

Development of Nuclear Energy
Programme and the Role of
Government and International
Organisations

Special Symposium for the IAEA
50th Anniversary

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Installed Generating Capacity (as on 31-10-2006)

Thermal (Coal & Gas)	83.7 GW
Hydro-electric	33.2 GW
Renewable	6.2 GW
Nuclear	3.9 GW
Total	127 GW

Integrated Energy Policy

Projected Requirements by the year 2031 -32

Thermal (coal & gas)	390 GW
Hydro-electric	150 GW
Renewable	97 GW
Nuclear	63 GW
Total	700 GW

Reference :- Table 3.9, Integrated Energy Policy, Report of the Expert Committee; Aug 2006

Power Sector Ownership

- 100% Private Sector participation in Generation (except nuclear) , Transmission & Distribution; including Foreign Direct Investment
- Central Government Company can set up Nuclear Power Plants, as per the present Atomic Energy Act
 - Thermal Reactors : NPCIL
 - Fast Breeder Reactors : BHAVINI
- Atomic Energy Act under amendment for private sector participation in nuclear power generation

FIRST STAGE

Established Comprehensive Indigenous Capabilities to Design, Equipment Manufacturing, Construction, Commissioning, O&M of 220 MWe PHWRs

Development, construction Commissioning, O&M of 540MWe PHWRs

Design of 700 MWe PHWR under review by AERB

Developed Front End & Back End Technologies of Complete Fuel Cycle

Set up LWR's with Imported technology & Foreign funding as capacity addition, Construction of KK Project under progress

IMPORTED ROUTE

Indian Nuclear Power Programme:
Current Status

SECOND STAGE

Fast Breeder Test Reactor already generating electricity

Construction of 500 MWe Prototype Fast Breeder Reactor recently started

THIRD STAGE

Experimental reactor using U233 fuel in operation

Thorium Fuel bundles fabricated & used in PHWR; U233 produced

Nuclear Power Programme

- Three Stage Nuclear Power Program
 - First Stage has reached a level of maturity. 540 MW and 700 MW reactors designed indigenously
 - Second Stage: 500 MW PFBR under construction
 - 3rd Stage AHWR : Construction expected to start in next 1 to 2 years
- Capability from mining to reprocessing including waste management

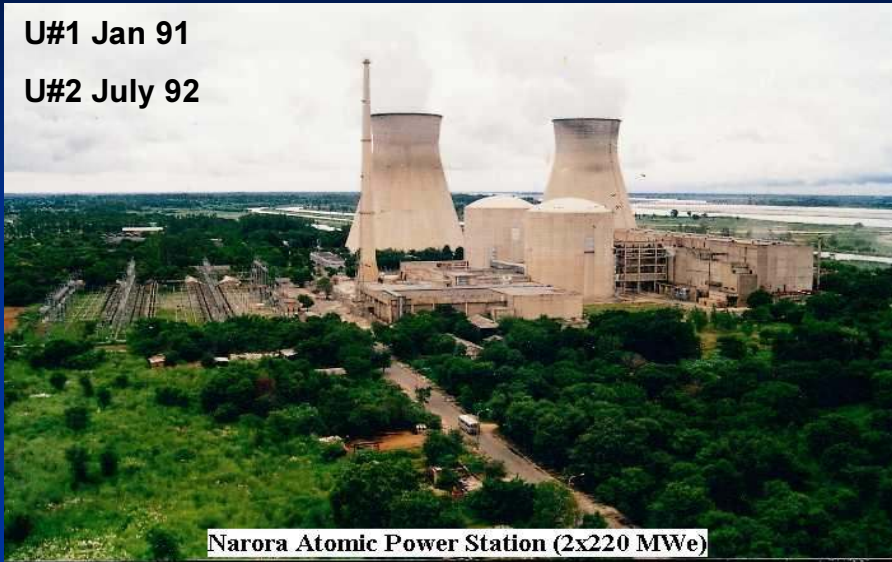
Present Nuclear Power Status

- Sixteen Reactors consisting of 2 BWRs & 14 PHWRs with total Capacity of 3900 MW in operation
- One more 220 MWe PHWR made critical in February 2007
- Six Reactors Consisting of 3 PHWRs, 2 PWRs & 1 FBR with Capacity of 3160 MW under construction
- Four sites approved in principle for construction of eight more reactors for capacity addition of 6800 MW : 4 PHWRs of 700 MW and 4 LWRs of 1000 MW

NPPs in Operation

U#1 Jan 91

U#2 July 92



Narora Atomic Power Station (2x220 MWe)

