

4 Eventful Years of Solid Achievements

A Fillip to the Nuclear Power Programme

Department of Atomic Energy

2014 – 2018

Transformational Boost to Nuclear Industry

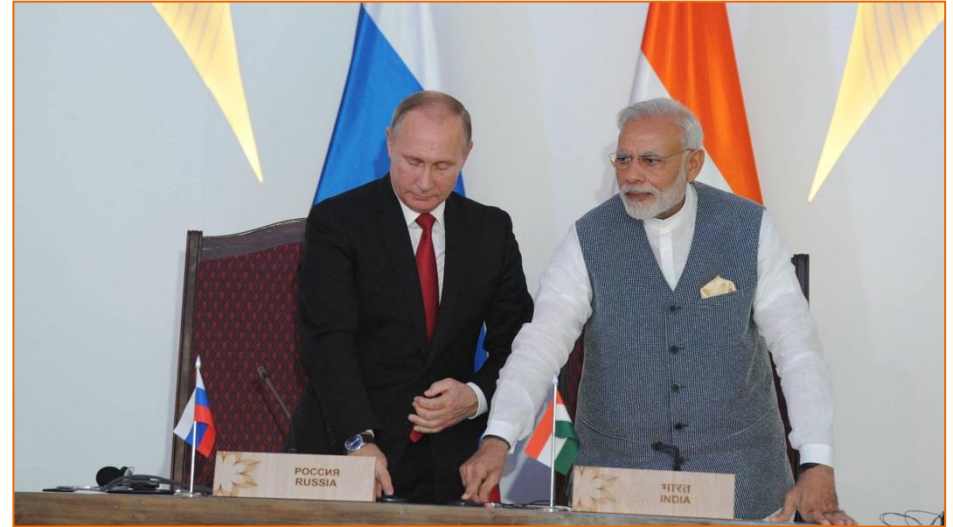
- Cabinet approved fleet-mode construction of **10 indigenous nuclear reactors** for addition of **7000 MW** (700MWx10) to the installed capacity; a major boost to **domestic nuclear industry**
- Approval for construction of **2 more reactors**, KKNPP 5&6, at Kudankulam in cooperation with Russia



Indigenous Nuclear Power Plant under construction at Kakrapar, Gujarat

Cooperation and Laying New Foundations

- Second reactor of KKNPP, Unit 2, dedicated to the **Indo - Russian Friendship and Co-operation**. Achieved 100% power in Jan 2017
- Laid foundation concrete for two reactors, **Units 3&4 of KKNPP**, each of 1000 MW



Prime Minister of India, Shri. Narendra Modi and President of Russian Federation, Mr. Vladimir Putin, jointly dedicated KKNPP2 to the Indo - Russian Friendship and Co-operation

Highest Ever Operational Reactors

- **22 nuclear reactors operational** with total installed capacity of 6780 MW
- **2000 MW** added by the two reactors of KKNPP, currently the biggest ones in the country
- **Additional 6700 MW** in the offing with 9 new nuclear reactors

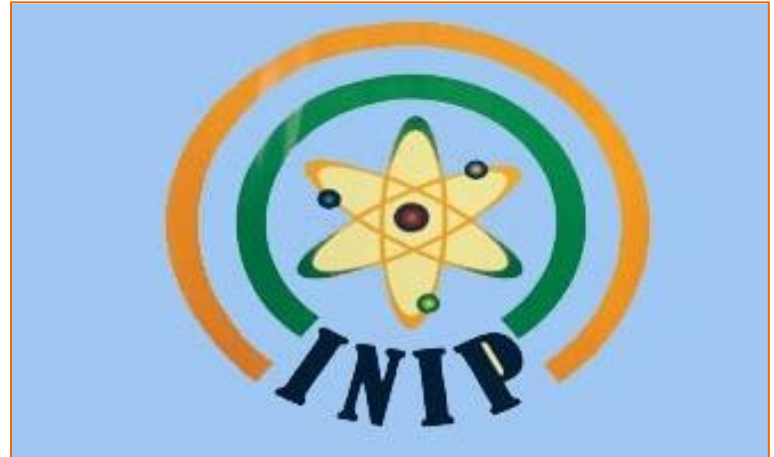


Kudankulam Nuclear Power Plant in Tamil Nadu is providing clean energy to the southern power grid

