Future energy – use of thorium in nuclear power

Some of our SciBar participants prepared this glossary, independently of Dr Owen. Your feedback on the level of information and usefulness of the SciBar glossaries is most welcome.

ADS Accelerator-driven system.

ADSR Accelerator-driven subcritical reactor. Using a particle accelerator to supply neutrons to a reactor core that is subcritical (unable to sustain a chain reaction) but undergoes fission when supplied with neutrons from an external source.

Energy amplifier An alternative term for an accelerator-driven system. A high-energy particle beam stimulates a subcritical nuclear reactor to undergo fission, and the energy released both powers the particle accelerator and generates electricity for the grid.

LFTR (liquid fluoride thorium reactor) A different type of thorium reactor to an ADS. A thorium-232 'blanket' surrounding a MSR absorbs fission neutrons so that some thorium-232 begins the thorium cycle. This 'breeds' uranium-233 to refuel the fission reactor. The uranium and plutonium used to start the LFTR could potentially be taken from 'spent' nuclear fuel, i.e. waste from nuclear power stations.

MSR (molten salt reactor) A reactor that uses liquid fuel – fissionable uranium or plutonium dissolved in molten fluoride salts of lithium and beryllium.

Particle accelerator Device used to accelerate charged particles (such as protons) to very high speeds, on order to collide particles at high energies and through this to break down matter into smaller particles.

Neutron spallation 'Spalling' or chipping neutrons from the nuclei of atoms in a target, in a particle accelerator. Shooting protons into a lead target can produce neutrons for use in thorium reactors.

Nuclear fission When a large, unstable nucleus splits into two smaller nuclei, releasing energy.

Subcritical reactor A nuclear fission reactor that requires an external neutron source to induce fission. Without the neutron supply, fission ceases.

Thorium cycle Thorium-232 is a naturally occurring radioactive isotope that does not undergo nuclear fission. If thorium-232 is bombarded with high-speed neutrons, it becomes thorium-233. This decays in stages to become uranium-233, which is fissionable and can produce power in a nuclear reactor. The fission products have much shorter half-lives than the uranium fuel cycle, making thorium reactors 'cleaner'.

Useful weblinks:

http://www.telegraph.co.uk/finance/comment/7970619/Obama-could-kill-fossil-fuels-overnight-with-a-nuclear-dash-for-thorium.html August 2010 article outlining some of the historical background and arguments for thorium reactors.

http://www.thorea.org/publications/ThoreaReportFinal.pdf June 2010 report 'Towards An Alternative Nuclear Future' from ThorEA, the thorium energy amplifier association. Long, but Chapter 1 has good bulleted summaries of ADSRs.

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