U#1 May 93

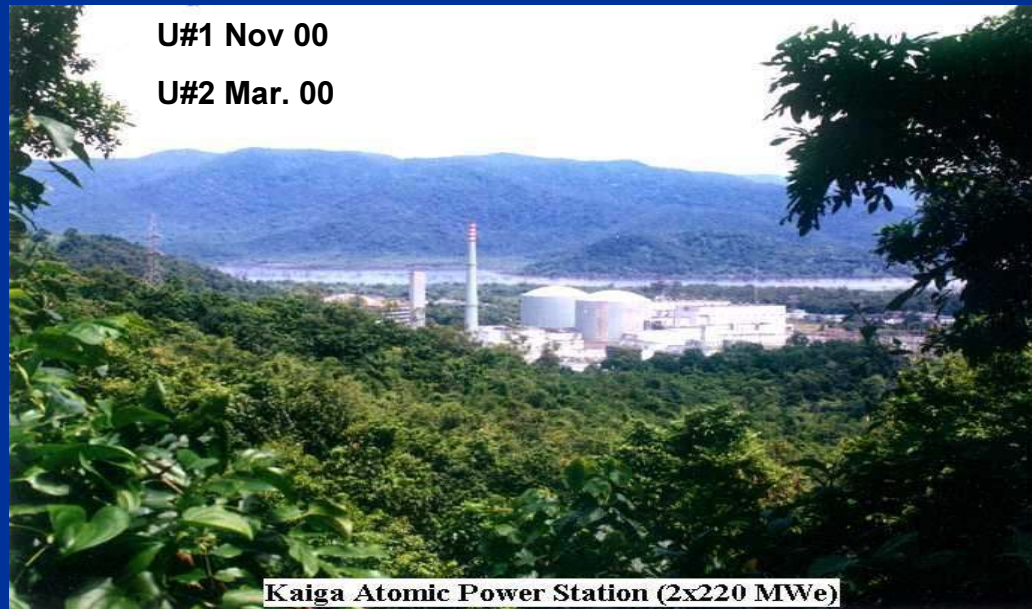
U#2 Sept. 95



Kakrapar Atomic Power Station (2x220 MWe)

U#1 Nov 00

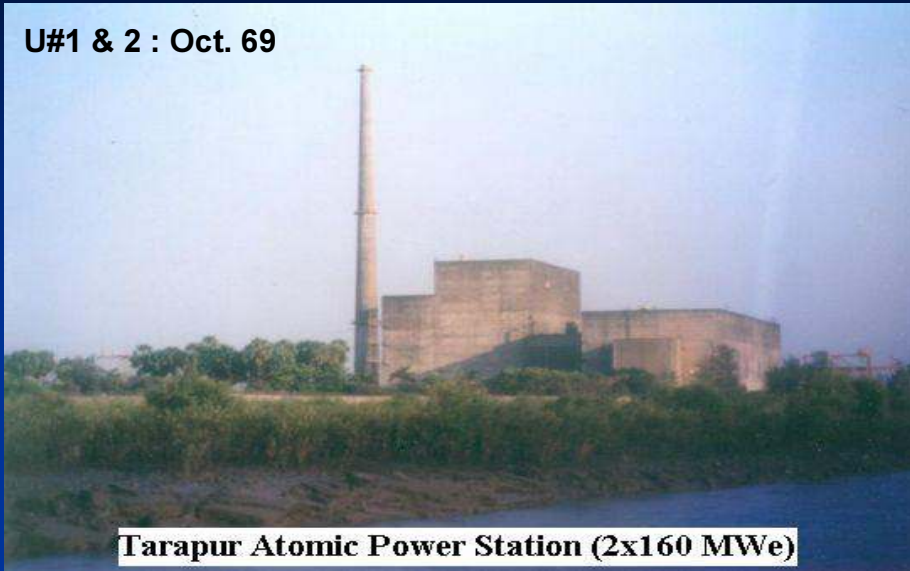
U#2 Mar. 00



Kaiga Atomic Power Station (2x220 MWe)

NPPs in Operation

U#1 & 2 : Oct. 69



Tarapur Atomic Power Station (2x160 MWe)

U#4 Sept. 05

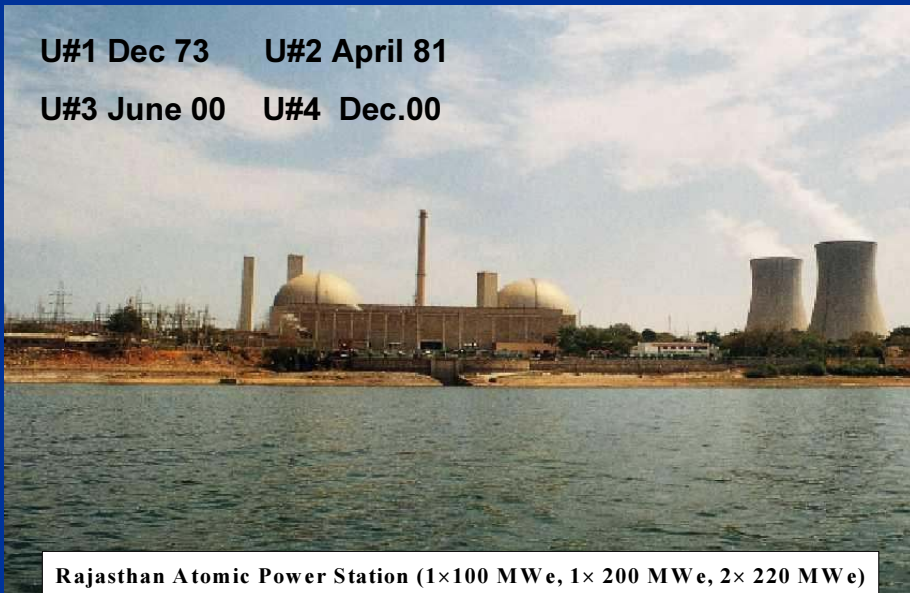
U#3 May 06



Tarapur Atomic Power Station-3&4 (2x540 MWe)

