Nuclear cannibals

March 4 2008

Nuclear energy production must increase by more than 10 percent each year from 2010 to 2050 to meet all future energy demands and replace fossil fuels, but this is an unsustainable prospect. According to a report published in Inderscience's International *Journal of Nuclear Governance, Economy and Ecology* such a large growth rate will require a major improvement in nuclear power efficiency otherwise each new power plant will simply cannibalize the energy produced by earlier nuclear power plants.

Physicist Joshua Pearce of Clarion University of Pennsylvania has attempted to balance the nuclear books and finds the bottom line simply does not add up. There are several problems that he says cannot be overcome if the nuclear power option is taken in preference to renewable energy sources.

For example, the energy input required from mining and processing uranium ore to its use in a power plant that costs huge amounts of energy to build and operate cannot be offset by power production in a high growth scenario. There are also growth limits set by the grade of uranium ore. "The limit of uranium ore grade to offset greenhouse gas emissions is significantly higher than the purely thermodynamic limit set by the energy payback time," he explains.

In addition, nuclear power produces a lot of heat as a byproduct and this directly heats the Earth. This is only a relatively small effect, but as energy consumption grows it must be taken into consideration when balancing the energy equation.

However, it is the whole-of-life cycle analysis that Pearce has investigated that shows nuclear power is far from the "emission-free panacea" claimed by many of its proponents. Each stage of the nuclear-fuel cycle including power plant construction, mining/milling uranium ores, fuel conversion, enrichment (or de-enrichment of nuclear weapons), fabrication, operation, decommissioning, and for short- and long-term waste disposal contribute to greenhouse gas emissions, he explains.

Nuclear may stack up against the rampant fossil-fuel combustion we see today, but only by a factor of 12. This means that if nuclear power were taken as the major option over the next forty years or so, we would be in no better a position in terms of emissions and reliance on a single major source of energy than we are today given the enormous growth nuclear required over that timescale.

Pearce's analysis is based on current practice in the United States with regard to the mining and enrichment of ore. He suggests that rather than abandoning nuclear power, efforts should be made to improve its efficiency considerably. First, we could start utilizing only the highest-concentration ores and switch to fuel enrichment based on gas centrifuge technology, which is much more energy-efficient than current gaseous diffusion methods.

Nuclear plants might be used as combined heat and power systems so the "waste" heat is used, rather than allowing them to vent huge quantities of heat to the environment at the end of the electricity generation cycle. Pearce also suggests that we could "down-blend" nuclear weapons stockpiles to produce nuclear power plant fuel.

Source: Inderscience Publishers