Opening Doors to International Technologies

- **Indian Nuclear Insurance Pool (INIP)** for Rs. 1500 Crore operationalised in August 2016
- **IAEA's Convention on Supplementary Compensation (CSC)** for nuclear damage ratified in February 2016

Workshop on Civil Liability for Nuclear Damage (CLND) IAEA in May 2016



India's Largest Radioactive Waste Management Plant

- India's largest Radioactive Waste Management Plant (WIP) **operationalised** at Kalpakkam



HLW Service Distribution (Left) Area and Melter Cell Top View (Right) of WIP Kalpakkam (Top)

Progressing Towards the Second Stage

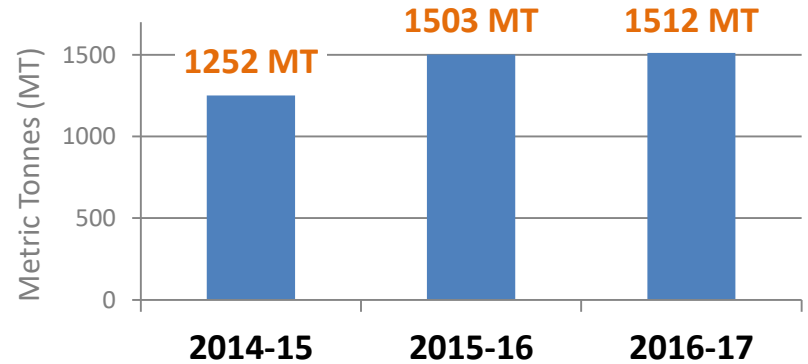
- **Prototype Fast Breeder Reactor** undergoing commissioning
- **First criticality** of 500 MWe reactor at Kalpakkam, Tamil Nadu expected in 2018



PFBR at Kalpakkam in Tamil Nadu is ushering India to the next stage of nuclear power

Record Breaking Nuclear Fuel Production

- **World record production** of fuel for indigenous nuclear reactors for 3 consecutive years 2014-15, 2015-16, and 2016-17
- Feat achieved by production units at Hyderabad, Telangana and Pazhayakayal in Tamil Nadu

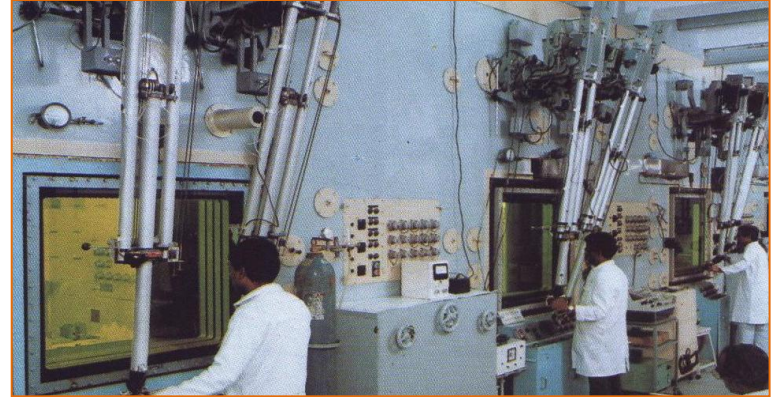


World Record in Production of PHWR Fuel



Isotope Production A New Record

- **Over 75 radioisotopes** produced for various applications
- **10 Lakh+ patients** benefitted annually across **120 Nuclear Medicine Centres** and **400+ radioimmunoassay labs**
- **DHRUVA Reactor at BARC** for medical isotope production ran at highest capacity in 2016-17



Hot-Cell Operations for Radio-Isotope Production

Innovations in Healthcare Technologies

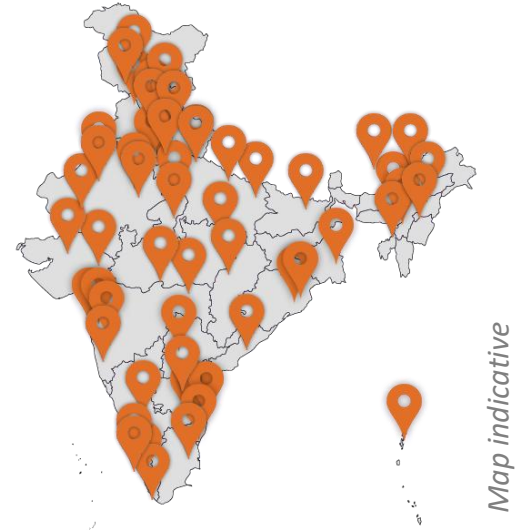
- **Developed process** to extract Caesium isotope from liquid nuclear waste for making glass pencils used in **blood purification devices**
- **First-of-its-kind** in the world, **India the only country** to have this technology in commercial domain
- **7 Blood Irradiators** have been supplied to hospitals