U#1 Dec 73 U#2 April 81

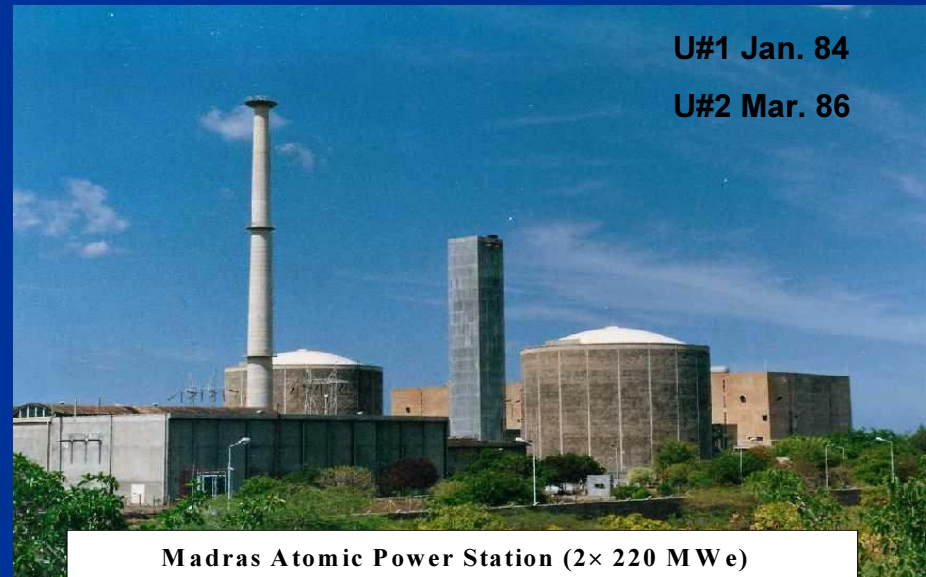
U#3 June 00 U#4 Dec.00



Rajasthan Atomic Power Station (1x100 MWe, 1x 200 MWe, 2x 220 MWe)

