

GOVERNMENT OF INDIA  
DEPARTMENT OF ATOMIC ENERGY  
**LOK SABHA**  
**UNSTARRED QUESTION NO – 4319**  
ANSWERED ON 26/03/2025

**SAFE PRODUCTION OF ATOMIC ENERGY**

4319. DR. THIRUMAAVALAVAN THOLKAPPIYAN

Will the PRIME MINISTER be pleased to state:-

- (a) whether the Government has done any research for the safe production of atomic energy and if so, the details thereof;
- (b) whether the Government apart from Electricity production has developed the atomic energy uses in agriculture, biology, industry and medicine; and
- (c) if so, the details thereof?

**ANSWER**

THE MINISTER OF STATE FOR PERSONNEL, PUBLIC GRIEVANCES & PENSIONS  
AND PRIME MINISTER'S OFFICE (DR. JITENDRA SINGH)

- (a) Yes. Department of Atomic Energy (DAE) has done extensive research for the safe production of atomic energy. Highest priority is accorded to safety in all aspects of nuclear power viz. siting, design, construction, commissioning and operation. Nuclear power plants are designed based on the paramount safety principles of defence in depth, Redundancy, Diversity and Fail-safe design features; thus, ensuring multiple barriers between the source of radioactivity and the environment. The operations are performed through well laid out procedures by highly qualified, trained and licensed personnel.

Bhabha Atomic Research Centre (BARC) a constituent unit of DAE, has done extensive research & is providing technological support to Nuclear Power Corporation of India Limited (NPCIL) for safe operation of Pressurized Heavy Water Reactor (PHWR) based Nuclear Power Plants (NPPs) under normal and off-normal conditions. The research field includes development of reactor materials, effect of irradiation on materials, nuclear & radiation monitoring instrumentation, reactor control system and many more. The plant safety is

ensured through R&D done for structural integrity, thermal hydraulic and radiation safety. The research ensured defence in depth philosophy practiced in NPP design and operations. R&D is also done for other operating reactors on similar line to ensure safe operation. Similarly, Indira Gandhi Centre for Atomic Research (IGCAR) has done extensive research on Fast Breeder Reactor technology.

- (b) & (c) Yes. Department of Atomic Energy is a multi-disciplinary Nuclear Research Centre of India having excellent infrastructure for advanced Research and Development with expertise covering the entire spectrum of usages of atomic energy. DAE plays a crucial role in various societal sectors such as nuclear agriculture & food preservation, health care, water treatment, waste management, and hydrogen production through its extensive research and technological advancements. Various technologies pertaining to societal applications developed by DAE are mentioned below:

**Nuclear Agriculture & Food Preservation:**

1. To ensure food security in years to come, DAE has well laid programmes for crop improvement, food preservation using radiation technology for food security. Using radiation induced mutagenesis along with cross breeding, BARC has developed varieties in oilseeds (groundnut, mustard, soybean and sunflower), pulses (urbean, mungbean, pigeonpea and cowpea), rice, jute and wheat etc. Total 70 (seventy) improved crop varieties have been developed, Gazette notified and released for commercial cultivation across the country. These crop varieties have desirable traits such as high yield, disease resistance, early maturity, climate resilience, biotic and abiotic stress tolerance etc.
2. Preservation of food forms another important area for Food Security. Feasibility of food irradiation for preservation has been studied for a number of agricultural and food commodities for several years. Food Safety and Standards Authority of India (FSSAI) notified “Food Safety and Standards (Food Product Standards and Food Additives) Sixth Amendment, 2016 and the Food Safety and Standards (Packaging and Labelling) Fourth

Amendment, 2016” related to standards and labelling requirements for irradiated foods.

Radiation processing of food is very effective in treating the agricultural produce and flesh foods. Extension of shelf life of these produces is very much dependent on the produce, variety and storage conditions.

BARC has developed radiation-based technology for setting up irradiation plants and protocols for gamma irradiation of several food items to extend their shelf life, provide safe foods and promote exports. A large number of food items for various objectives are being irradiated commercially.

Standard Operating Procedures (SOPs) involving gamma irradiation and subsequent storage in controlled environment have been developed for shelf-life extension of onion and potatoes up to 7.5 months and 8 months, respectively, while retaining the quality attributes. Large-scale trials have been carried out for the same. SOPs involving radiation technology has successfully demonstrated extended shelf life of mangoes to facilitate export through sea route. SOPs for shelf-life extension of cereals, wheat, spices, mushroom, fruits & vegetables such as green tomato, broccoli, poultry, fish and fishery products have also been developed.

Some of the irradiation-based food preservation technologies, developed and transferred to private entrepreneur for commercialisation, are preservative free Shelf Stable Jamun product, Sprouts & Sweet Corn Kernels, intermediate moisture shrimp and ready-to-eat (RTE) intermediate moisture (IM) fruits cubes.

Litchi Treatment plant based upon BARC technology was set-up at National Research Centre on Litchi, ICAR located at Mushahari, Muzaffarpur, Bihar. An Indian patent has been awarded to this technology which increases the shelf-life of litchi up to 60 days.

