40 Years of Nuclear Electricity in India

40 YEARS OF NUCLEAR ELECTRICITY IN INDIA

DEDICATION

Dedicated to Dr. Homi Jehangir Bhabha (1909-1966)--architect of India's Nuclear Power Programme.

Dr. Homi. J. Bhabha said in 1944 "When nuclear power has been successfully applied for power production, say in a couple of decades from now, India will not have to look abroad for its experts but will find them ready at home". – Prophetic.

The Indian nuclear power programme was flagged off on May 8, 1964 with the signing of an agreement with General Electric, USA for construction and commissioning of two Boiling Water Reactors (BWRs) of 210 MWe each at Tarapur, Maharashtra. The first unit of Tarapur was synchronized to the grid on 1st April, 1969, heralding a new era of Nuclear Power generation in the Asian sub- continent. The second unit of Tarapur was synchronized to the grid on 8th May, 1969.

Over the last 40 years many modifications have been carried out on both the units for safe and efficient operation. An in-depth review of the operating experience, ageing management, and design and safety analysis was carried out in 2005 for its safety upgradation to the current standards.

It is a matter of pride that all these modifications and upgradations were carried out by the indigenous developments.

It was the vision of Dr. Bhabha, father of Indian nuclear power programme, that India should have a three stage nuclear power programme so that the abundant reserves of thorium in India can be utilised in the third stage. The first stage of the programme was started on 16th December 1973 with the commissioning of Rajasthan unit- 1. Over a period of three and half decades 15 PHWRs have been added with a total installed capacity of 4120 MWe.

The Proto-type Fast Breeder Reactor is being set up at Kalpakkam which will be the foundation for the second stage of the programme.

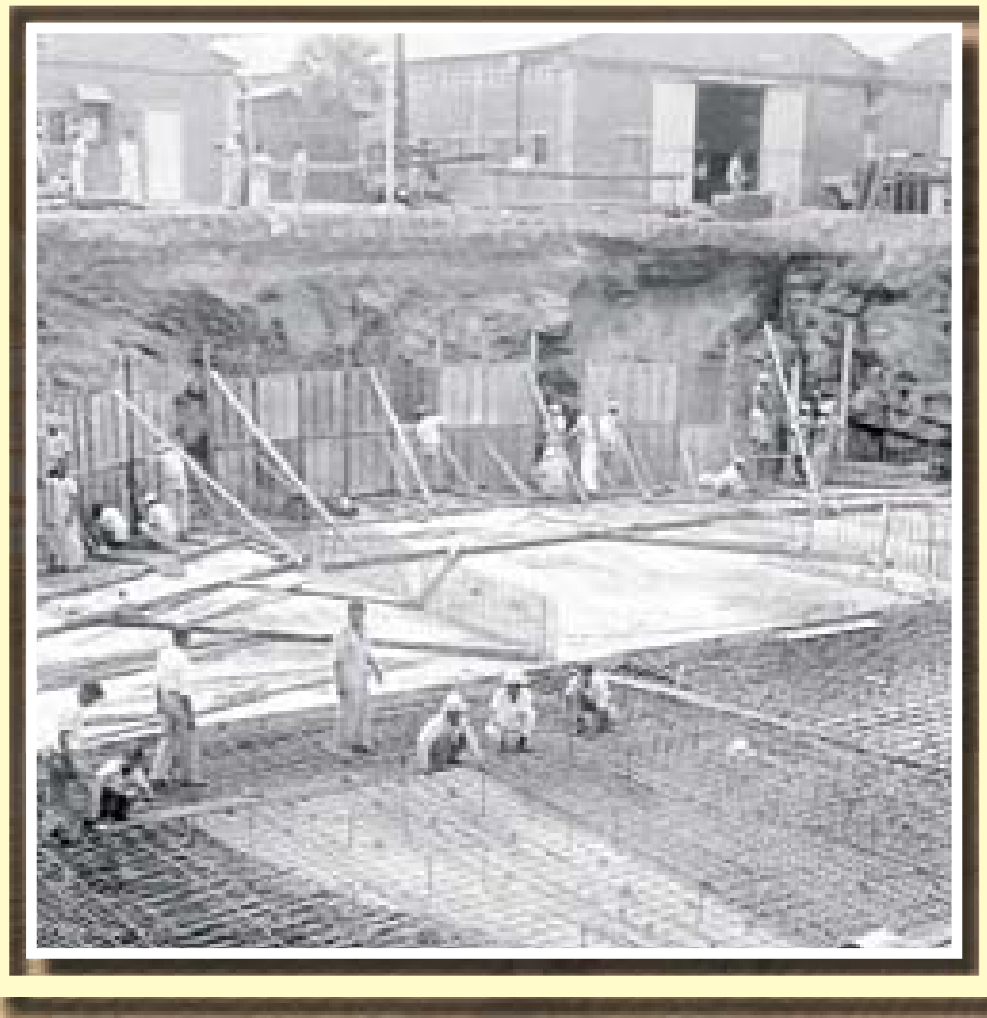
This souvenir gives a glimpse of the 40 years of nuclear power in India, a journey which started in 1969 from Tarapur.

