AUSTRALIAN NUCLEAR FORUM

Plutonium Utilisation

Policy

Plutonium should be recycled to fuel thermal and fast breeder power reactors. (Adopted 8/8/02.)

Summary and Conclusions

Some 900 tonnes of reactor grade plutonium currently exists in the world and this is increasing at about 50 tonnes per year. Some 8-10 tonnes of this is being recycled into current power reactors as mixed oxide fuel. This increases the utilisation of the world's uranium resources to some extent. However, a more effective method is to recycle the plutonium in fast breeder reactors. The use of FBRs has been delayed because of their higher generation costs but application of FBRs promises to increase the world's energy resources by an amount greater than that of the world's fossil fuel reserves. Thus disposal of plutonium as waste is not only expensive, but is shortsighted from energy conservation and CO2 generation perspectives.

Considerations

1. Plutonium Generation

The earth's first plutonium was generated prehistorically in small quantities in natural reactors such as that at Oklo in Gabon some 2 billion years ago. The first kilogram quantities of plutonium were made by the USA as part of the Manhattan Project during WWII. Subsequent programs by the present nuclear weapons states has led to a world stockpile of weapons grade plutonium «7% Pu240) of somewhat more than 200 tonnes.

Power reactors also generate plutonium, each producing about 300kg a year - but this reactor grade plutonium contains an array of higher plutonium isotopes that makes it unsuitable for fission-based weapons. Current light water reactors also burn about half of the plutonium they create and this process produces about one third of the power generated.

At present there exists some 900 tonnes of reactor grade plutonium existing in discharged spent fuel in the world. This inventory is increasing at about 50 tonnes yearly.

2. Power Reactor Plutonium in Weapons

Reactor grade plutonium is not used for making fission-based weapons. While it is true that all power reactor generated plutonium isotopes will fission with fast neutrons, the spontaneous fission rates for two of the higher plutonium isotopes (Le. 240 and 242) are too great to allow the plutonium to be used to make reliable and effective weapons. Consequently none of the present nuclear weapons states have utilised such material. In addition, the International Atomic Energy Agency's international safeguards regime actively works to prevent diversions of this material for non-peaceful purposes.

3. Recycle in Thermal Reactors

As stated above, about half of the plutonium generated in the world's power reactors is consumed in situ. Thus, such reactors are well capable of burning recycled reactor grade plutonium after it has been suitably processed. This approach displaces some of the fresh enriched uranium feed and increases uranium utilisation overall. Fuel made from such recycled plutonium is termed mixed oxide (MOX). Currently in the OECD some 22 tonnes of plutonium is separated per year with 8-10 tonnes of this used in MOX fuel.

4. Recycle in Fast Breeder Reactors

The most efficient use of reactor-grade plutonium is to recycle it in fast breeder reactors. These reactors have the potential to increase the energy extraction efficiency from uranium by some 60 times over the present thermal reactors. This means the energy potential of the world's uranium reserves is greater than the energy potential of the world's fossil fuel reserves (i.e. coal, gas and oil) and without the attendant CO2 emissions. Clearly then, FBRs are a means of producing energy that the world cannot ignore.

FBRs have been proven through the prototype phase but their electricity generating costs will be higher than present coal-fired or thermal reactor plants. Thus the installation of commercial FBRs must await rising generating costs for presently available methods, and/or effective political moves to reduce CO2 generation rates.

5. Disposal as Waste

Much misguided effort is presently being expended to devise methods of disposing of plutonium bearing materials as nuclear waste. This is not only wasteful in the energy sense, but is wasteful economically. The problem of isolating plutonium from the environment over millennia is much more difficult than just isolating fission product waste. The latter essentially decays away after 1000 years or so whereas plutonium takes much longer. Thus there is considerable incentive from this point of view to recycle plutonium in reactors and not throw it away.

6. References.

1. "Plutonium", Nuclear Issues Briefing Paper 18, June 2002, Uranium Information Centre.

2. "Plutonium Recycling: The Use of 'Mox' Fuel", Appendix from 1999 Annual Report of ASNO.

3. "Electricity Generation Alternatives for Australia," J. Brough and J. Fredsall, ANF Discussion Paper, 31/5/01.