The Infrastructure Road to Recovery

Go Nuclear!

Super-Safe Nuclear Power: the Meltdown-Proof Pebble Bed Reactor

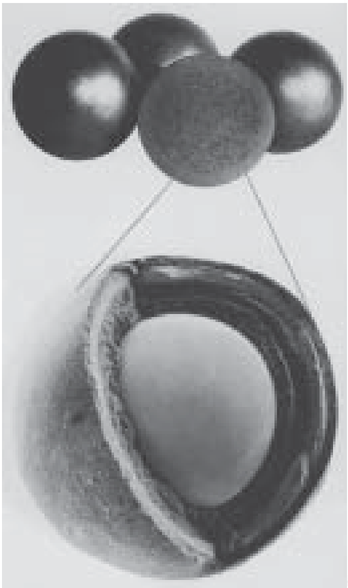
This diagram, a cutaway of Fig. 1 (p. 30), illustrates the breathtakingly simple function of a Pebble Bed Modular Reactor (PBMR), as designed by South Africa's Eskom company. The steel pressure reactor vessel of the PBMR is six metres in diameter and 20 metres high, inside a building that is 21 metres below ground. The walls of the reactor vessel are lined with one- metre thick graphite bricks. Inside the reactor vessel are 310,000 fuel "pebbles" which are the size of tennis balls, plus 130,000 graphite balls, which moderate the reaction. The fuel pebbles contain uranium, which releases the neutrons that cause fissioning in other uranium, thereby releasing even more neutrons that expand the process in what is known as a *chain reaction,* while the moderator pebbles slow the neutrons down enough to ensure a *controlled* chain reaction.

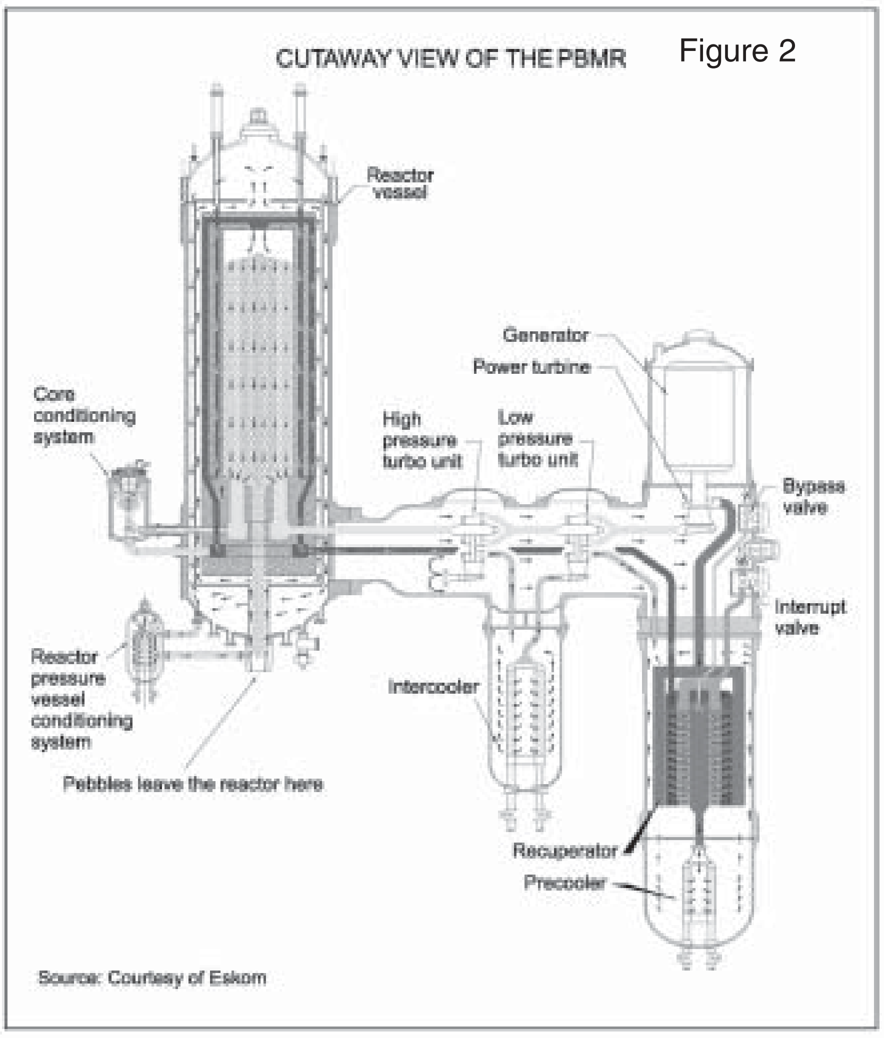
The fuel pebbles consist of about 15,000 tiny particles of uranium oxide, each coated with layers of ceramics and silicon carbide, forming an impenetrable barrier which contains the fuel. These particles are then mixed with graphite and moulded into pebbles. These pebbles can operate even at very high temperatures of nearly 900ºC, and in fact can withstand temperatures at which normal fuel rods in conventional reactors would fail. A further safety aspect of these pebbles is that the radioactive fission products of the spent fuel are locked inside the fuel particles, thanks to their silicon carbide coating. Therefore, even in the worst conceivable emergency, the radiation is safely contained, and after use, the pebbles can be safely stored, very cheaply.