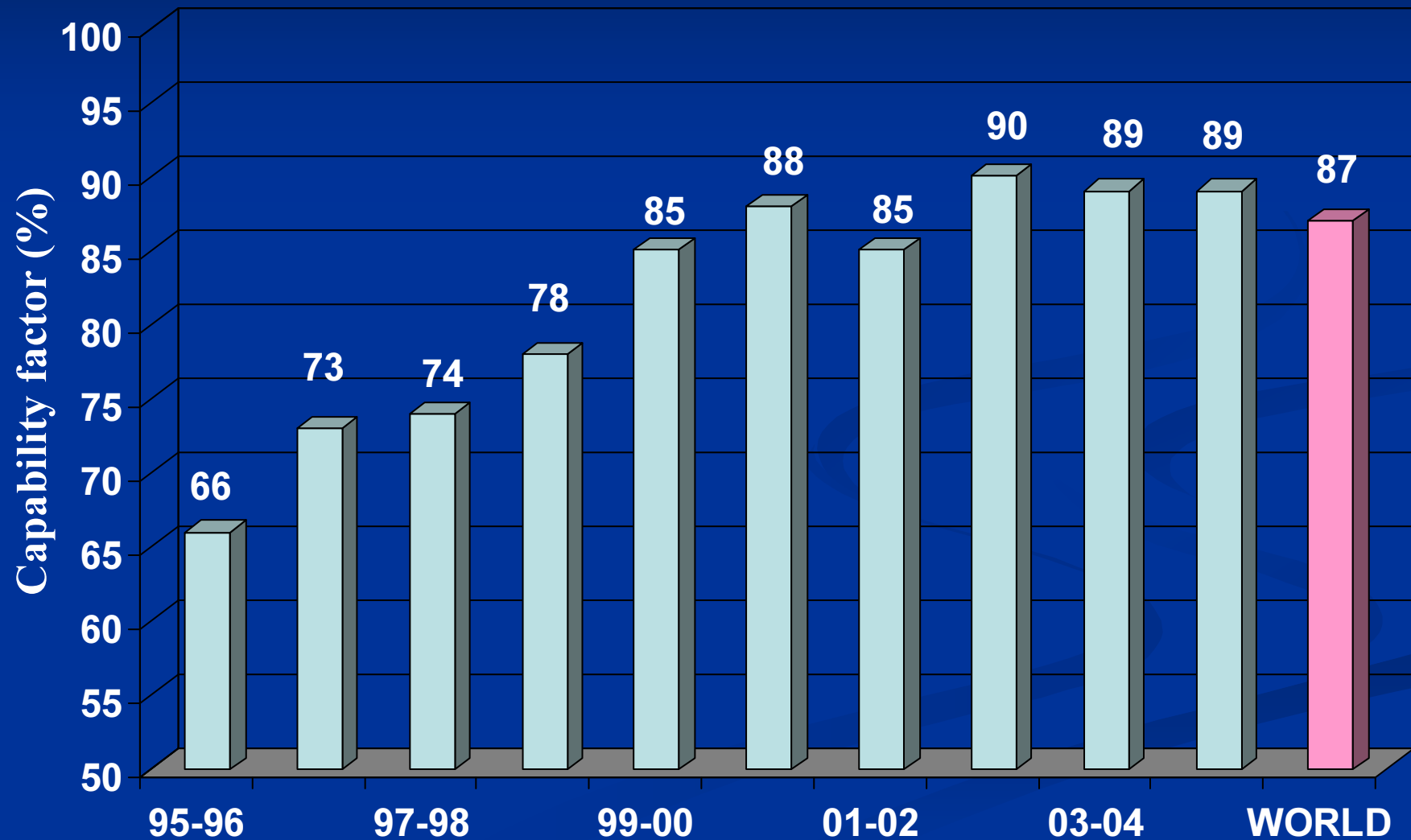
U#1 Jan. 84

U#2 Mar. 86

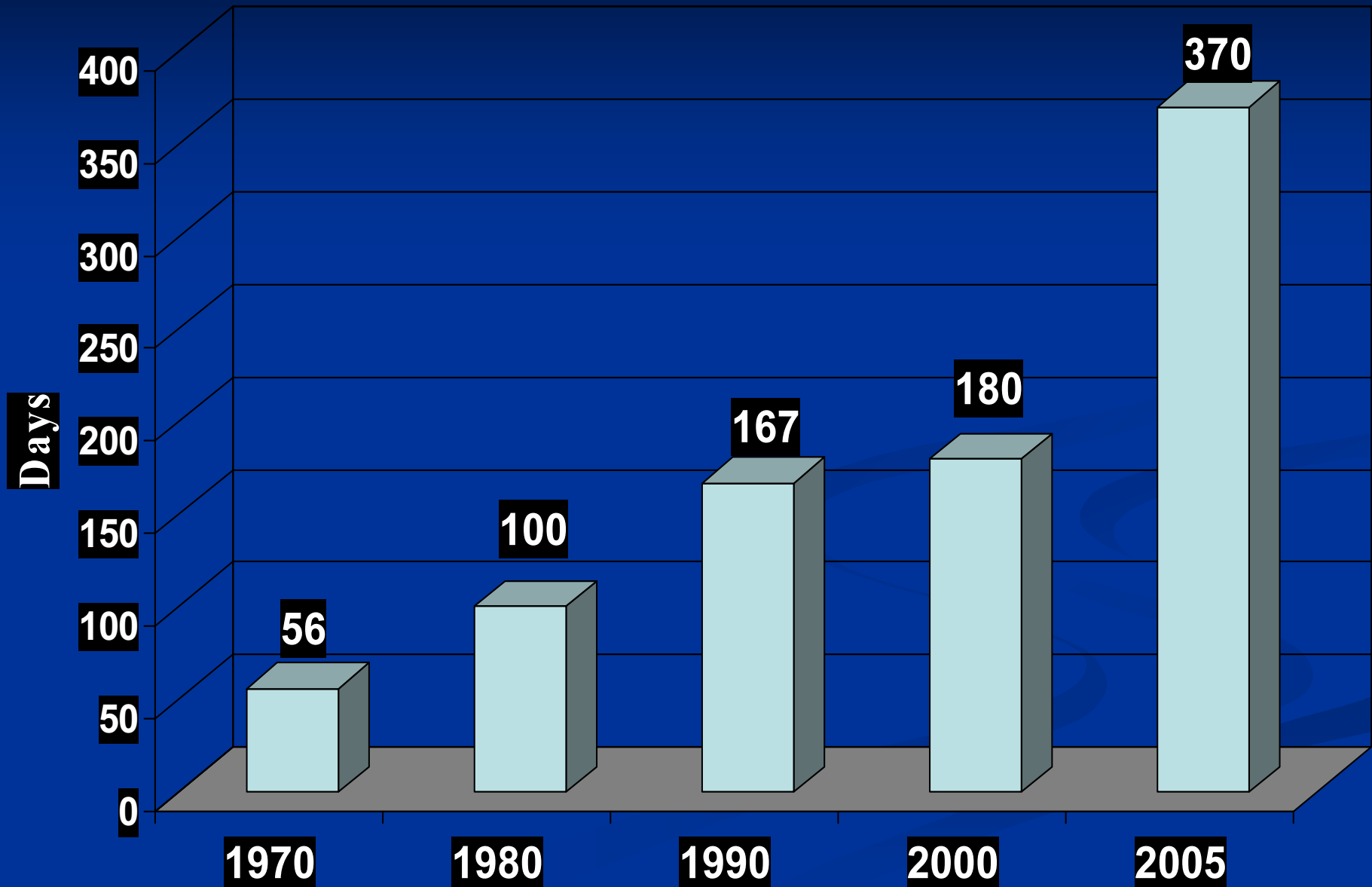


Madras Atomic Power Station (2x 220 MWe)

Unit Capability Factor (NPCIL Median)



