Uranium Mining & Milling Industry in India
Per Capita Power Consumption

Bar chart showing per capita power consumption across various countries:
- Germany: 7382 kWh/Capita
- Japan: 7281 kWh/Capita
- U.K.: 5843 kWh/Capita
- World: 2400 kWh/Capita
- India: 473 kWh/Capita
Power: The urgent need

- Per capita power consumption is low.
- Installed generation cap. to be raised from 138.73 to 417GWe by 2020
- Share of nuclear power to increase from 4120 to 20,000 MWe by 2020
- Uranium requirement to increase accordingly
Power Sources and Constraints

**COAL:**
- Inadequate coal reserves
- Strain on transportation
- High ash in Indian coal and low calorific value.
- $\text{CO}_2$ emissions

**OIL & GAS AS FUEL:**
- Inadequate reserve, 70% requirement is met by import
- Complex geo-political environment
Power Sources and Constraints

**HYDROELECTRIC**
Limited to geographically suitable sites
Sites are mostly away from demand centers.
Dependent on rain-fall.
Effect on ecology
Displacement of vast population.

**NON-CONVENTIONAL**
Limited scope at present level of technology
Poor capacity factor
Diffused and intermittent source
“......... We must break the constraining limits of power shortages, which retard our development. Nuclear energy is not only cost effective, it is also a cleaner alternative to fossil fuels......”

Dr. Manmohan Singh,
Kalapakkam,
23rd Oct, 2004
Energy Security for India

- India has moderate uranium reserves: 61,000 t recoverable metal.
- It can support 10,000 MWe of PHWR.
- India has 30% of world reserve in thorium: 2,25,000 t recoverable metal.

Total: 112.10 GWe

Total: 1344 GWe
Three Stage Nuclear Power Programme

Stage – I PHWRs
- 15 - Operating
- 3 - Under construction
- Several others planned
- Scaling to 700 MWe
- Gestation period has been reduced
- POWER POTENTIAL \( \cong 10,000 \) MWe

LWRs
- 2 BWRs Operating
- 2 VVERs under construction

Stage - II
Fast Breeder Reactors
- 40 MWe FBTR - Operating since 1985
  Technology Objectives realised
- 500 MWe PFBR - Under Construction
- POWER POTENTIAL \( \cong 530,000 \) MWe

Stage - III
Thorium Based Reactors
- 30 kwth KAMINI - Operating
- 300 MWe AHWR - Under Development

POWER POTENTIAL IS VERY LARGE

Availability of ADS can enable early introduction of Thorium on a large scale.
## Indian Nuclear Power Programme

<table>
<thead>
<tr>
<th>REACTOR TYPE AND CAPACITIES</th>
<th>CAPACITY (MWe)</th>
<th>CUMULATIVE CAPACITY (MWe)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>15 PHWRs and 2 BWRs reactors at 6 sites</strong>&lt;br&gt;under operation, Tarapur, Rawatbhata, Kalpakkam, Narora, Kakrapar and Kaiga</td>
<td>4,120</td>
<td>4,120</td>
</tr>
<tr>
<td><strong>3 PHWRs under construction at</strong>&lt;br&gt;Kaiga (2x220 MWe), RAPS-5&amp;6(2x220 MWe)</td>
<td>660</td>
<td>4,780</td>
</tr>
<tr>
<td>(to be completed during XI Plan)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>2 LWRs under construction at</strong>&lt;br&gt;Kudankulam(2x1000 MWe)</td>
<td>2,000</td>
<td>6,780</td>
</tr>
<tr>
<td>(to be completed during XI Plan)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>PFBR under construction at</strong>&lt;br&gt;Kalpakkam (1 X 500 MWe)</td>
<td>500</td>
<td>7,280</td>
</tr>
<tr>
<td>(to be completed during XI Plan)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Projects planned till 2020</strong>&lt;br&gt;PHWRs(8x700 MWe), FBRs(4x500 MWe), LWRs(6x1000 MWe), AHWR(1x300 MWe)</td>
<td>13,900</td>
<td>21,180</td>
</tr>
<tr>
<td><strong>TOTAL by 2020</strong></td>
<td>21,180 MWe</td>
<td></td>
</tr>
</tbody>
</table>
STATUS OF URANIUM RESERVES IN INDIA

Total: 1,07,268 te U₃O₈

(as on March 2007)
Uranium Mining in India
Under the administrative control of
Department of Atomic Energy