Extracting *wealth from waste*, Caesium-137 pencils are produced from high level liquid radioactive waste

Affordable Cancer Care for One and All

- **National Cancer Grid** now links 137* locations across India; one of the largest cancer networks in the world connects cancer centres, research institutes, patient groups and NGOs
- New hospitals operationalised at **Sangrur** and **Visakhapatnam**
- New hospitals coming up at **Varanasi** and **Mohali**
- Two Hospitals at **Guwahati** and **Varanasi** taken over for upgradation
- Work started for **Radiation Medicine Research Centre** at Kolkata

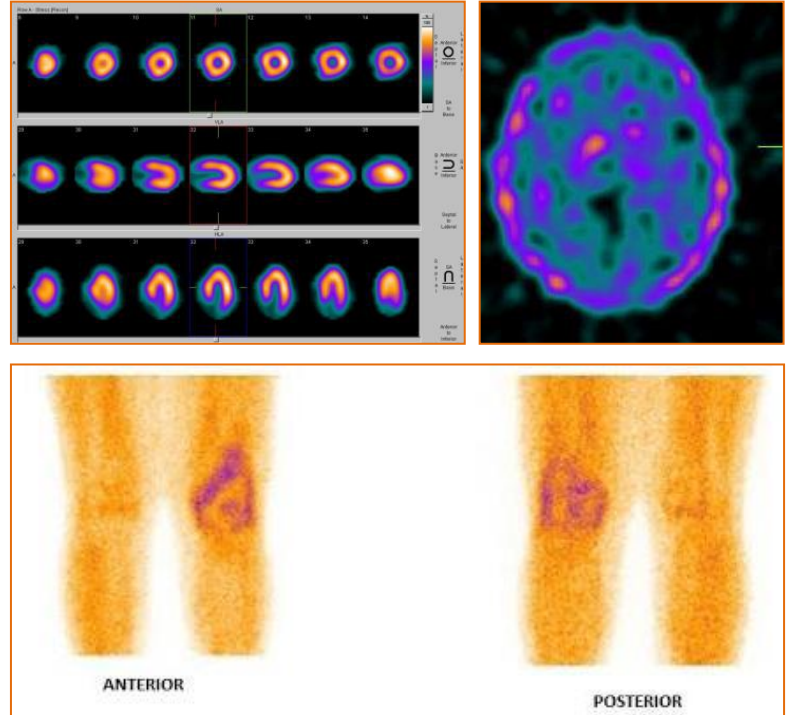


* <https://tmc.gov.in/ncg/index.php/list-of-centers>

Advancements in Cancer Drug Production

- **Human trials for radionuclide based drugs** for diagnostic, therapeutic and palliative treatment for cancer
- **17 drugs already deployed** and 10 more are in the pipeline

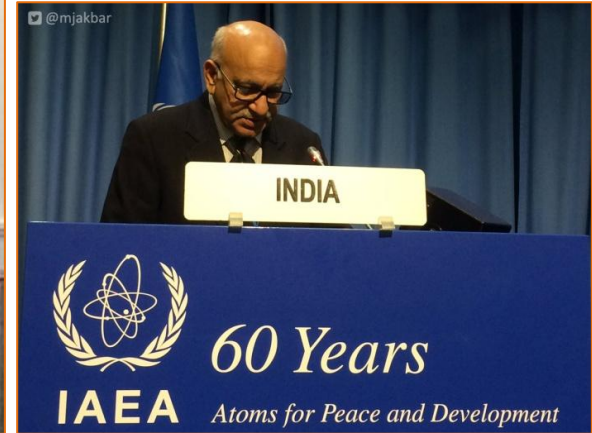
Techneium isotope, ^{99m}Tc , used in imaging of Heart (Top Left), Brain (Top Right) and prosthesis infections (Bottom)



