PARLIAMENT QUESTION: NUCLEAR FUEL PROGRAMME

प्रविष्टि तिथि: 23 JUL 2026 3:59PM by PIB Delhi

Department of Atomic Energy (DAE) is promoting the indigenous thorium-based technologies to ensure long-term energy security, and to achieve self-reliance in the nuclear fuel cycle.

India has limited resources of uranium and vast reserves of thorium. To optimally utilise the limited uranium resources and exploiting the large thorium reserves for achieving long term energy security in a sustainable manner, DAE is pursuing Three Stage Nuclear Power Programme. The programme is based on closed fuel cycle, wherein the spent fuel from one stage is utilised for extracting the fissile material, to be used as fuel in the next stage.

DAE has developed expertise in reactor design, manufacturing, construction and front-end and back-end fuel cycle technologies of Pressurised Heavy Water Reactors (PHWRs) deployed in the first stage of the nuclear power programme.

The fissile material, plutonium, extracted from the spent fuel from domestic PHWRs is used as fuel for the second stage of nuclear power programme. Bhabha Atomic Research Centre (BARC) has successfully developed indigenous capabilities and implemented the back-end fuel cycle technologies including fuel fabrication. The back-end fuel cycle plants are operational at Tarapur and Kalpakkam. In addition, Integrated Nuclear Recycle Plant (INRP) at Tarapur and the Fast Reactor Fuel Cycle Facility (FRFCF) at Kalpakkam are under construction for reprocessing, waste management of spent fuel from PHWRs and Fast Breeder Reactors (FBRs) respectively. The PFBR attained its first criticality in 6th April 2026, marking India's entry into the second stage of the programme.

The third stage envisages use of U-233 bred from Th-232 as fuel. In this regard, the Department has undertaken sustained research and development for thorium utilisation. Thorium Oxide (Thoria) pellets have been used in the initial cores of operating PHWRs, and Thoria-based fuels have been irradiated in BARC research reactors. The irradiated Thoria pins have been reprocessed to obtain uranium-233, which has been fabricated as fuel for Kalpakkam Mini Reactor (KAMINI) reactor at Indira Gandhi Centre for Atomic Research (IGCAR), Kalpakkam.

The Government is undertaking sustained initiatives for long-term utilisation of thorium resources under the Three-Stage Nuclear Power Programme. The programme aims to multiply the domestically available fissile resource through the use of natural uranium in PHWRs, followed by use of plutonium, obtained from the spent fuel of PHWRs, in FBRs. Large scale utilisation of thorium will subsequently follow, making use of fissile uranium-233 bred from thorium in a breeder reactor fuelled using plutonium, only after adequate installed capacity of FBRs has been achieved. R&D efforts are underway for development of technologies for thorium utilisation. Molten Salt Reactor (MSR) is envisaged as one of suitable technologies for thorium utilisation for the long-term in a sustainable manner. The DAE is in the process of development of MSR aimed to demonstrate the technologies required for the efficient utilisation of thorium. R&D on development and qualification of special materials, molten fluoride salt chemistry,

component development is in progress for molten salt demonstration reactor. These efforts are aimed at ensuring that mature thorium technologies are available before large-scale deployment, thereby strengthening India's long-term energy security, fuel sustainability and self-reliance in nuclear energy.

This information was given by Union Minister of State for Prime Minister’s office and Personnel, Public Grievances and Pensions, Atomic Energy and Space, Dr. Jitendra Singh, in a written reply in the Rajya Sabha today.

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