Uranium Corporation of India Ltd (a Public Sector Enterprise)

With mandate to mine and process uranium ore

Set-up in 1967

Operating: Five underground mines
One openpit mine
Two ore processing plants

Constructing: One underground mine
One mega mining and processing project

Planning: Two mega mining & processing projects

Net worth: 240 million USD
Manpower: 4600

Uranium Requirement of India

INDIGENOUS PRODUCTION

Operating mines & Plants
- Operating units under capacity expansion

New mines & Plants
- Under construction
- Planned for construction

OVERSEAS OPPORTUNITIES
- Possibility of acquisition of uranium properties
- Sea water, phosphate rock etc

POSSIBILITY OF OTHER SOURCES

- Under construction
- Planned for construction
Hosts a number of multi-metallic deposits
Host country’s largest uranium resources
Discovery of first uranium deposit (Jaduguda - 1951)
Treasure-house for evolution of uranium mining and processing activities
SINGHBHUM SHEAR ZONE

• URANIUM DEPOSIT discovered at JADUGUDA – 1951
• JADUGUDA MINE commissioned in 1968 (230m depth)
• Deepened in 1976 (640m depth)
• Deepened in 2001 (905m depth) – Underground shaft

• BHATIN UNDERGROUND MINE - A small deposit with limited life and depth persistence
• Commissioned in 1986 (200m depth)

  • NARWAPAHAR MINE - A large mechanised mine with trackless equipment
  • Entry through decline (7°) and vertical shaft
  • Operating since 1995

• TURAMDIH MINE – In operation since 2003
  • Mining technology similar to Narwapahar

• BAGJATA MINE – Commissioned in Dec. 2008
  • Mining technology similar to Narwapahar

• BANDUHURANG MINE – Commissioned in 2009
  • The first opencast uranium mine of the country
Cut-and-Fill Stoping
Equipment in UCIL
## URANIUM ORE PROCESSING

Operates two plants in Singhbhum

<table>
<thead>
<tr>
<th>Plant</th>
<th>Key Information</th>
</tr>
</thead>
</table>
| **JADUGUDA PLANT** | Commissioned in 1968  
|                | Expanded two times  
|                | 3rd phase expansion underway                         |
| **TURAMDIH PLANT** | Operational in 2007  
|                | High level of automation  
|                | Further expansion taken up                           |

### Major Processes

- Acid leaching
- Ion Exchange
- MDU Production
URANIUM ORE PROCESSING

Automation:
- Particle size monitors
- Horizontal belt filter
- Pressure filter
- High degree of instrumentation – PLC based control system with Man
CRUSHING, GRINDING & DEWATERING

LEACHING

MDU FILTRATION & PACKING
WASTE MANAGEMNET

- Waste rock of mines used for back-filling of stopes
- Coarser fraction tailings (deslimed) used for back-filling
- Slimes stored in impoundment facility (Tailings Pond)
- Plant effluent treated before discharge to public domain

TAILINGS POND

- Well engineered with natural barriers on three sides
- Channel ways and well-laid drainage system for discharge of effluents
- Reclamation of Tailings pond after use
WASTE MANAGEMENT

View of Tailings Pond at Jaduguda

Coursing of Tailings pond water to ETP

Treatment of Effluent

Reclamation of used Tailings Pond with soil cover and plantation
TUMMALAPALLE URANIUM PROJECT

**Surface Topography**

- **Ore Lenses**
- **F/W Band**
- **H/W Band**

**TUMMALAPALLE URANIUM PROJECT**

- **Strata bound type deposit**
  - **Strike extension:** 5.6 km
  - **Dip:** 15° - 17°
  - **Mineralisation up to 275 m depth**

- **Width of lodes after block modelling:**
  - HW Lode 3.2 m
  - FW Lode 2.5 m
  - **Parting between lodes:** 1.5 to 3 m

**Carbonate host rock**
MINE DEVELOPMENT AT TUMMALAPALLE

- Main Decline
- Decline East
- Decline West
- Pillar 15.0m
- Main Conveyor

Dimensions:
- 5m x 3m 9° gradient 15m apart
- 4.5m x 3m
PROPOSED MINING METHOD
MINING EQUIPMENT

MAJOR EQUIPMENT:

