Fast Reactor Technology:
A Path to Long-Term Energy Sustainability

Position Statement
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The American Nuclear Society believes that the development and deployment of advanced nuclear reactors based on fast-neutron fission technology is important to the sustainability, reliability and security of the world's long-term energy supply. Of known, proven, energy technologies, only nuclear fission can provide the large quantities of energy required by industrial societies in a sustainable and environmentally acceptable manner.

Natural uranium mined from the earth's crust is composed primarily of two isotopes: 99.3% is U-238, and 0.7% is the fissile U-235. Nearly all current power reactors are of the "thermal neutron" design and their capability to extract the potential energy in the uranium fuel is limited to less than 1% of that available. The remainder of the potential energy is left unused in the spent fuel and in the uranium, depleted in U-235, that remains from the process of enriching the natural uranium in the isotope U-235 for use in thermal reactors. With known fast reactor technology, this un-utilized energy can be harvested, thereby extending by a hundred-fold the amount of energy extracted from the same amount of mined uranium.

Fast reactors can convert U-238 into fissile material at rates faster than it is consumed making it economically feasible to utilize ores with very low uranium concentrations and potentially even uranium found in the oceans[1,2,3]. A suitable technology has already been proven on a small scale[4]. Used fuel from thermal reactors and the depleted uranium from the enrichment process can be utilized in fast reactors and that energy alone would be sufficient to supply the nation's needs for several hundred years.

Fast reactors in conjunction with fuel recycling can diminish the cost and duration of storing and managing reactor waste with an offsetting increase in the fuel cycle cost due to reprocessing and fuel refabrication. Virtually all long-lived heavy elements are eliminated during fast reactor operation, leaving a small amount of fission product waste which requires assured isolation from the environment for less than 500 years.[4]

Although fast reactors do not eliminate the need for international proliferation safeguards, they make the task easier by segregating and consuming the plutonium as it is created. The use of on-site reprocessing makes illicit diversion from within the process highly impractical. The combination of fast reactors and reprocessing is a promising option for reasons of safety, resource utilization, and proliferation resistance.[5]

Reaping the full benefits of fast reactor technology will take a decade or more for a demonstration, followed by buildup of a fleet of operating power stations. For now and in the intermediate-term future, the looming short-term energy shortage must be met by building improved, proven, thermal-reactor power plants. To assure longer-term energy sustainability and security, the American Nuclear Society sees a need for cooperative international efforts with the goal of building a fast-reactor demonstration unit with on-site reprocessing of spent fuel.

References:

1. COHEN, B.L. "Breeder reactors: A renewable energy source." *American Journal of Physics*, **51**, 1, (Jan. 1983).

2. WEINBERG, A. "The Second Fifty Years of Nuclear Fission", Proc. Special Symposium: 50 Years of Nuclear Fission in Review, Ontario, June 5, 1989, Canadian Nuclear Society.

3. SEKO, N. "Aquaculture of Uranium in Seawater by a Fabric-Adsorbent Submerged System." *Nuclear Technology,* **144**, (Nov. 2003) pp 274-278.

4. "Some Physics of Uranium" (available on the Internet at <http://www.world-nuclear.org/education/phys.htm> (Dec. 2005).

5. HANNUM, W.H. "The Technology of the Integral Fast Reactor and its Associated Fuel Cycle," *Progress in Nuclear Energy*, **31**, 1, (1997).