Longest Continuous Operation



NPPs under construction

Kaiga-3&4



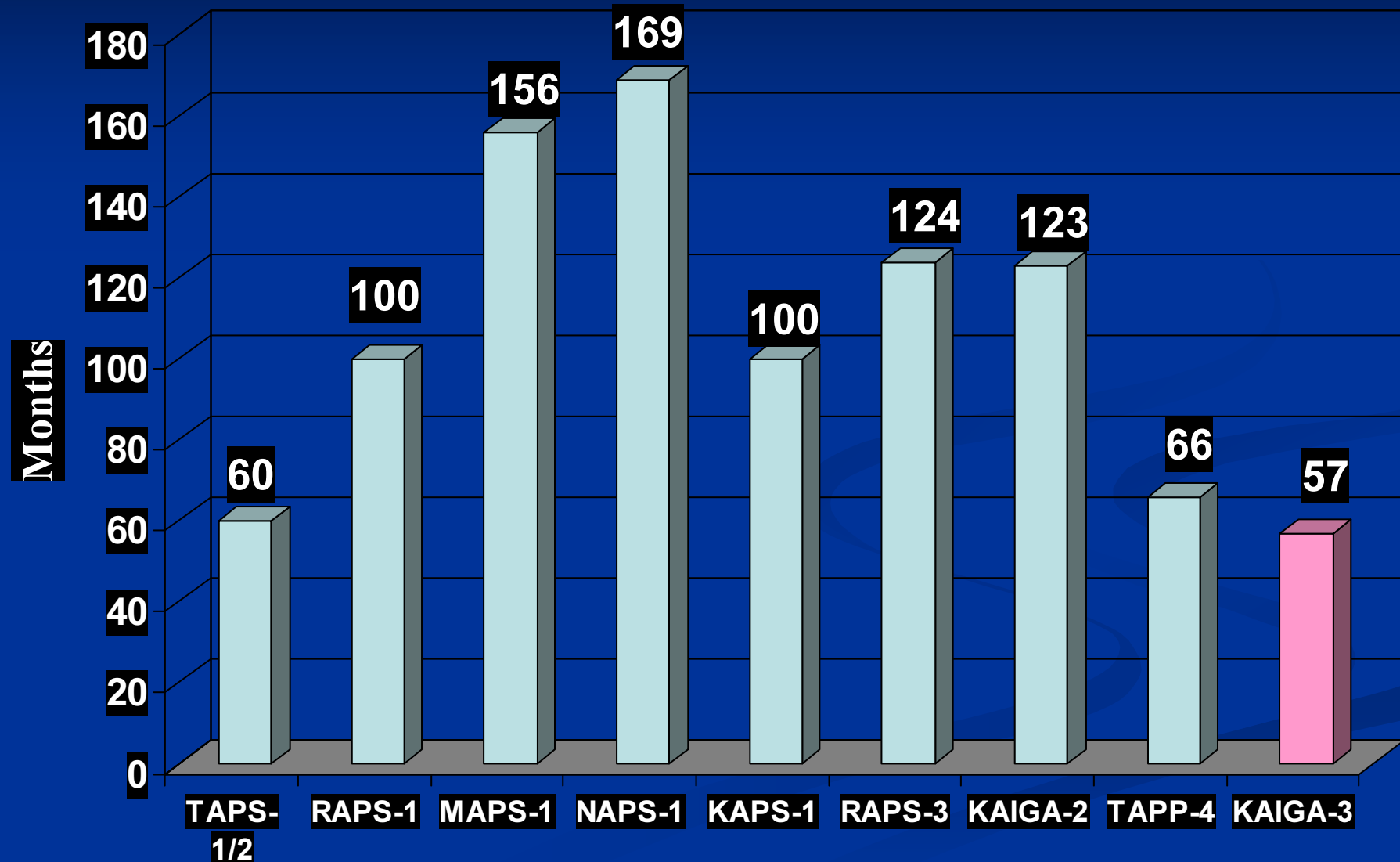
RAPP-5&6



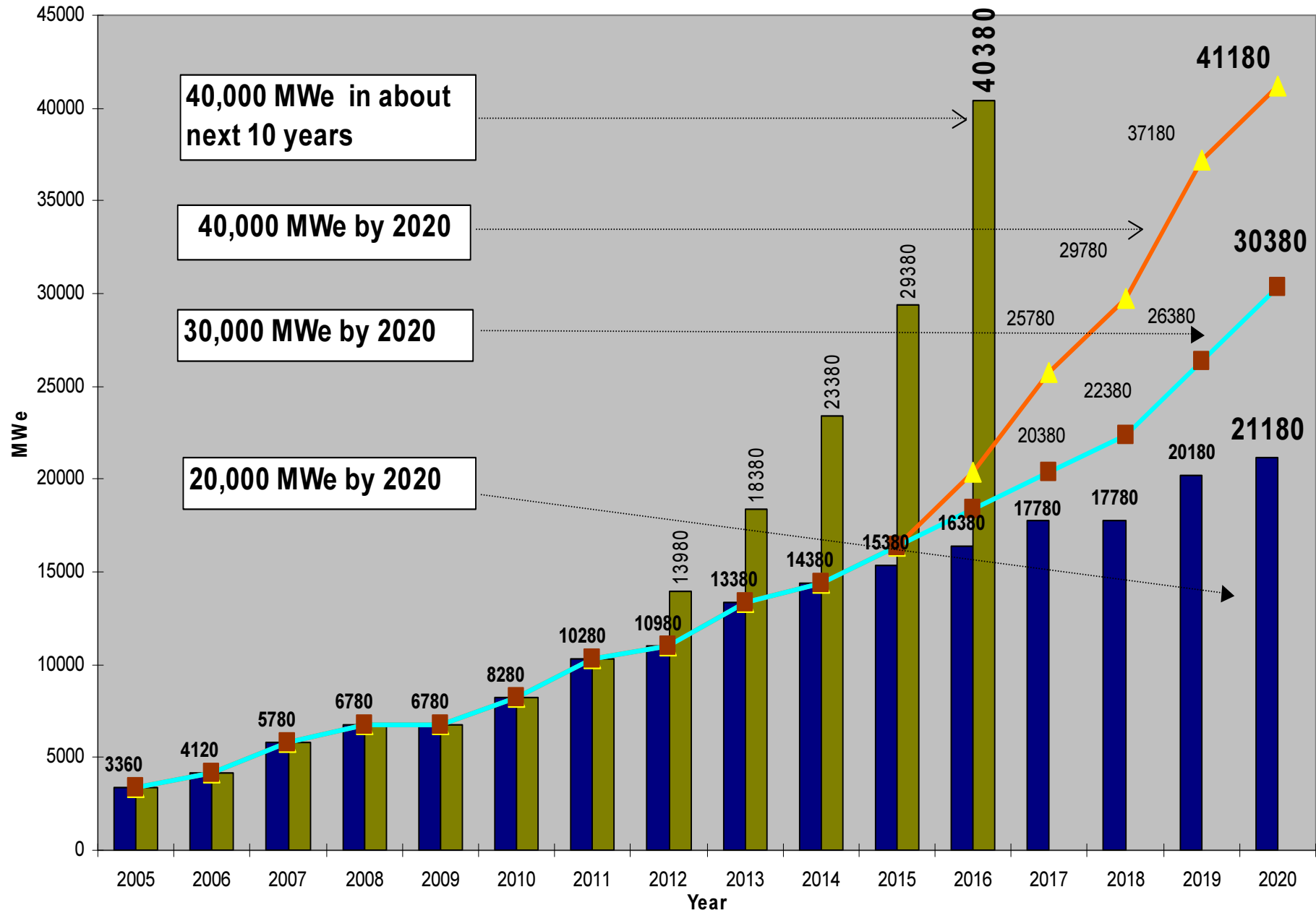
Kudankulam NPP



Time from FPC to Commercial Operation