FOREWORD

SIGNING OF CONTRACT

A turn-key contract for the construction of two boiling water reactors (BWRs) is signed with the General Electric, USA on May 8, 1964. The contract signed in Washington will lead to setting up of two units of 210 MWe each at Tarapur and was to provide India a first-hand experience of operating a nuclear power plant under Indian grid conditions.

India took a head-start in the field of nuclear power with the commencement of construction of Tarapur units in October 1964. About four decades later, India was to emerge as a country with eight reactor units concurrently under construction – highest in the world at that epoch.



CONSTRUCTION BEGINS

ERECTION OF DRY-WELL HEAD

Installation of primary containment dry-well head in May 1966. Erection of heavy equipment including critical nuclear components is one of the expertise of NPCIL.

Dr. Vikram Sarabhai, the then Chairman AEC examining the methodology of erection of reactor vessel on a model-demo.

ERECTION OF REACTOR VESSEL

Looking ahead. Once commissioned, Tarapur plant was to metamorphose the sleepy hutment of Tarapur into a bustling industrial area. By the turn of century, even as India was to become a fast developing economy with a population of over a billion, nuclear power was to emerge as an important source of power to fuel the economy. Above, supposedly a mother and a child look at the erection of reactor vessel in 1966.

Tarapur laid a healthy tradition of strong media interactions. In future, NPCIL was to hold several programmes for media on regular intervals and interact with them on a continuous basis. Below, a press delegation visiting Tarapur plant in 1967.

PRESS VISIT

MRS. INDIRA GANDHI VISITS TARAPUR

Tarapur, a treasured asset is valued and adored by policy and decision makers. Above, the then Prime Minister (late) Mrs. Indira Gandhi visits Tarapur in October 1967 ahead of commencement of its operation. A large number of esteemed guests from different walks of life were to pay a visit to Tarapur in the days to come.

Transportation and erection of dedicate, often heavy and over-dimensional, critical components was to evolve into a highly sophisticated area, with the use of modern and complex tools and tackles. Below, transportation of neutron monitors at TAPS 1&2 in 1967. Background shows action four decades later.

FUEL LOADING

Fuelling a powerful future. Tarapur units use low enriched uranium (LEU) as fuel and have faced challenges due to disruptions in its supply. The challenges have been successfully over-come and the units have operated un-interruptedly. Below, manual fuel loading in January 1969.

The first unit of Tarapur is connected to grid on April 1, 1969 and the first unit of electricity produced by uranium fission flows into the grid for the first time anywhere in Asia. Tarapur heralds a new era of nuclear power in Asia, the region which was to see fastest growth of nuclear power in the world in the new millennium. Tarapur also becomes the largest operating unit of any kind in India. The unit is declared commercial on November 1, 1969 and dedicated to the Nation by the then Prime Minister (late) Mrs. Indira Gandhi on January 19, 1970 (below).

WHITE HOUSE DELEGATION

White House delegates visit Tarapur in July 1977. (L-R) Mr. K. Nanjundeswaran and Mr. Raghavan, explaining the complexities of a nuclear reactor to the delegates.