To produce electricity in a PBMR, helium gas at 500ºC is inserted at the top of the reactor, and passes among the fissioning fuel pebbles, leaving the reactor core at 900ºC. From there it passes through three turbines, the first two driving compressors, and the third the generator. There the natural thermal expansion of the helium is transformed into the rotational motion to generate electricity. The expanded helium is then recycled into the reactor core by two turbocompressors. The helium leaves the recuperator at about 140ºC, and its temperature is lowered further to about 30ºC in a water-cooled pre-cooler. The helium is then repressurised, and moves back to the heat exchanger to pick up heat before going back to the reactor core. This direct cycle helium turbine simplifies the normal reactor operations, and makes many standard aspects of conventional reactors unnecessary. The outlet temperature of 900ºC is also far higher than the 280º–330º of conventional reactors, and gives this type of reactor its name: high temperature reactor.

The inherent and passive safety systems of the PBMR make it "meltdown proof". In any imaginable accident scenario, the reactor shuts itself down, without any additional safety systems. Further, there is a self-stabilising temperature effect in the reactor core: if the temperature rises, it slows down the neutron production that is central to the chain reaction fissioning process, and fission decreases, because of the large amount of unfissionable uranium-238 in the fuel particles which capture the neutrons.

How the PBMR works. A cutaway of the PBMR, right, and below, the interior of the fuel pebbles that contain the nuclear reaction and by-products, and make PBMRs "meltdown proof".





Hot Air Over Wind Energy

by Greg Murphy (Reprinted from the Fall 2001 21st Century Science and Technology *magazine.)*

In the Midwest and other parts of the country, near-bankrupt farmers are being sold a bill of goods by the Department of Energy about how they should rent (or lease) their land to be used as "wind farms," where "high tech" windmill turbines will allegedly make them money by selling electricity to the power grid. In fact, the only way wind power can make money, is with huge government subsidies, tax breaks, and phoney accounting.

Here's what the wind-power windbags are doing, and why it won't work.

The push for "alternative energy sources" goes back to the post-John F. Kennedy paradigm shift, when the ruling elites decided to shift America from an agro-industrial economy to a post-industrial service society. The widescale promotion of anti-technology ecologism—and fears about the most efficient available energy source, nuclear power—were part of that game plan. This insanity mushroomed during Jimmy Carter's Administration, and has been getting worse ever since. To increase the use and development of wind energy and other renewable sources, the Clinton Administration modified its proposed Federal utility restructuring legislation, mandating an increase in the percentage of electricity produced by renewable sources from 2% today, to 7.5% by the year 2010. (Sen. James Jeffords (I-Vt.), has proposed to increase the percentage of electricity produced by wind to 20%.)

In 1999, Energy Secretary Bill Richardson, announced the Wind Powering America Initiative which set the goal of producing 80,000 megawatts of electricity from wind power by the year 2020.