NUCLEAR POWER PROGRAMME (Capacity Buildup)



NUCLEAR POWER PLANTS IN OPERATION

RAWATBHATA
740 MWe
(1x100+1x200+2x220)

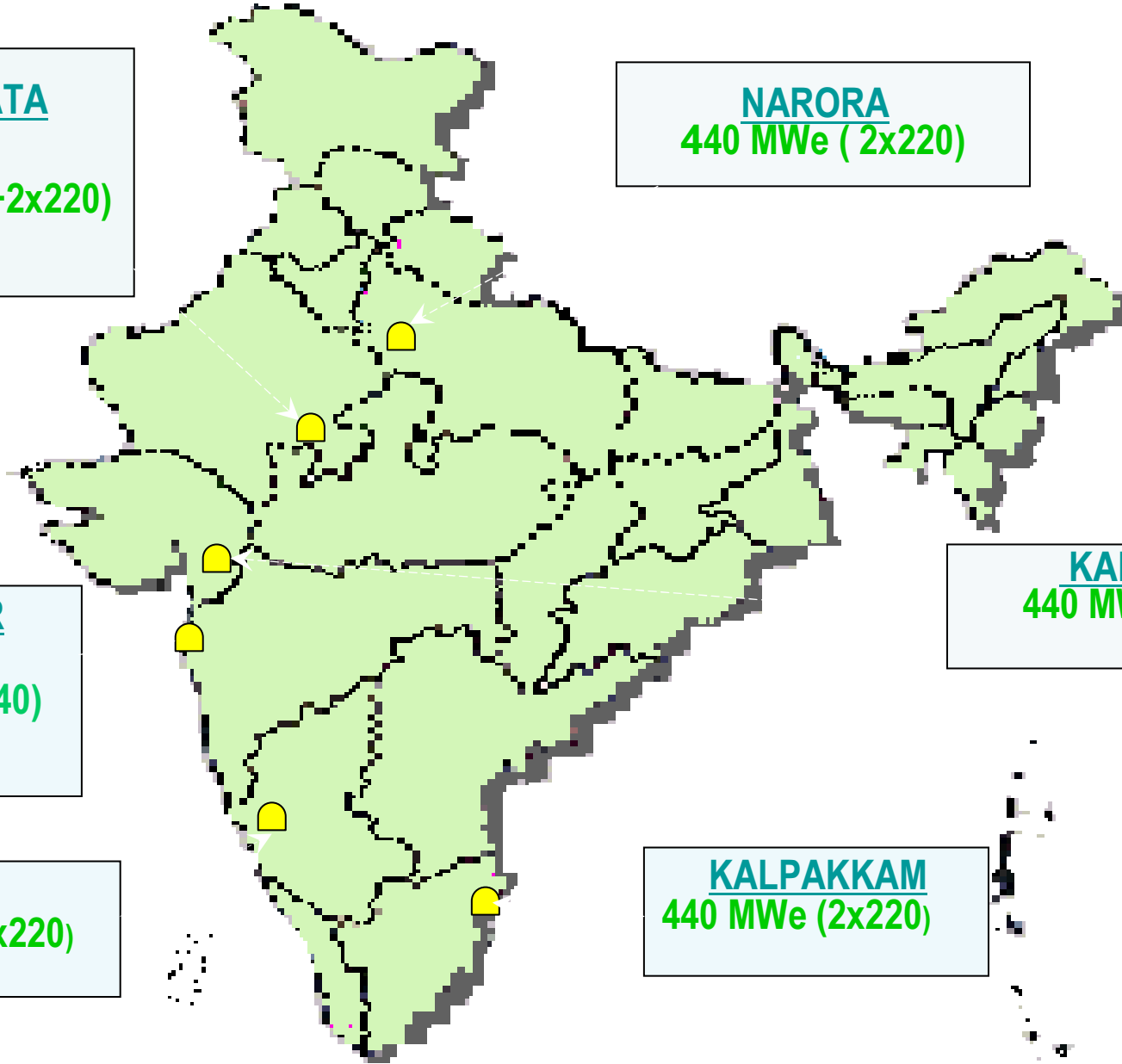
NARORA
440 MWe (2x220)

TARAPUR
1400 MWe
(2x160 + 2x540)

KAKRAPAR
440 MWe (2X220)

KAIGA
440 MWe (2x220)