The then Prime Minister, (late) Shri Morarji Desai paid a visit to Tarapur in May 1979. (L-R) Messrs B.K. Bhasin and K.P. Rao take the PM on a guided tour.

SHRI MORARJI DESAI VISITS TARAPUR

SHRI MORARJI DESAI VISITS TARAPUR

SILVER JUBILEE CELEBRATIONS

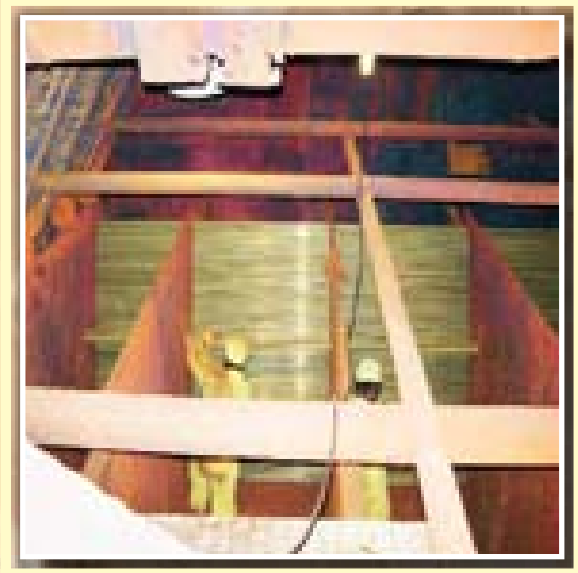
Tarapur completes 25 years of its service to the nation in the year 1995. The two units were re-rated in 1984 to 160 MWe each. Today, the two units continue to be a source of cheap electricity at Rs. 0.94 a unit.

Tarapur celebrates three decades of successful operation. The Missile Man of India, Dr. APJ Abdul Kalam visits plant in 2001. Tarapur units have been operating at a level comparable to the best in the world. The units have clocked a capacity utilisation of about 90% or even higher in the last many years. The two units have supplied more than 77, 000 million units of electricity to the grid (as on March 31st, 2009).

DR. APJ KALAM'S VISIT

LIFE MANAGEMENT OF TAPS 1&2

Tarapur completes its 40 years of illustrious service to the Nation on April 1, 2009. The units have undergone safety up-gradation, renovation and refurbishment to bring them to the current level of technology. The up-gradation was accomplished based on the recommendation of safety review of the plant. Glimpses of up-gradation and refurbishment, (clockwise) a new air drier; installation of full capacity emergency Diesel generator in seismically qualified building; and re-tubing in condenser.



Sr.No	Awards Detail	Year
1.	Gold shield for outstanding performance of station from Ministry of Power	2000-01, 2001-02 2002-03, 2003-04
2.	Gold Shield National Award for meritorious Performance of the station from Ministry of Power	2004-05
3.	Atomic Energy Regulatory Board Industrial Safety Award	2002, 2003
4.	Atomic Energy Regulatory Board Fire Safety Award	2002, 2003, 2005, 2006, 2007, 2008
5.	Appreciation letter from Chairman, AERB for maintaining good fire safety standards.	2004
6.	NPCIL Industrial Safety Award	2002
7.	National Safety Council Award for meritorious performance in the Industrial Safety consecutively for three years	1998, 1999, 2000
8.	National Safety Council Award for Lowest average accident frequency rate.	2002
9.	National Safety Council Award for Longest Accident free period	2002, 2003, 2005
10.	Suraksha Puruskar from the National Safety Council	2004
11.	Shrestha Suraksha Puruskar from the National Safety Council	2005
12.	National Safety Award for Lowest average accident frequency rate by Ministry of Labour and Employment.	2005

TAPS, like other nuclear power stations also implements various neighborhood welfare schemes including:

- Free Medical camps
- Construction of school building
- Maintenance of roads
- Regularization of water supply
- Promotion of sports activities
- Free education to tribal students in department's school.
- School uniforms and books to needy students.
- Aid during natural calamities

EXCELLENCE IN PERFORMANCE

Tarapur, one of the oldest operating nuclear power plants of its kind in the world has been recognised and awarded for its excellent performance. Below, Honourable Prime Minister, Dr. Manmohan Singh giving away National Award for meritorious performance (Gold Shield) for the year 2004-05 in July 2007 to Dr. S.K. Jain, CMD, NPCIL(middle), and Site Director Tarapur Maharashtra site, Shri U. Ramamurty (right).

