

PARLIAMENT QUESTION:CLOSED FUEL CYCLE TECHNOLOGY

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India follows a Closed Nuclear Fuel Cycle, aligned with its three-stage nuclear power programme in order to optimally utilize India's limited uranium resources and to exploit its large thorium reserves for long term energy security. It involves the recovery and recycling of fissile and fertile material from spent nuclear fuel (SNF), rather than disposing of it as waste. This approach enables enhanced utilization of nuclear material resources, improves energy security, and minimizes high-level radioactive waste volumes. The programme aims to use domestic uranium in the Pressurised Heavy Water Reactors (PHWRs) and use plutonium obtained from the reprocessing of spent fuel of PHWRs in Fast Breeder Reactors. Large scale use of thorium will subsequently follow, first to breed Uranium-233 from Th-232 and then utilize U-233 as fuel.

Reprocessing facilities are operationalized for reprocessing domestic nuclear spent fuel from PHWRs. For realization of the second stage of the nuclear power programme, Fast Breeder Test Reactor and other facilities were established for material research and proof of design concepts. Prototype Fast Breeder Reactor (PFBR) & integrated nuclear reprocessing plant for fast reactor fuel is under construction at Kalpakkam.

Research on thorium utilization for the third stage of the closed fuel cycle continues to be a high priority R&D area of the Department of Atomic Energy (DAE). In this regard, necessary R&D is being carried out in Bhabha Atomic Research Centre (BARC) and other research organisations attached with DAE. Some important highlights of these achievements and activities are the following:

- i. Thorium Oxide (Thoria) pellets contained in bundles have been used in the initial cores of PHWRs and valuable experience has been generated in operation and re-use of this irradiated thorium fuel. Thoria based fuels have also been irradiated in the research reactors of BARC. After such irradiation, these fuel elements have been examined in the laboratories at BARC for post-irradiation studies.
- ii. The irradiated Thoria pins of research reactors have been reprocessed to obtain Uranium-233. The recovered Uranium-233 has been fabricated as fuel for the 30kW (thermal) KAMINI reactor, which is in operation at Indira Gandhi Centre for Atomic Research (IGCAR) at Kalpakkam. This is the only reactor in the world operating with Uranium-233 fuel.
- iii. The technologies for fabrication of Thoria based fuel pellets, carrying Uranium 233, have been established at laboratory scale.

Uranium Corporation of India Ltd. (UCIL) a Public Sector Undertaking (PSU) under Department of Atomic Energy (DAE) has been mandated to mine and process uranium ore in the country. In line with DAE's requirement of uranium to fuel nuclear power plants, UCIL has outlined a plan for expansion which includes maintaining sustained supply from existing facilities through debottlenecking of certain deficiencies, modernization and capacity expansion of some existing units.

Atomic Minerals Directorate for Exploration and Research (AMD), a constituent unit of Department of Atomic Energy (DAE), has the mandate to identify, evaluate and augment mineral resources of uranium and thorium in the country.

To strengthen the country's nuclear fuel security and speedy augmentation of these resources, AMD is carrying out integrated and multi-disciplinary exploration (including heliborne and ground geophysical surveys, ground geological, geochemical and radiometric surveys and drilling) in identified thrust areas of the country by utilising state-of-the-art technology.

As on date, AMD has established 4,33,800t *in-situ* U₃O₈ resource in 47 uranium deposits located in Andhra Pradesh, Telangana, Jharkhand, Meghalaya, Rajasthan, Karnataka, Chhattisgarh, Uttar Pradesh, Uttarakhand, Himachal Pradesh and Maharashtra.

Besides, the Directorate has established 1.18 million tonne (Mt) thorium oxide (ThO₂) resource contained in 13.15 Mt *in-situ* monazite (a mineral containing thorium) resource in 136 deposits associated with the coastal beach and inland placers located in Kerala, Tamil Nadu, Odisha, Andhra Pradesh, Maharashtra, Gujarat, West Bengal and Jharkhand. In addition, 29,900t *in-situ* ThO₂ resource in hard rocks has been established incidental to the rare earth oxide resource in the state of Gujarat.

This information was given by Dr. Jitendra Singh, Union Minister of State (Independent Charge) for Science and Technology, Earth Sciences, MoS PMO, MoS Personnel, Public Grievances & Pensions, Department of Atomic Energy and Department of Space, in a written reply in the Lok Sabha today.

NKR/PSM

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