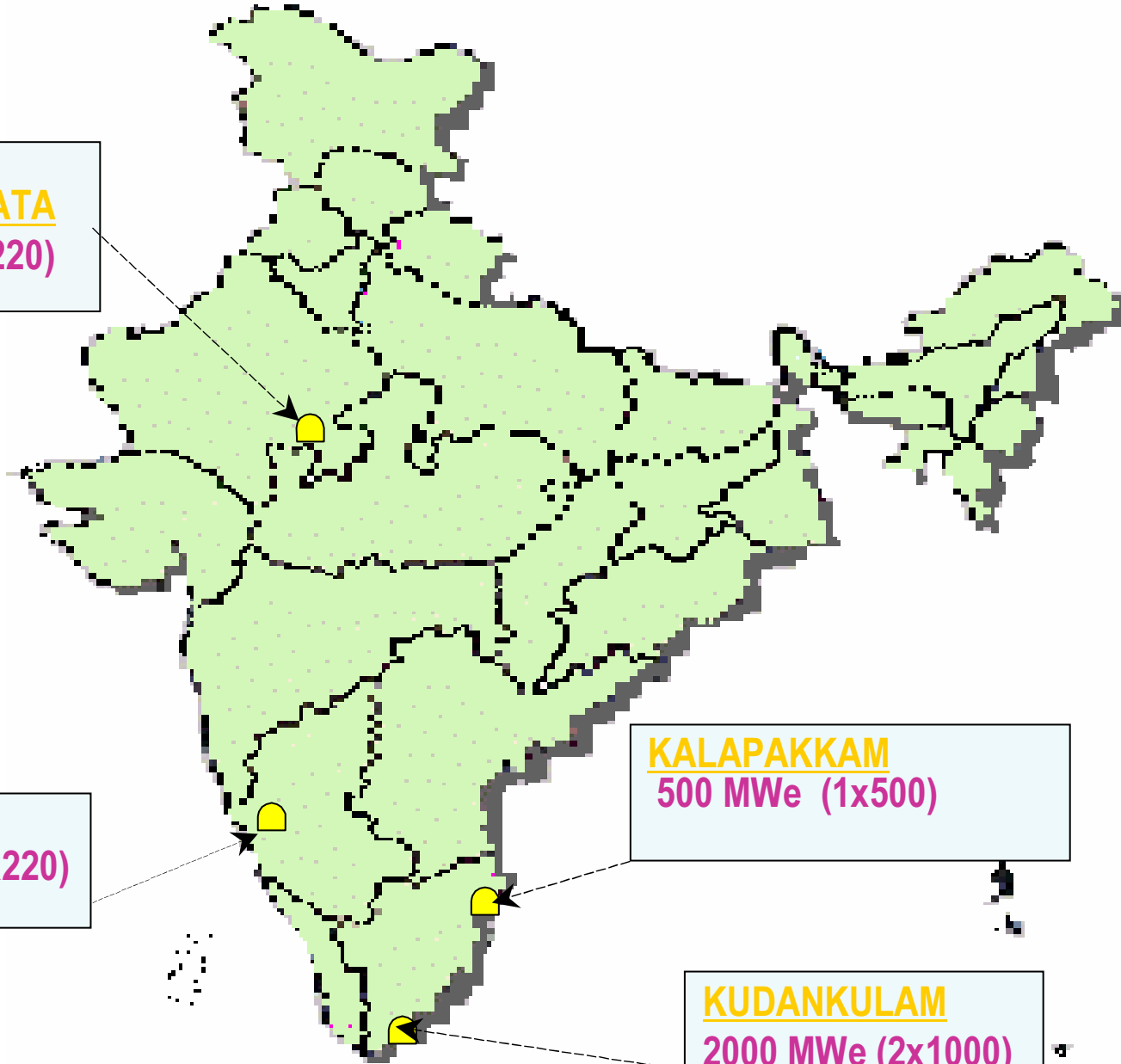
KALPAKKAM
440 MWe (2x220)



NUCLEAR POWER PLANTS UNDER CONSTRUCTION



RAWATBHATA
440MWe (2X220)