- Low Profile Loaders (LHD)
- Low Profile Dump Truck (LPDT)
- Drill Jumbo
- Low Profile Dozer
- Low Profile Bolting Machine
- Stationary hydraulic rock breaker/sizer
- Belt conveyor
- Utility Vehicles
  - Lube Truck
  - Passenger Vehicle
  - Crane
  - Bulk Explosive Van
LAMBAPUR URANIUM PROJECT

- Unconformity proximal type deposit
- One open cast and three underground mines planned
- Plant to be constructed 54 km away from the mine site
  - Acid Leaching
  - Ion Exchange
  - MDU Product
Adjustable roof, height 1.77 m (max)
Ground clearance: 0.26 m
Rock drill: COP 1838ME
Feed length 5.29 m
Hole depth: 3.40 m
Turning radius: 5.6/2.9 m (outer/inner)
Boom coverage: 7.5/5.4 m (w/h)

Total length: 8.73 m
Bucket: E-O-D (Eject-O-Dump)
Bucket tip height: 2.51 m
Ground clearance: 0.33 m
Tramming capacity: 6 t
Bucket volume: 2.1 m³ (2.7 yd³)
Turning radius: 5.4/2.2 m (outer/inner)
LAMBAPUR URANIUM PROJECT: CONCEPTUAL
THICKENED TAILINGS DISPOSAL SYSTEM

- Pre-coat re-cycle
- Process re-use
- Horticulture
- Dust suppression in ore handling
- Water make-up

Holding pond water return

Treated liquid effluent to

Thickened tailings thickener

Plant Stacking area

Thickened tails

Water sprinkling for dust suppression

Rainwater after normal run-off

Holding pond
MAHADEK BASIN

- An inaccessible terrain
- Annual rainfall >10,000 mm
- Poor infrastructure
Sandstone type tabular orebody
Depth of mineralisation: 45 m
Dip: 3 – 5°
Openpit mining planned
ORE

CRUSHING

GRINDING

DEWATERING

WEAK ACID LEACHING

W.A.L FILTRATION

CAKE

STRONG ACID LEACHING

S.A.L FILTRATION

FILTRATE

REAGENTS

CAKE

NEUTRALISATION

SAND-SLIME SEPERATION

TAILINGS THICKENER

SLIME

TAILINGS POND

O/F

U/F

DECANT WATER POND

EFFL. TREATMENT PLANT

REAGENTS

RECY. WATER

SAND FOR BACKFILLING OF MINE

PREP. DRUM CAKE

RECIPETATED DRUM CAKE

Acid leaching (Two stages)

MDU Product

Major Processes

ION EXCHANGE

IRON PPN. & SEPERATION

MDU PPN.

DRIYING AND PACKING

REAGENTS

LIME

NEUTRALISATION

CLARIFICATION

ELUANT

PAINTING POOL

RECY. NEUTRAL WATER

RECY. WATER

PRECIPETATED DRUM CAKE

TAILINGS THICKENER

SLIME

SLIME

U/F

O/F

SAND FOR BACKFILLING OF MINE

DECANT WATER POND

EFFL. TREATMENT PLANT

PREP. DRUM CAKE

RECIPETATED DRUM CAKE
EXPLORATORY MINING AT BHIMA BASIN

- Fracture controlled orebody
- Hosted in Limestone and Granite
- 100 – 300m depth

Computerised 3-D model showing orebody and exploratory developments (under progress)
SMALL LOW GRADE DEPOSITS

Constraints in locating large tonnage high grade uranium deposits in the country, may lead to dependence on exploiting more of low grade low to medium tonnage deposits.

Exploitation of uranium in small scale does not in any way reduce the inherent problems of uranium mining.

URANIUM TAILINGS MANAGEMENT

Uranium mill tailings impoundment in environment is a matter of public concern.

Production & processing of large quantity of ore results in generation of large volume of tailings.

Newer concepts like TTD System are under implementation to minimise the tailings pond area.
CHALLENGES AHEAD

RECLAMATION OF EXISTING TAILINGS PONDS

• Remediation of existing ponds at Jaduguda - Eco-restoration with suitable soil capping and vegetation.

• Efficacy of microbial leaching of tailings and microbial modifiers - being looked into.

• Migration of contaminants into adjoining environment.

NEGATIVE PUBLIC PERCEPTION

• Negative public perception about nuclear industry in general

• Negative perception about mining as a polluting industry

• Exaggerated safety concerns regarding tailing ponds

• Activists influence negative public opinion by spreading misinformation
CORPORATE SOCIAL RESPONSIBILITY
THANK YOU