Letter to the Editor

Further Comments on Aqueous Fissile Solution Supercritical Experiments

Das notes in Ref. 1 that the peak power of supercritical aqueous fissile solution experiments is limited to some 6000 MW due to peak pressure limitations of the core vessel.

Much higher power levels may obviously be attained in vessels designed for higher pressures or in destructive tests that allow the core to blow apart into the surroundings, as BORAX-1 did in 1955 after reaching 19 000 MW (although this was not in an aqueous-type core).

Both types of experimental strategies entail high cost without any great scientific or practical value readily apparent. Such experiments would carry high value, however, if they were modified so as to attempt to demonstrate power pulse modification by continuous fuel solution injection during the supercritical burst.

Specifically, the goal would be to demonstrate arbitrary pulse half-width and peak power duration (i.e., an increase from milliseconds to seconds and minutes) by the rapid and constant addition of a fuel solution by a high-pressure pump through the bottom of the vessel to replace the fuel solution that is expanding and escaping out the open end. In effect, one would have an open-cycle, circulating fluid fuel reactor that achieves full operating power level in milliseconds.

If such operation could be demonstrated at relatively low power, this would provide confidence for extrapolating the concept to extremely high power levels, as may prove useful for high-performance interplanetary rocket propulsion. This implies power levels on the order of several hundred thousand megawatts. Core temperatures on the order of 30 000 to 80 000 K should be achievable before the ratio of neutrons produced to neutrons absorbed drops too far below 2.

Setups for experiments involving fuel solution and fission product dispersal may consist of an arrangement similar to the French one for testing beryllium fuel (chemical) rocket engines[2,a] to avoid environmental contamination. In some countries, high-power rocket experiments could be carried out in underground caverns, particularly those left over from certain nuclear bomb explosions. Eventually, tests in outer space could be carried out with little risk of atmospheric contamination (assuming a tangential thrust vector) because rocket exhaust velocity is many times gravitational escape velocity.

In the meantime, computational nuclear hydrodynamics analysis would be a great help.

REFERENCES

1. S. DAS, "Comment on 'Reactivity Feedback Mechanisms in Aqueous Fissile Solutions,'" *Nucl. Sci. Eng.*, **118**, 127 (1994).

2. A. DAVENAS, "History of the Development of Solid Rocket Propellant in France," *AIAA J. Propulsion Power*, **11**, *2*, 285 (Mar.-Apr. 1995).

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[a]See p. 290 of Ref. 2 for beryllium rocket tests.