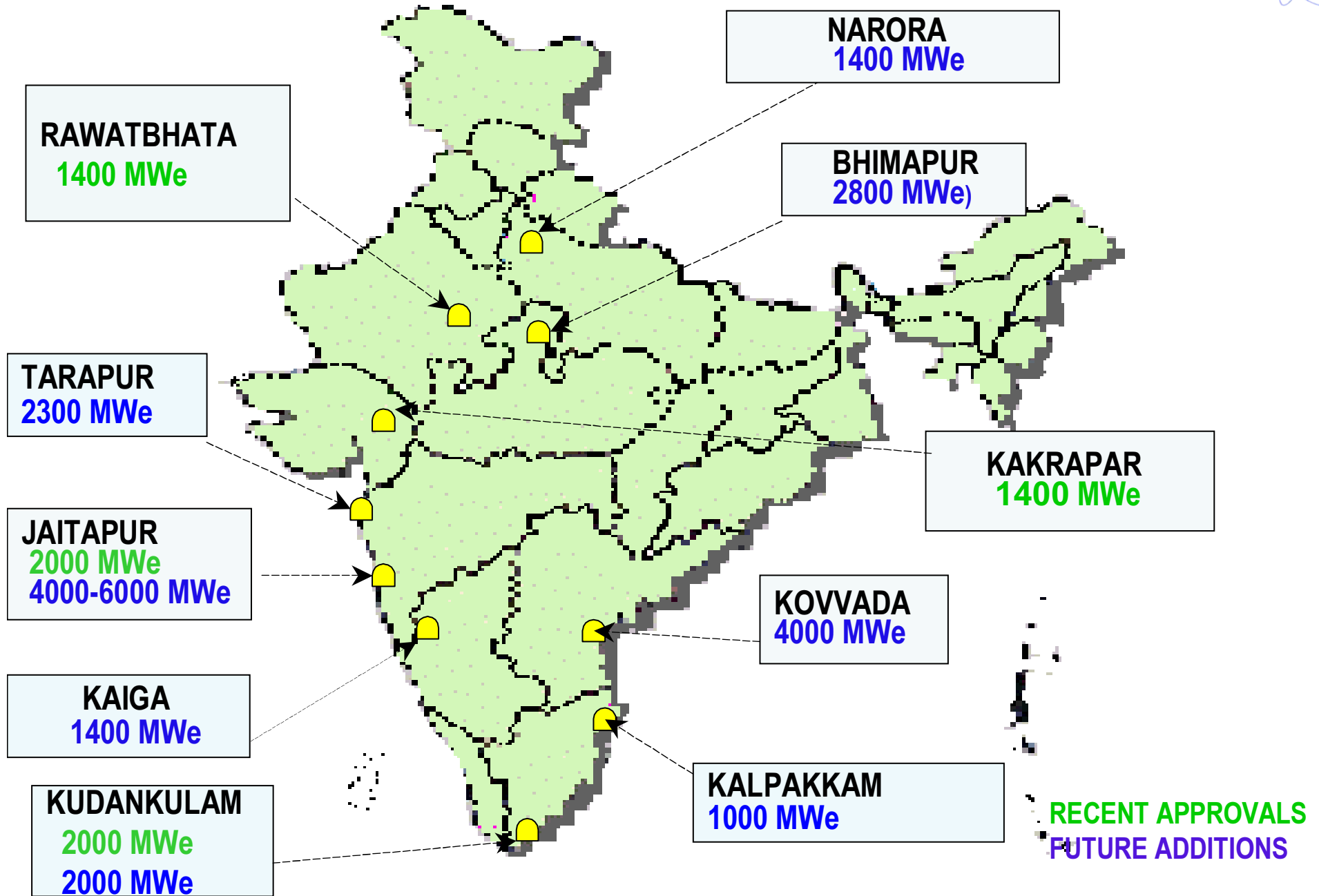
KAIGA
220 MWe(1x220)

KALAPAKKAM
500 MWe (1x500)

KUDANKULAM
2000 MWe (2x1000)

3160 MWe under construction

RECENT APPROVALS AND FUTURE ADDITIONS



Import of LWRs with Fuel

- Import of LWRs and fuel in the energy policy to meet energy requirements
- Construction of LWRs at Kudankulam in progress
- Four new LWRs approved by Govt for construction at Kudankulam site & new site at Jaitapur
- More coastal sites for LWRs being finalised
- Plan to build clusters of 6 to 8 LWRs at one site
- Construction of NPPs at many sites simultaneously

Importing LWRs

- Through Inter-government Agreement signed between two countries
- Negotiations for convoy of 6 to 8 reactors per site
- Licensed Reactor design in own country
- Safety aspects of Reactor design will be reviewed and licensed by Indian Regulatory Authority (AERB)
- Costs & safety features form important considerations

Foreign Delegations Visit to India

- Japanese delegations visited many Indian nuclear installations in 2006-2007.
- US, French and Canadian delegations also visited Indian nuclear installations in 2006-2007.
- Delegates from UK, Australia, etc. visited India to discuss various matters of mutual interest.

Role of Government

- Appointment of a site selection committee by Department of Atomic Energy
- Approval of the report of site selection committee
- Environmental clearance from Ministry of Environment and Forest
- Approval by Atomic Energy Regulatory Board for
 - Design basis report and preliminary safety analysis report developed by NPCIL
 - Site clearance for construction of NPP
 - Construction clearance (excavation, FPC, super structure)
 - Commissioning, fuel loading and criticality
 - Power operation

The wake up call

- Chernobyl accident shook the world.
- The Nuclear community resolved to share and help.
- Three Mile Island accident taught a lesson.
- WANO was formed, NPCIL one of the first members.
- IAEA was strengthened, NPCIL/DAE major contributor.

W A N O

WORLD ASSOCIATION OF NUCLEAR OPERATORS



IAEA



Role of International Organisations

- NPCIL member of WANO (Atlanta, Tokyo and Moscow Centres), IAEA and COG.
- Peer Review for pre startup and operating power plants.
- Participation in Workshop, Seminar and Training of WANO, IAEA and COG.
- Technical Support Missions and Bench Marking.
- Participation of Indian specialists in various IAEA committees for development of codes and guides.

Expectations from IAEA

- To help and support India's entry into the new emerging era.
- Perpetual fuel supply from a pool under IAEA safeguard.
- Special campaign for close fuel cycle programme to help more resources of energy and reducing waste problem.
- Exposure of Indian engineers in various international missions and programmes of IAEA.
- Increase in participation of Indian persons in development of IAEA codes and guides.

CHALLENGES AHEAD

- Taking care of aging reactors
- Security beef up of units
- Handing over reigns to next generation
- Absorption of different nuclear technologies.
- PWR, LWR, FBR etc.

Let us all share our experiences
and make nuclear power the
safe and clean power option