Stronger Scientific Collaborations

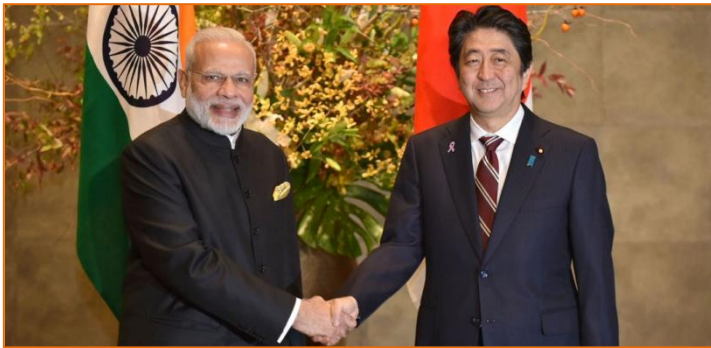


Signed agreement for mega science project on LIGO



Stronger collaboration with IAEA

New Beginnings and International Cooperation



India has partnered with the leading nuclear nations of the world

Global Centre for Nuclear Energy Partnership

- Vision to promote **safe, secure and sustainable nuclear energy** through global partnership
- Campus at Bahadurgarh, Haryana **operationalized** in April 2017
- **6 courses**, both national and international, conducted in the new campus
- **1,100+ participants, 300+ faculty members** from International Atomic Energy Agency (IAEA) and 15+ countries



Agreements & MoUs for Technical Exchange

- Global Centre for Nuclear Energy Partnership (GCNEP) MoU with **Vietnam Atomic Energy Institute (VINATOM)**
- MoU with **Department of Natural Resources of Canada** for cooperation in science, technology and innovation
- **Industrial Way Forward Agreement** between NPCIL and Électricité de France S. A., France



March 2018: GCNEP and VINATOM sign MoU for capacity building and of VINATOM and cooperation in the field of atomic energy for peaceful purposes

Neighbourhood Competence Building

- **Intergovernmental Agreement** with People's Republic of Bangladesh
- **Interagency Agreement** between Global Centre for Nuclear Energy Partnership and Bangladesh Atomic Energy Commission (BAEC)
- **Interagency Agreement** between AERB and BAEC
- **Trilateral Cooperation MoU** with Russia and Bangladesh on Rooppur Nuclear Power Project in Bangladesh



