AUSTRALIAN NUCLEAR FORUM

Australian Uranium Enhancement Industries

Policy

The ANF supports the establishment of commercial uranium enhancement industries in Australia including:

a. **Conversion of U308 to UF6,**
b. **Enrichment of Uranium to levels used in nuclear power reactors,**
c. **Fabrication of nuclear fuel for use in nuclear power reactors.**

(Adopted 2/5/05.)

Summary and Conclusions

Australia has about one third of the world's low cost uranium but currently the ore is simply mined, refined and exported. The value of this export in 2004 was $A41 OM but if this uranium were enhanced by the establishment of the above processes, the exported fuel could be worth in the order of $A 1. 7Bn per year. This added value not only would mean greater income to this country but would be an important source of additional employment. Also, the production of reactor fuel here would facilitate the introduction of nuclear power if this were proven to be advantageous.

Lastly, the operation of an enrichment plant will produce depleted uranium of an amount some seven times greater than the enriched uranium produced. This depleted uranium would constitute a tremendous energy asset for future use here and/or overseas.

Considerations

1. Nuclear Fuel Market

Australia has 31 % (Le. 1.15 MtU) of the world's uranium resources up to $US80/kgU. This significant asset is being exported for use in countries with nuclear power programs at the rate (in 2004) of 7973 tonnes U at a value of $A41 OM per year. Following export from this country the uranium is further processed to produce fuel for power reactors - reactors that generate some 16% of the world's electricity. The end value of the total world nuclear fuel element market is about $A 14Bn per year. Thus although Australia exports one quarter of the uranium mined, these exports are only worth about 3% of the total fuel market.

Enhancement processes employed overseas for use in the predominant light water reactors include conversion to uranium hexafluoride, uranium enrichment (up to a maximum 5% U235), and fuel fabrication. These steps constitute about 6%, 41 % and 22% of the fihal cost.

2. Australian Developments

Australia has long had an interest in the nuclear fuel market and in the late 60's began an R&D program at the AAEC to explore the feasibility of enhancing the uranium for export and for use in a possible domestic nuclear power program. The effort was mainly centered on methods of uranium enrichment, primarily with centrifuges and lasers. Enrichment to 3.6% U235 was obtained with centrifuges by 1978 but then in 1982 a change in government led to the program being cancelled effectively writing off the approximately $A 100M investment that had been made by then. The laser method continued, however in the form of the molecular separation process called SILEX. R&D on this process was later partly funded by the US Enrichment Corp until about 2003 when USEC involvement ended. The SILEX process remains to be proven as a commercially viable enrichment method.

3. Conversion of U3O8 to UF6

Conversion of U3O8 into UF6 is a relatively straightforward chemical process. It is carried out in order to provide a feed gas to the enrichment process. UF6 has advantages because of it's physical properties (it is a gas at manageable temperatures and pressures). Furthermore, fluorine has only one isotope meaning that the molecular separation of U235F6 from U238F6 can be achieved on the basis of the 1% weight difference of the uranium isotopes alone. Also, UF6 can exist as a solid at mild pressures and temperatures so it can be stored and transported relatively easily.

4. Uranium Enrichment

The original enrichment processes developed for the Manhattan Project included gaseous diffusion, centrifuges, thermal diffusion and electromagnetic separation. Other processes have been examined but today the majority of uranium enrichment is still carried out by gaseous diffusion and centrifuges. However, most of the gaseous diffusion plants have now been shut down and production has shifted to the centrifuge process which is cheaper to build and run.

If an enrichment plant were established here in the near future no doubt it would have to employ imported technology. This is so because neither of the locally developed separations processes were advanced to the stage of commercial application, moreover in the case of the centrifuge method, most of the technology is probably lost by now. This may not be a serious financial impediment if sufficient time were allowed to carry out the necessary R&D to the point where a commercial plant could be built.

Another point in favour of such a plant is that this country offers relative safety from nuclear materials theft – a feature vital to world security. In fact for this reason the IAEA's Director General ElBaradei recently proposed regional enrichment and fuel reprocessing centres under multinational control. Australia could be the site for such a regional centre.

It should also be noted that another product of the enrichment process is depleted uranium having about 0.25% U235. About 1.2 million tonnes of this product is currently being stored overseas for future use in the fast breeder reactors. FBRs would become a possibility when the easily won uranium resources are exhausted since, from the same quantity of natural uranium, they produce about 60 times more energy than produced by current reactors. The partial retention of locally produced depleted uranium through mechanisms such as conditional purchase or fuel leasing should be examined as a hedge for ensuring the nuclear option would remain available for this country's long-term energy supply.

5. Fuel Fabrication

Fabrication of nuclear fuel for use in today's reactors first requires the conversion of the enriched uranium hexafluoride to UO2. This is then pressed into pellets and placed into zirconium alloy tubes. Typically some 100 to 250 of these tubes are then grouped together to form fuel assemblies ready for insertion into a reactor. An important consideration in developing this technology is that the fuel elements so produced must be able to coexist in reactors with fuel elements of other vendors since the refueling of most power reactors replaces only a portion of the fuel load at a time. This means that the designs may have to be licensed from foreign vendors until sufficient experience is gained locally to go it alone.

6. References.

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