PHWR Programme

The units set up after Tarapur 1&2 were of Pressurised Heavy Water Reactor (PHWR) type. These units constitute the first stage of India's nuclear power programme. The units have evolved since 1970s, when Rajasthan units were set up, both technologically as also in unit size.

700 MWe & above

FUTURE PROJECTS

540 MWe

220 M We

2000s Commercialisation

1990s Consolidation

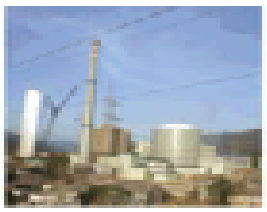
1980s Standardisation

1980s Indigenisation

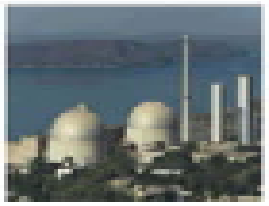
1970s Technology Demonstration

TAPS 3&4

RAPS 3&4



KGS 3&4



RAPS 1&2

MAPS 1&2

NAPS 1&2

KAPS 1&2

KGS 1&2

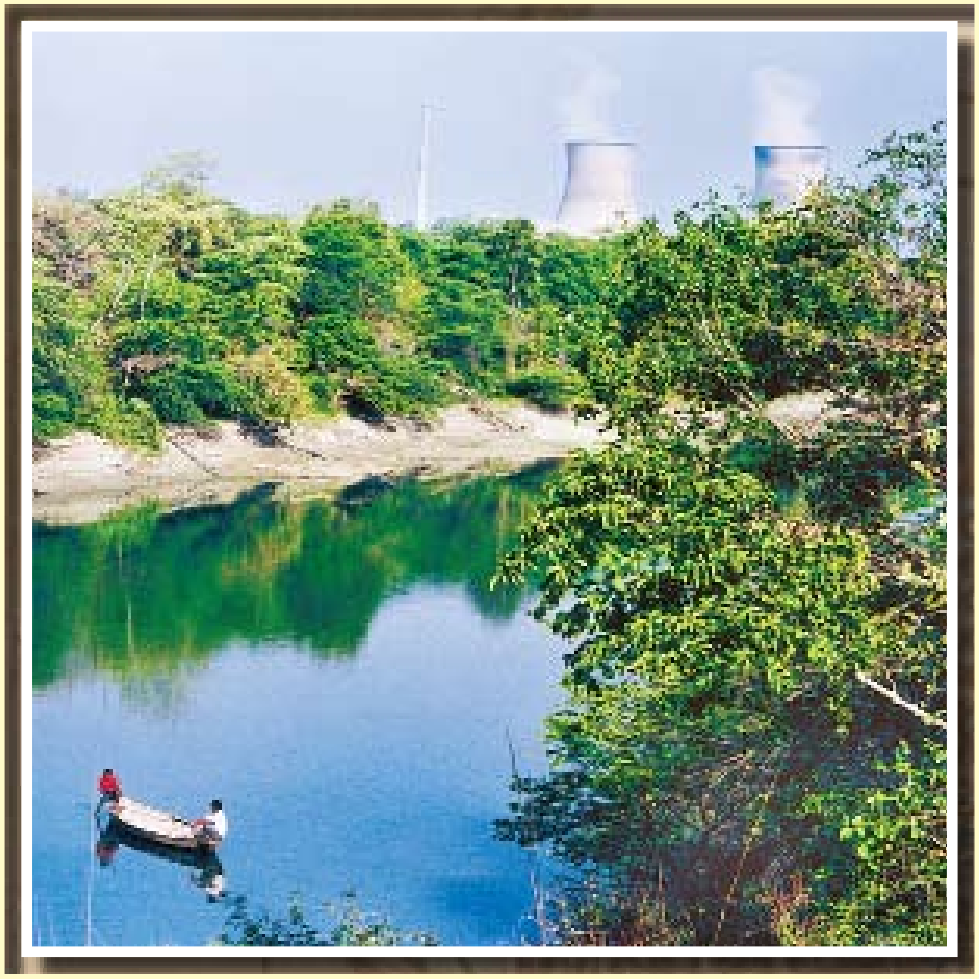
RAPS 5&6

RAPS

The first two PHWR units in India were set up at Rawatbhata in Rajasthan. The unit-1 and its successor unit-2 were in effect prototypes for India even as Douglas Point reactor, on which they were modelled, was for Canada. The two units become commercial in 1973 and 1981 respectively. Today, the site is India's first nuclear park with four units under operation and additional two at an advanced stage of completion. The unit-2 has undergone safety up-gradation and refurbishment including repair of over pressure relief device, a technological feat indeed. The unit-4 made a record of uninterrupted operation of 373 days in 2006.

Engineers introduced several design features and innovative design changes in Madras Atomic Power Station when a decision was taken to commence work in 1967. MAPS was first indigenous plant. The two units commenced commercial operation in 1984 and 1986. The units, were de-rated to 175 MWe each in 1989-90 due to a technical problem in one of the components (sparger) which ensures a good mixing of heavy water moderator entering the reactor vessel (calandria). The units also have undergone Enmasse Coolant Channel Replacement and other safety up-gradation and R&M. The capacity of the units has been restored to its original 220 MWe each. The station celebrated its silver jubilee of service to the Nation in 2008.

