GOVERNMENT OF INDIA
DEPARTMENT OF ATOMIC ENERGY
RAJYA SABHA
UNSTARRED QUESTION NO. 2081
TO BE ANSWERED ON 04.08.2022

Development of Atomic Energy in the Country

2081 **Dr. Sasmit Patra :**

Will the ***PRIME MINISTER*** be pleased to state:

(a) details on the development of atomic energy in the country during the last five years;
(b) details on the future plans of development of atomic energy in the country; and
(c) total anticipated expenditure towards its development?

ANSWER

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

(a) Details on the development of atomic energy in the country during the last five years is enclosed as **Annex- I**.
(b) Details on the future plans of development of atomic energy in the country are enclosed as **Annex- II**.
(c) The total anticipated expenditure towards its developments is Rs.2,39,593 crore.

* * * * *

Annexure- I

Details on the development of atomic energy in the country during the last five years:

1) A semi-automated remotised channel inspection system known as BARCIS (BARC Channel Inspection System) for In-Service Inspection (ISI) of coolant channels of PHWRs was developed. ISI of coolant channels is essential to provide assurance of continued safe operation of pressure tubes over reactor life-time.

2) BARC Vessel Inspection System (BARVIS) has been developed for inspection of beltline of BWR type reactor pressure vessels. BARVIS has been deployed successfully during refueling outages in TAPS-1&2. Development and deployment of BARVIS is first of its kind which has enabled the cleaning and inspection of welds in core belt region.

3) BARC developed various technologies for molten salt breeder reactors & High Temperature Reactors (HTRs). Some of the developments include indigenous developments of molten salts and materials; development of techniques for salt preparation, characterisation and purification; design and development of components and their test facilities; development of TRISO (TRi-ISOtropic) coated particle fuel; and instrumentation.

4) Under indigenous efforts towards development and demonstration of Thorium-based reactor technology; BARC has designed Advanced Heavy Water Reactor (AHWR, 300 MWe). This 300 MWe reactor using thorium-based fuel will serve as a technology demonstrator not only for the thorium fuel cycle technologies, but also for several advanced passive safety features. It is also having advanced safety and passive engineered systems which enhance its safety. The basic design of AHWR has been completed. In order to facilitate an early scrutiny of the innovative features of the design from the safety considerations, a Pre-Licensing Design Safety appraisal of the reactor has been completed by the Atomic Energy Regulatory Board(AERB).

5) A Critical Facility for Advanced Heavy Water Reactor was commissioned at BARC and is being used since then for carrying out experiments to further validate the physics design features of Advanced Heavy Water Reactor (AHWR).

6) Indira Gandhi Centre for Atomic Research (IGCAR) has designed the first-of-its-kind 500 MWe Prototype Fast Breeder Reactor (PFBR) at Kalpakkam, Tamilnadu.

7) IGCAR has commissioned a unique facility KAMINI (Kalpakkam Mini Reactor), a research reactor at Kalpakkam, pioneering the third stage of nuclear programme in the country towards utilizing the vast resources of thorium. It is also a national facility for Neutron Radiography of critical components in the nuclear and strategic sectors, Neutron Shielding and Neutron Activation of materials.

8) Medical Cyclotron Facility started delivering high current proton beams and commercial production of radioisotopes/ radiopharmaceuticals for cancer diagnostics and delivered to various hospitals/ Nuclear Medicine Centres at Kolkata.

9) The acceleration and extraction of heavy ion beams with around 19MeV/nucleon energy from country's first K-500 superconducting cyclotron achieved. Currently, this 19MeV/nucleon is the highest beam energy available in India for basic science research.

10) Radioactive Ion Beam (RIB) facility has been developed using the Online Isotope Separation (ISOL) technique utilizing the high current light ion beams from K-130 cyclotron at Variable Energy Cyclotron Centre (VECC).

11) Design and development of LB650 (650 MHz, low beta ~ 0.61) Superconducting Radio Frequency (SRF) cavity has been carried out, as part of R&D activities on SRF and associated technologies under Indian Institutions and Fermilab Collaboration (IIFC). The first VECC-make single cell LB650 achieved world-record accelerating gradient of 34.5 MV/m with Quality factor (Q) of 2x109 and 30MV/m with Q = 1.5x1010 at 2K temperature.

12) Various advanced experimental facilities for cyclotron based basic research have also been developed at VECC under the project "Advanced Experimental Physics Research". Detector systems, such as, Charged Particle Detectors Array (CPDA), Neutron multiplicity detector, Neutron Time-Of-Flight (n-TOF) detector array, Large Area Modular BaF2 Detector Array (LAMBDA), High resolution Compton

suppressed Clover HPGe detector array, fast scintillator detector, penning ion trap facility etc. have been developed.

13) Material Science research has been successfully carried out using cyclotron beams in order to make new structural materials for strategic use in reactor pressure vessels etc.

14) Longest continues operation by Kaiga Generating Station-1 (KGS-1) of 962 days; continues operation of more than a year 17 times (including continues operation of more than two years 3 times); Plant Load Factor (PLF) of 87.6% by the operating fleet of reactors in 2021-22; Kakrapar Atomic Power Project-3 (KAPP-3), a First-Of-A-Kind indigenous 700 MW Pressurized Heavy Water Reactor synchronized with grid; completion of 52 years of operation of Tarapur Atomic Power Station-1&2 (TAPS- 1&2), the oldest reactors in the world and highest generation of 47,112 Million Units of electricity in 2021-22.

Annexure- II

Details on the future plans of development of atomic energy in the country:

1) Three-stage nuclear power programme has been chalked out to use thorium as a viable and sustainable option at the inception of India's nuclear power programme. On account of physics characteristics of Thorium, it is not possible to build a nuclear reactor using Thorium alone. It has to be converted to Uranium-233 in a reactor before it can be used as fuel.
2) Design and development of an indigenous 18MeV Medical Cyclotron which serve as import substitute of the medical cyclotron for the production of the most commonly used radioisotopes for diagnostic and therapeutic treatment of cancer, at an affordable cost to the common man.
3) Development of new radioisotopes / radiopharmaceuticals using existing Medical Cyclotron for diagnostics / therapy of cancer patients.
4) Development of Scientific Infrastructures for Basic and Applied Research which include various state of art detector facilities, such as, high efficiency gamma multiplicity array of fast scintillators, segmented low energy photon spectrometer, charged particle multiplicity filter, scintillator detector for Total Absorption Spectroscopy (TAS), etc.
5) Development of Advanced National Facility for Unstable Rare Isotope Beam (ANURIB) which includes development of beams of unstable radioactive ion beams for nuclear spectroscopy, material science and radiobiology studies. Development of a superconducting electron LINAC (Linear Accelerator).
6) The present day capacity of generation of power of 6780 MW is planned to be increased to 22480 MW by progressive completion of projects under construction and accorded sanction.

*****