LETTER TO THE EDITOR

COMMENTS ON THE USE OF WEAPONS-GRADE URANIUM IN POWER REACTORS

Recently, there have been reports in the international press and in trade journals that highly enriched uranium (HEU) currently in the possession of the erstwhile Soviet Union countries is likely to be sold for ultimate use in the current generation of light water reactors (LWRs). This letter is intended to point out that mixing HEU with natural uranium or depleted uranium is an absolute waste of the energy spent in increasing the ^{235}U content in the weapons-grade uranium to values of the order of 93%. Besides, based on the prevailing market rates per separative work unit (SWU) and for natural uranium, the cost of the low-enriched uranium (LEU) that is produced by mixing weapons-grade uranium with natural uranium or depleted uranium is much higher than the cost of uranium enriched to what is needed in LWR fuel, starting from natural uranium.

Assuming that gaseous diffusion plants consume ~2500 units of electricity per SWU, production of weapons-grade uranium results in the consumption of ~588 875 kW·h of electricity per kg of HEU. Blending it with natural uranium and producing 3% enriched uranium (LEU) that can be used in LWRs means an effective consumption of >14 600 units of electricity per kg of LEU. On the other hand, production of 3% enriched uranium starting from natural uranium requires only ~10 750 units of electricity per kg of LEU. Thus, blending weapons-grade uranium to produce LWR-grade LEU leads to ~35% more electricity consumption per kg of LEU. Even though the electricity consumed in the production of the blended LEU is only ~5% of the nearly 290 000 kW·h of electricity that a kilogram of LEU would generate in an LWR, the wastage of energy by blending HEU with natural uranium to produce LEU is of questionable merit, especially since the HEU can be put to better use, as indicated below.

As far as the economics goes, the current practice of the U.S. Department of Energy is to charge a substantially higher rate per SWU if the product contains >20% ^{235}U. Taking $500/SWU if the product has >20% ^{235}U and $150/SWU if the product assay is <20% ^{235}U, the cost of 3% enriched uranium works out to be a little more than $3000/kg if it is produced by mixing weapons-grade uranium with natural uranium, compared with $755/kg if the LEU is produced by enriching natural uranium.

The question arises as to how best to use the weapons-grade uranium that is already available. A detailed analysis has indicated that burning HEU mixed with thorium in a high-temperature gas-cooled graphite reactor (HTGR) using a once-through cycle has highly attractive fuel utilization characteristics, even compared with a pressurized heavy water reactor working on a once-through natural uranium fuel cycle, which is reputed to be the best reactor system among the currently deployed thermal reactors as far as natural uranium utilization efficiency is concerned. Taking these facts into consideration, it would be prudent to keep the weapons-grade uranium until demonstration-type and prototype HTGRs are ready to be deployed. Otherwise, HEU will have to be produced in order to start the prototype HTGRs on an HEU plus thorium fuel cycle.

M. R. Balakrishnan

Bhabha Atomic Research Centre
Bombay 400 085, India

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