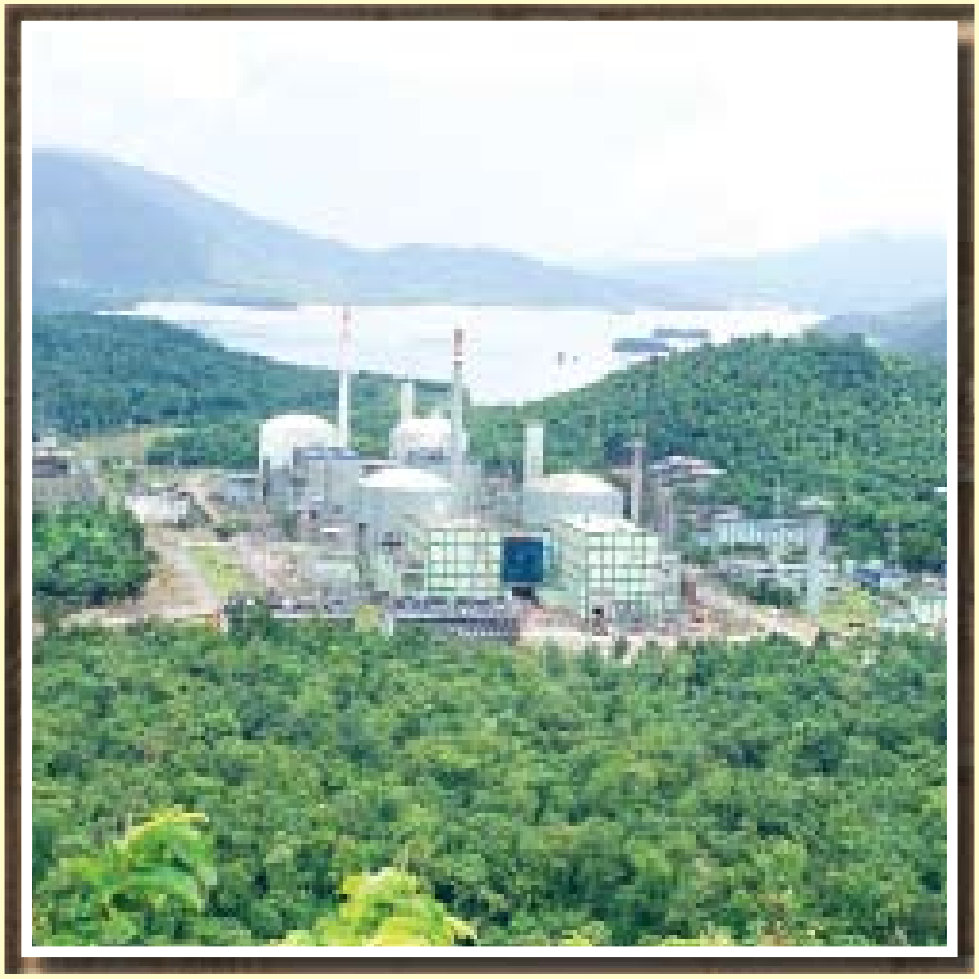
NAPS



The feedback from Rajasthan and Madras units paved the path for the development of India's 220 MWe standardised design of PHWR. First two such units were set up at Narora. The design included several innovative features raising the safety standards. The first unit was declared commercial on January 1, 1991 and the second on July 1, 1992. Narora plant was the first nuclear power plant in Asia to get ISO-14001 accreditation for environment management system. Subsequently all the nuclear power stations have been accredited for ISO – 14001 and many of them for IS – 18001 (Occupational Health and Safety Management System).

The valuable experience gained at Narora was gainfully utilized at Kakrapar. The two units, similar in design with Narora, were commissioned in a shorter period and with less pain. It was the first plant where heavy duty cranes and other means of automation were employed for erection of large equipment. The two units commenced commercial operation in May 1993 and September 1995 respectively. Kakrapar plant was the first Indian nuclear power plant to undergo peer review by the World Association of Nuclear Operators (WANO). Unit-1 set a record of continuous operation of 372 days in the year 2005.

K G S



Kaiga site presently comprise four units of 220 MWe each, of which one is under construction and likely to be commissioned shortly. The site, remotely located in the thick of smoky blue mountains of Uttar Kannada district, receives over 4000 mm of rains during monsoon spanning nearly six months. Engineers devised innovative methods to overcome such hurdles and maintain work-pace. The last unit, Kaiga-3, achieved criticality in less than five years from the start of construction which is comparable with the best in the world. Kaiga-2 achieved a distinction of un-interrupted operation of 529 days in 2008.