Trilateral Cooperation MoU
with Russia and Bangladesh

Extending Cancer Care Technology



BHABHATRON, the indigenous cancer-therapy machine



Mongolia
April 2015



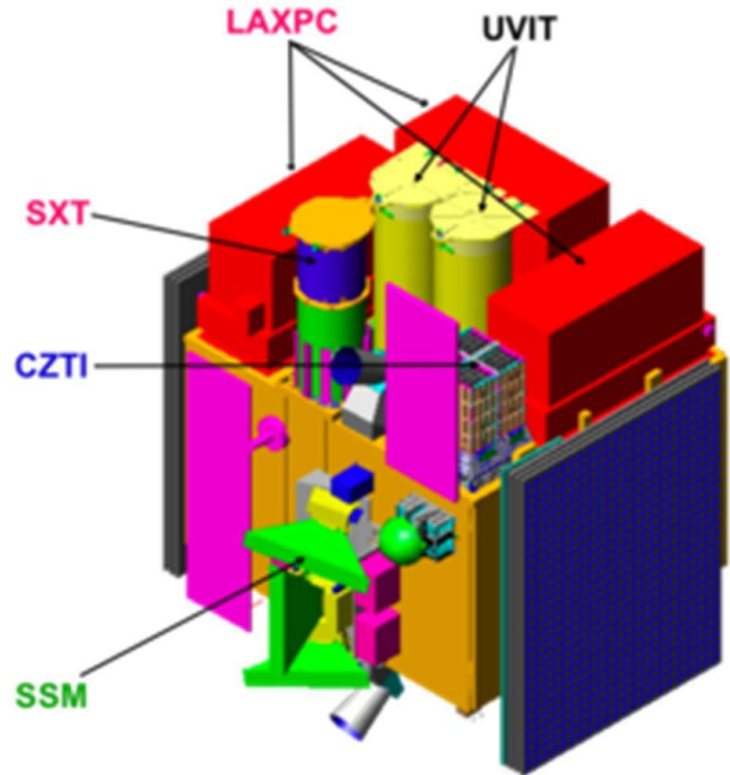
Kenya
July 2016



Kyrgyzstan
Dec 2016

ASTROSAT Astronomy Satellite

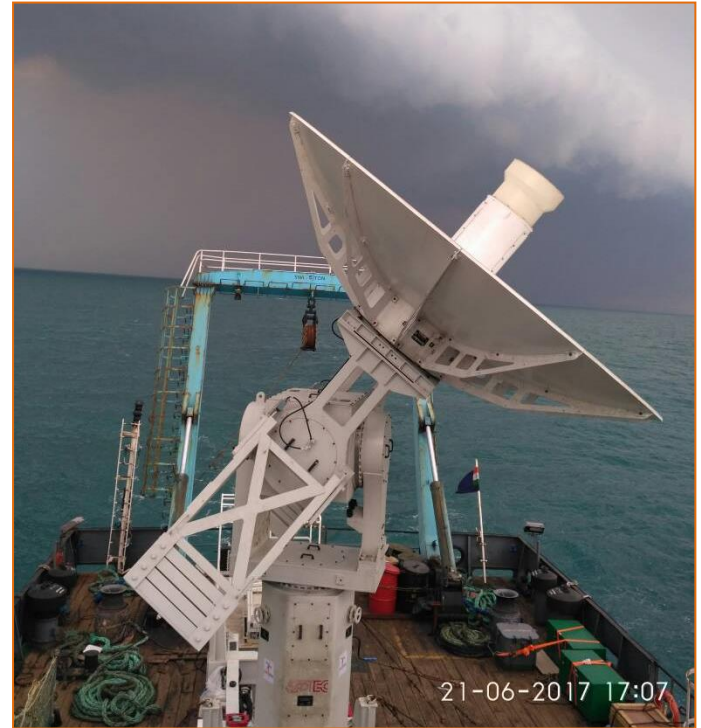
- ASTROSAT, the **first Indian Astronomy satellite** launched in Sept 2015
- **Tata Institute of Fundamental Research** developed 3 of the 5 major instruments
 - Large Area X-ray Proportional Counters (LAXPC)
 - Soft X-ray Telescope (SXT)
 - Cadmium-Zinc-Telluride Imager (CZTI)



Antenna and Guidance Systems

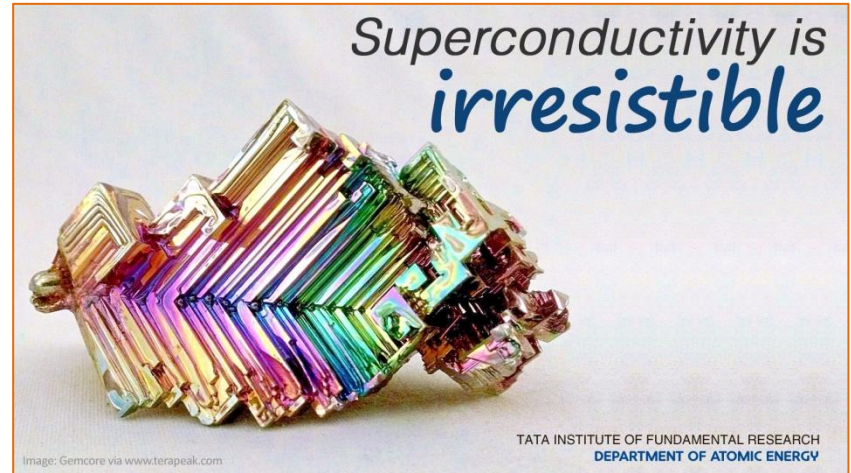
- **4.6 metre Ship-borne Antenna** system developed for tracking Satellites, Re-Entry Capsules etc.
- **Deployed and Used successfully** for PSLV mission
- Successful trial of **Seeker for BharMos Missile**

4.6 metre Ship-borne
Antenna system



Breakthrough Discovery on Superconductivity

- **Breakthrough study** by Scientists of TIFR on superconductivity in pure Bismuth
- The discovery **challenges** the 1972 Nobel Prize winning theory of superconductivity