To help make wind power more competitive, the Federal government provides a 1.5-cent per kilowatt-hour (kwh) Production Tax Credit for all electricity generated by new wind plants for the first 10 years of operation. This Production Tax Credit will expire on December 31, 2001, and the American Wind Energy Association is currently lobbying Congress to extend the tax credit for at least five more years.

Several states are pushing for legislation, known as Renewable Portfolio Standards (RPS), which mandates that a certain percentage of electrical power must come from so-called renewable sources, like wind power, and that these wind percentages increase year after year. Some of the states are giving tax incentives or rebates for the purchase of small wind turbines, as in the case of California, which currently offers a tax rebate of up to 50% of the purchase price of the wind turbine.

Phoney Cost Accounting

The truth that the wind energy windbags don't want to tell the public, is the real cost of production of wind power! They claim it is presently around three to six cents per kilowatt hour—not quite competitive with other sources, but in the ballpark. In truth, even with government subsidies, tax breaks, and phoney accounting, the cost is many times that.

In the 1980s, the cost of generating wind power was about 38 cents per kwh, according to the November 1998 Renewable Energy Policy Program report, titled "Expanding Wind Energy: Can Americans Afford It?" There have been improvements in efficiency of wind turbines, which have come out of materials and design research in the aerospace industry. However, this has been nowhere near enough to drop generation cost to the level being claimed. The three to six cents per kwh claimed by the industry for wind power is not a true cost, but an accounting fiction, called a *levelized* cost.

Technically, the levelized cost of energy, is the cost in current dollars of all fuel, capital, and operating and maintenance expenses during the lifetime of the power plant, divided by the estimated output in kilowatt-hours over the lifetime of the power plant. In the case of a wind farm, there is no cost for fuel, but the wind turbine is dependent on nature to provide the necessary wind. The problem with considering the levelized cost in the case of wind energy is that this cost is figured on the assumption of a *constant maximium* wind for a given area.

Great swathes of land are tied up in the grossly inefficient production of electricity, using windmills.
Photo: AFP/lee Celano/ljc

In other words, levelized cost assumes a constant wind, every day for 20 to 30 years! There is no place on the Earth that the wind blows at a constant maximum average speed all the time.

Further, these calculations are dishonest about the maintenance cost, keeping them unrealistically low. They figure for a wind farm, which might consist of 100 to 250 windmills, a maintenance crew of three men and a truck. They also assume a yearly repair cost at a ridiculously low total of about $750 a year.

In reality, wind turbines have considerable down time for repairs and cleaning. One recent study found that flying insects—such as bees, locusts, gnats, and butterflies—cut the efficiency of turbines by as much as 25%. Thousands of insects fly into the turbine blades and die, forming a ragged crust on the blades leading edge. Even a millimetre of this crust generates drag that can ruin the turbine's efficiency.

Another consideration is the power transmission cost. Even if, after the 1.5 cents Federal subsidy, windmills could sell electricity at six cents per kwh, the power still has to move along the transmission grid to the consumer. Because wind power is an intermittent power source, rates for access to the transmission grid are higher. To counter this, the American Wind Energy Association is lobbying for what they call "fair access" to the transmission grid.

Windmill power will never be competitive with more modern forms of energy production. For one thing, the same improvements in technology that might make the wind turbine more efficient would also improve the efficiency of turbines turned by coal, oil, gas, and nuclear. But, even if technological improvement could miraculously make the cost of wind power competitive with modern forms such as nuclear, would we want it?

Wind Fails Energy Density Test

The fact is that there is a more important factor than cost-in-the-small to be considered in evaluating an energy source. If you look at the overall demands for electrical energy and industrial process heat in a growing industrial economy, wind energy could never begin to provide even a tiny percentage of what is needed. First, you must look at the concentration of energy per area of work, which is shown as kwh per square kilometre. Next, you look at what levels of energy flux density will foster the increase of the population density. The energy density of wind is intrinsically too low to maintain the population at current levels, and will lead to population decrease over time—which is exactly what the Malthusian environmentalist movement wants to accomplish.

In order for all mankind to progress, we have to develop sources of energy with higher flux density and develop the technology that can make use of these sources.