3. Eco-friendly and biodegradable BARC-hydrogel, which can absorb water up to 550 times of its weight has been developed and deployed for agriculture in arid regions.

4. Gamma Chamber Facility at IGCAR, has been used for irradiation of seeds and plants by various universities for research purposes.

### **Medicine & Biology:**

1. Radioisotopes:

Nuclear Medicine uses radioactive isotopes (radio-isotopes) for the non-invasive diagnosis of several human diseases, including in the area of cardiology, oncology (cancer), neurology, psychiatry and infectious diseases and for the treatment of thyrotoxicosis, thyroid cancer, neuroendocrine tumours, neural crest tumours, bone-pain palliation etc. BARC regularly produces radio-isotopes and radiopharmaceuticals and supply through Board of Radiation and Isotope Technology (BRIT) to various nuclear medicine centres across India for diagnostics and therapeutic application for treatment of various types of cancers.

BARC has developed and demonstrated partition technology for recovery of caesium-137, strontium-90 and ruthenium-106 from high level waste for medical applications. Non-dispersible glass pencils containing caesium-137 are being used in blood irradiators. Strontium-90 is used for milking of yttrium-90 for cancer treatment. Cost effective  $^{106}\text{RuBy}$  (ruthenium brachytherapy) plaques (round, notched, paediatric) has been developed for eye cancer treatment and supplied to various hospitals in the country.

2. Chlorophyllin tablet has been developed by BARC as regenerative nutraceutical and antioxidant and launched by a licensee with a commercial name of Aktocyte. The tablets are approved by Food Safety and Standards Authority of India (FSSAI) as nutraceutical.
3. BARC is significantly contributing in the field of Nuclear Medicine and for diagnostic and therapeutic services for cancer treatment through its clinical patient services units at Radiation Medicine Centre (RMC), Mumbai.
4. NO<sub>x</sub> releasing dressing for the treatment of diabetic foot ulcer and other chronic wounds has been developed. The technology has been transferred to two private firm and Drugs Controller General of India (DCGI) approval has been obtained for manufacturing & commercialisation.

5. Thermal Imaging for Early Detection of Breast Cancer - Technique has been applied for early detection of breast cancer successfully as an adjunct imaging modality in rural area and is now proposed on a larger scale.
6. Radio-isotope Production: The indigenous production of Sr-89 is an important societal need and a valuable import substitution; it is a pure beta emitter with a half-life of 50.5 days and used for palliative care of bone metastatic cancer. Production of Sr-89 with high specific activity at Fast Breeder Test Reactor (FBTR), Kalpakkam was successfully demonstrated. The product satisfied all the Quality Control Parameters as per the US, European and International Pharmacopeia. Bio-distribution study is in progress. This technology ensures increased availability and complete import substitution.
7. “Mobile Health – Wellness Program for the Rural Population” is being implemented in the rural areas in and around Chengalpattu region with DAE developed Technologies.

## **Industry:**

### **1. Water Treatment:**

- i. Several membranes assisted technologies have been developed at BARC for desalination of brackish & seawater and purification of contaminated water for drinking purposes at domestic and/or community levels. Desalination and water purification includes purification with respect to microbiological decontamination, arsenic removal, iron removal, de-fluoridation, salinity and hardness removal. The technologies have been transferred to several private entrepreneurs on non-exclusive basis for commercialisation and field deployment. BARC has installed BARC developed water purification technologies in 200 equivalent villages in India including BSF border posts at Kutch & Barmer posts, Central Railway platforms in Mumbai and Indian Railway’s Deen Dayalu coaches.
- ii. BARC has developed Hybrid granular Sequencing Batch Reactor (hgSBR) technology for treatment of sewage waste water. The

technology has been successfully transferred to private entrepreneurs for commercialisation. The technology was successfully deployed in the Kumbh 2021 and Maha Kumbh 2025.

iii. A technology for removal of dye from effluent from textile industry has been developed and successfully demonstrated in a textile plant at Jodhpur.

2. **Waste Management:**

Sludge Hygienisation: BARC has developed radiation hygienisation technology for treating dry sewage sludge & converting into organic manure. 100 tons/day dry sludge hygienisation plants have been set up and operationalised by Ahmedabad and Indore Municipal Cooperation with technological support from BARC.

Nisargruna and Shesha, technologies work on bio-methanation, have been developed for managing bio-degradable kitchen and garden waste from small housing society. The bio-gas produced during the process can be used as fuel & remaining process waste can be used as manure.

3. **Hydrogen production:**

BARC has developed and successfully demonstrated hydrogen production technologies based on thermochemical processes namely; integrated process of Iodine-Sulphur (I-S) and Copper-Chlorine (Cu-Cl) and electrochemical process such as alkaline water electrolyser (AWE) for industry.

4. An Online Chemical Emergency Response System (CERS) with chemical sensors, dispersion models and GIS based impact assessment modules is developed for Chemical Disaster Management at industrial sites. The first version of CERS is implemented for Ammonia storage facilities of FACT Cochin, Kerala.

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