Decades old theory of superconductivity challenged by new findings at TIFR

Technologies for Water Purification

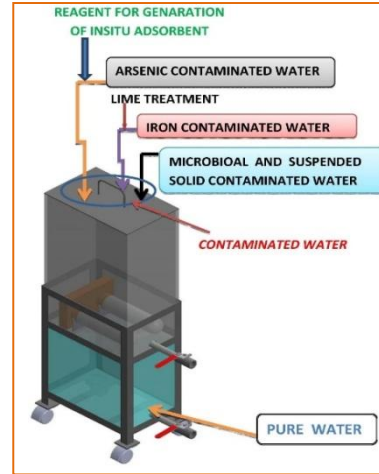
- Kit for Visual **Detection of Chromium contamination** developed and transferred for commercial production
- The kit addresses concerns related to Chromium contamination as per WHO standards



Superior to similar kits
available internationally

Technologies for Water Purification

- **Low cost**, Nano-composite ultrafiltration membrane based combo-device for water purification developed and transferred for commercial production
- **Doesn't require electricity or tap water**; extremely useful in rural and slum areas



Removes suspended materials and micro-organism with 99.99 % efficiency; removes arsenic contamination to < 10 ppb; removes iron contamination to < 0.3 ppm; Purifies 25-30 litres of water per day

Technologies for Water Purification

- Technology for preparation of thin-film composite based sea water reverse osmosis membrane developed and transferred for commercial production



Commercial production of Polyamide Coating Membrane

Technologies for Food & Agriculture

- Developed technology to **preserve Litchi up to 60 days** at low temperature while retaining its nutritional, sensory (taste), functional and colour qualities
- **Opens up trade avenues and minimises economic loss**
- Technology transferred to several entrepreneurs



Litchi after 4 Days of Harvest



Processed Litchi after 60 days at 4 °C

India second largest producer of litchi

Cultivated over an area more than 60,000 hectares

Annual production of approx. 5,00,000 tones

Technologies for Food & Agriculture

- Developed advanced varieties of **mustard seed** with higher yields than national check varieties. After successful field trials at Rajasthan, **TM108-1 pre-released in 2016**
- Developed advanced semi-dwarf variety of **Doobraj rice** with 35% higher yield, earlier maturity and better aroma. Being **pre-released in Chhattisgarh in May, 2017**



Mustard variety TM108-1 and TM204 have 16-22% higher yield than regular *Kranti*, *Pusa Bold* and *Shatabdi* varieties

Technologies for Bio-degradable Polymers

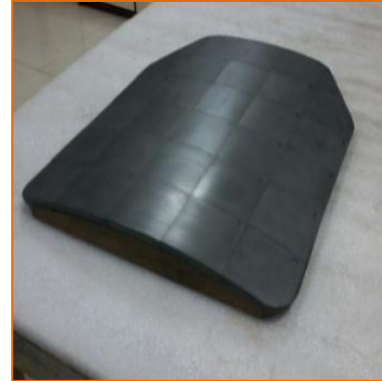
- Developed a new bio-degradable clay-polyethylene nano-composite film using gamma irradiation along with chemical treatment. The film **can be used for food irradiation applications**
- Easy biodegradation under normal conditions without generation of secondary wastes and toxic chemicals



Suitable for packaging for irradiated and microwave-processed food materials
Recyclable without affecting mechanical, thermal and optical properties of the film
Transparent, printable, cost-effectiveness and absolutely safe for human handling

Innovative new bullet-proof material

- **Bhabha Kavach**, a **light-weight bullet-proof Jacket** which gives personal protection against bullets of different threat levels has been developed and ready for production



Protection against SLR, AK-47 mild steel core bullet) weigh around 4.8 kg with trauma less than 20 mm

Technology for Bio-Pesticide

- **Novel Bio-pesticide formulations developed** and evaluated under field conditions
- Evaluations being carried out for adoption as an eco-friendly component of the insect pest management programmes with several municipal corporations



Bio-pesticide is found to be effective against mosquitoes

Indigenous Gold Standard

- BARC and CSIR co-developed India's first gold standard
- **भारतीय निर्देशक द्रव्य** (or BND 4021) enables jewellers to check the purity of gold jewellery and bullion
- **#MakeInIndia gold standard** helps save foreign exchange and minimises dependency on other countries



Bhartiya Nirdeshak Dravya is indigenous gold standard for checking purity of gold