a proposition. After all, the industry pushed Congress to make DOE responsible for spent fuel disposal. Some in the industry were unable to understand that such a proposition would likely be fatal to the future development of nuclear power; but others simply recognized that such future development was not their interest. These nuclear power plant operators do not have a substantial interest in building new nuclear power plants, or in meeting U.S. and world energy needs.

Cutaway View of the GT-MHR Reactor and Power Conversion Systems

One of the leading designs for small-sized (in this case, 285 Megawatts), more efficient, inherently safe high-temperature reactors using ceramic-nuclear fuels. To close the huge global energy gap for a population growing to 9 billion in this century, 5-6,000 such reactors with advanced designs need to be built worldwide by 2050.

This reactor's nuclear power core is cooled by helium gas, which passes through a gas turbine to produce additional power and greatly increase the efficiency of electricity production. The reactor vessel and power conversion vessel are below ground, the reactor's support system above ground.



Source: General Atomic

Such decisions are left to policy-makers, with the presumption that if and when any such national leaders were to promote nuclear power, the industry would then also get the support and subsidies that would construct high-cost, more profitable, nuclear power plants. They do not perceive the need to make a national commitment to produce a series of large-scale nuclear power plants, and then to mass-produce modular [smaller] nuclear power plants.

In addition, the nuclear power plant vendors, General Electric and Westinghouse, are shadows of their former selves. They primarily focus their lobbyists on looking for handouts from Congress. They are "cleaning up" with unnecessary billions of dollars being allocated every year to decontaminate, decommission, and remediate old government sites and nuclear power plants, and to undertake extreme, unnecessary, and highly profitable "radioactive waste management" programs. This includes the misrespresention of radiation as hazardous down to zero doses. (See, for example, the author's article, "It's time to Tell the Truth About the Health Benefits of Low Level Radiation," *21st Century Science & Technology*, Summer 2000.)

Therefore, Senator Baucus and the Congress are leaving the energy security of the nation in the hands of people who cannot implement this essential contribution to the U.S. and world economic and environmental sustainability. But, of course, we no longer have the technology expertise in government, as in the former Atomic Energy Commission (AEC), that actually developed nuclear power. So, in order for Senator Baucus and others to be responsible, the real question they need to address is the issue of how to create a responsible public policy that gets nuclear power built, but is not just Washington-directed hand-holding and/or a "government handout" to what they perceive is an industry, of plant operators with no construction experience, that is just looking for handouts.

In addition, the cost and political fallout on spent fuel storage and radioactive waste disposal is a product of an immature industry that has allowed, and even been complicit in, creating unnecessary political confrontations over issues that could have and should have been shown to be, and managed as, trivial factors, with no urgency for resolution. Unfortunately, the short-term outlook of an immature industry, combined with the enormous financial incentives to "manage" and dispose of spent fuel, has overcome any interests in providing a sound long-term public policy, and has even overcome the financial interests of the corporations themselves, much less the public, to provide cost-effective nuclear power plants as the essential energy source required to meet the needs of the 21st Century economy.

The Real Risk

We are at risk of impoverishing the developed countries, when current resources should have been geared to building the equivalent of 5,000-6,000 nuclear power plants by mid-21st Century, to meet the needs for economic prosperity of a world with 9-10 billion people in 2050. Instead of fighting to sell and build one power plant at a time, the industry should be planning to produce hundreds of plants per year within the next 30 years.

I would also note that Senator Baucus's response is especially disappointing because I would have considered him to be above the kind of disingenuous political rhetoric of his letter to constituents, that does not consider our actual energy supply and demand conditions at the beginning of the 21st Century, and the implications for the economic and environmental health, of the nation and the world.

The solution to the current impasse on energy is to have government leadership engage the economic, financial, and technology institutions with representatives of the energy-consuming industries. The charter would be to establish the economic framework in which to develop advanced technology; establish accurate costs and controls to site and construct nuclear power plants; and recommend initiatives in which industry and investor incentives are structured to assure that the U.S. and world economies obtain adequate supplies of energy to displace reliance on, and conflicts over, fossil fuel supplies and environmental costs, at the sufficiently low costs to maintain the international economy, support the developing world, and recover public (taxpayer and ratepayer) investments.