The design and development of large size of 540 MWe PHWR unit was undertaken in 1990s even as a series of standardised 220 MWe units were being set up. Construction works on two scaled up, new generation units with state-of-the-art technology commenced in the year 2000 at Tarapur, close to units 1 & 2. The two units employed modern methods of construction and project management. The first unit, in spite of being proto-type, was commissioned within five years. Successful commissioning of Tarapur 3 & 4 units led to development of future 700 MWe PHWR units. Thus, Tarapur once again become cradle to a new generation nuclear power plant.

TAPS 3&4

TECHNOLOGY MISSIONS

NPCIL has developed comprehensive capabilities under one roof from designing, construction, commissioning, operation and maintenance of nuclear power plants to refurbishment, safety upgradation and their life extension. Some of these operations, very complex and challenging have no parallels. (Clockwise from above); En-masse coolant channel replacement at RAPS-2; replacement of vintage hair-pin type boilers at MAPS; LASER cutting of coolant channel at KAPS.

The first Proto-type 500 MWe Fast Breeder Reactor (FBR) is nearing completion at Kalpakkam. The reactor will use plutonium as fuel and breed more fuel from the irradiation of thorium. Commissioning of PFBR will mark the dawn of second stage of India's 3-stage nuclear power programme.

THE SECOND STAGE: PFBR

ADD ONS: KKNPP

In order to achieve a faster nuclear capacity addition, light water reactors (LWRs) have been planned. Two such units are being set up in technical collaboration with the Russian Federation at Kudankulam and at an advanced stage of construction. The two units, of 1000 MWe each, are largest power units of any kind in the country.

"This world class plant built with full indigenous efforts is a matter of pride for all Indians. It has been a thrilling experience to be with all those of you who have made this achievement. On behalf of nation, I congratulate each and every individual involved in accomplishing this task".

Dr. Manmohan Singh
Prime Minister of India

TAPS 3&4 DEDICATION TO NATION

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