GOVERNMENT OF INDIA
DEPARTMENT OF ATOMIC ENERGY
RAJYA SABHA
UNSTARRED QUESTION NO.623
TO BE ANSWERED ON 16.08.2012

AVAILABILITY OF THORIUM AS A NUCLEAR FUEL

623. SHRI V.P. SINGH BADNORE:

Will the PRIME MINISTER be pleased to state:

(a) how much Thorium availability has been assessed in the country as a Nuclear Fuel;

(b) what is the progress of the research done to use Thorium as a Nuclear fuel; and

(c) when will Thorium be used in India as Nuclear Fuel in the Nuclear Power Stations/Plants?

ANSWER

THE MINISTER OF STATE FOR PERSONNEL, PUBLIC GRIEVANCES & PENSIONS AND PRIME MINISTER'S OFFICE (SHRI V. NARAYANASAMY) :

(a) India has abundant quantity of thorium resources contained in the mineral monazite occurring in the beach sand placer deposits along the eastern and western coasts of the country as well as the inland placers in parts of Kerala, Tamil Nadu, Odisha, Andhra Pradesh, West Bengal, Jharkhand and Chhattisgarh. Atomic Minerals Directorate for Exploration & Research (AMD) has carried out investigations in these areas, thereby establishing sizeable resources of 10.70 million tonnes of monazite which contains 0.963 million tonnes (9,63,000 tonnes) of thorium oxide (ThO_2) [Indian monazite on an average contains about 9 - 10% of ThO_2]. About 8,46,477 tonnes of thorium metal can be obtained from 0.963 million tonnes of thorium oxide (ThO_2).

The state-wise reserves of monazite established by AMD as on date are as follows:

State	Monazite
Kerala*	1.51
Tamil Nadu	2.16
Andhra Pradesh	3.74
Odisha	1.85
West Bengal	1.22
Bihar	0.22
Total	**10.70**

*including resources of lake and sea bed.

(b) Thorium plays a pivotal role in the Indian nuclear power programme. Right from the inception of this programme, work has been carried out on various aspects of thorium utilisation including mining and extraction of thorium, fuel fabrication, irradiation in reactors, reprocessing, and refabrication.

The research done in the area of utilisation of thorium as a nuclear fuel include the following:

- Thorium fuel fabrication through powder pellet route has been well established. Few tons of fuel have been made for CIRUS and Dhruva, Pressurised Heavy Water Reactors (PHWRs) and for blanket assemblies for Fast Breeder Test Reactor (FBTR). Few pins have been fabricated using mixed oxides of Thorium – Plutonium (Th-Pu) for irradiation in research reactors.
- Thoria (Thorium oxide) bundles are used in the initial cores of PHWRs. The irradiation experience of thoria based fuel in the research reactors CIRUS and Dhruva, PHWRs and test irradiations has been satisfactory.
- The thoria pins of CIRUS have been reprocessed to obtain Uranium- 233. The recovered Uranium-233 has been fabricated as fuel for KAMINI reactor, which is a small research reactor with 30 kWth capacity. This reactor, which is the only one in the world currently operating with Uranium-233 based fuel, is in operation at Indira Gandhi Centre for Atomic Research (IGCAR), Kalpakkam.
- The Post-Irradiation Examination of one of the thoria bundles irradiated in PHWRs has also been carried out for validation of reactor physics computations.
- Studies have been carried out regarding use of thorium in different types of reactors with respect to fuel management, reactor control and fuel utilisation.
- For timely demonstration of technology for thorium utilisation on a commercial scale, BARC has designed an Advanced Heavy Water Reactor (AHWR). The 300 MWe AHWR is specially meant for large scale commercial utilisation of thorium, generating nearly two-third of its power from fission of Uranium-233. The design of all nuclear systems of the reactor has been completed and associated confirmatory R&D is in a very advanced stage.
- A Critical Facility for Advanced Heavy Water Reactor (AHWR) has been commissioned in 2008 and is being used for carrying out experiments to further validate the physics design features of AHWR.

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c) The third stage of the Indian nuclear power programme contemplates making use of Uranium-233 – Thorium based reactors, which will provide energy independence to the country for several centuries. But physical characteristics of Thorium, makes it impossible to build a nuclear reactor using Thorium alone. Thorium has to be converted to Uranium-233 in a reactor before it can be used as fuel. However, the priority for India is to first produce Plutonium through irradiation of Uranium in Fast Breeder Reactors, since the extent of breeding is substantially higher with use of Plutonium/Uranium bearing fuel in Fast Breeder Reactors than with Thorium bearing fuel.

Hence, to achieve a faster growth of the Indian nuclear power programme, the second stage of the programme is based on utilisation of Plutonium and Uranium based fuel in Fast Breeder Reactors

Large scale deployment of Thorium for power generation, could thus be used mainly in the third stage which is dependent on the commercial operation of Fast Breeder Reactors with short-doubling time.

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