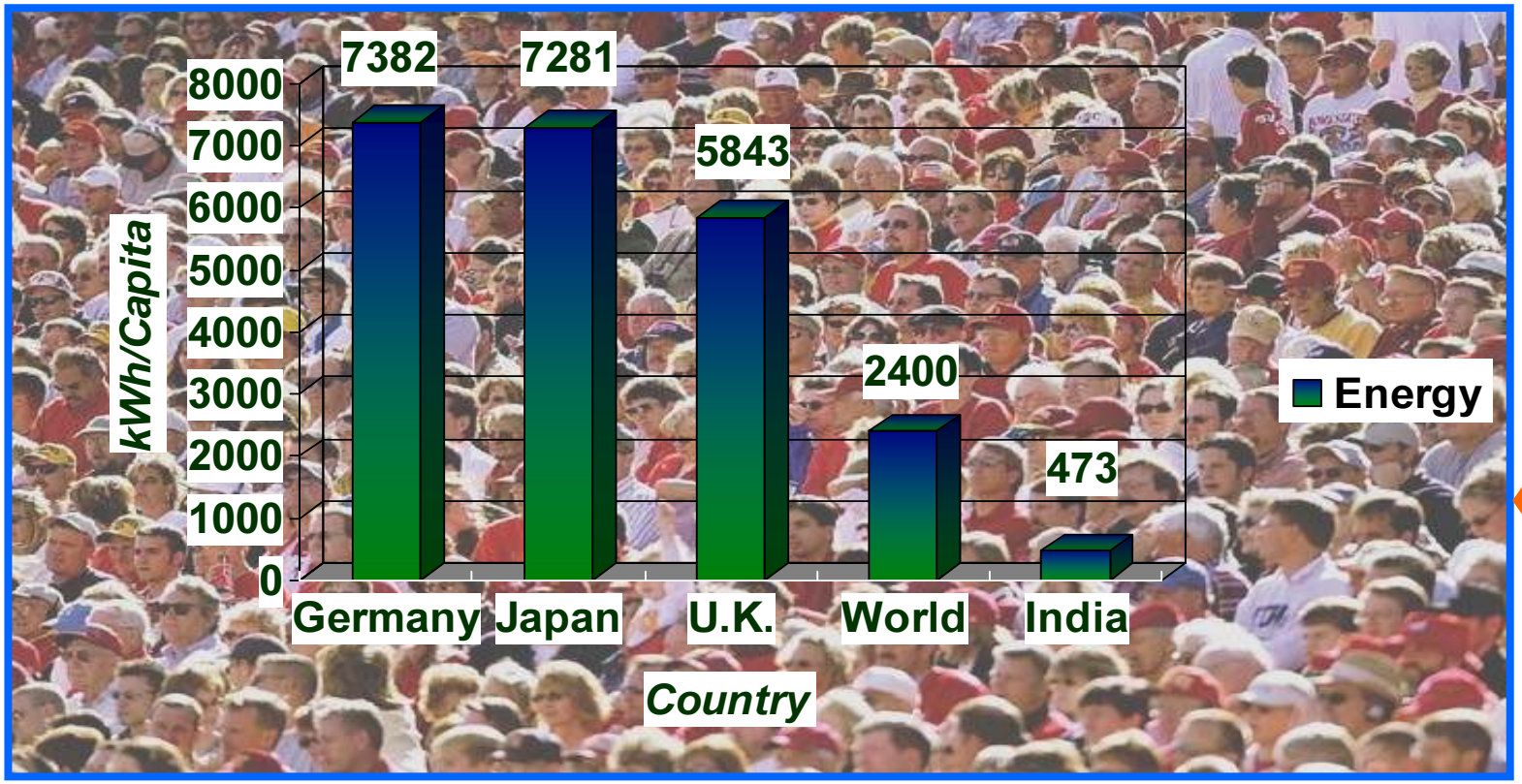
Uranium Mining

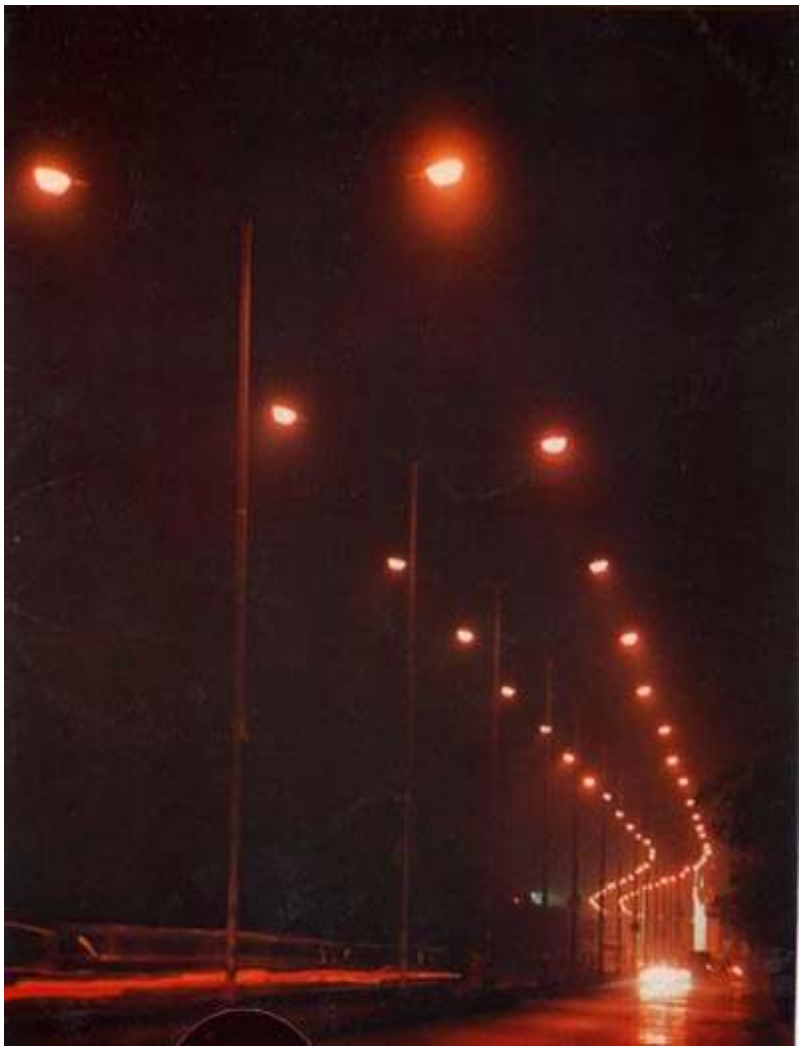
&

Milling Industry in India

Per Capita Power Consumption



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.
- 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

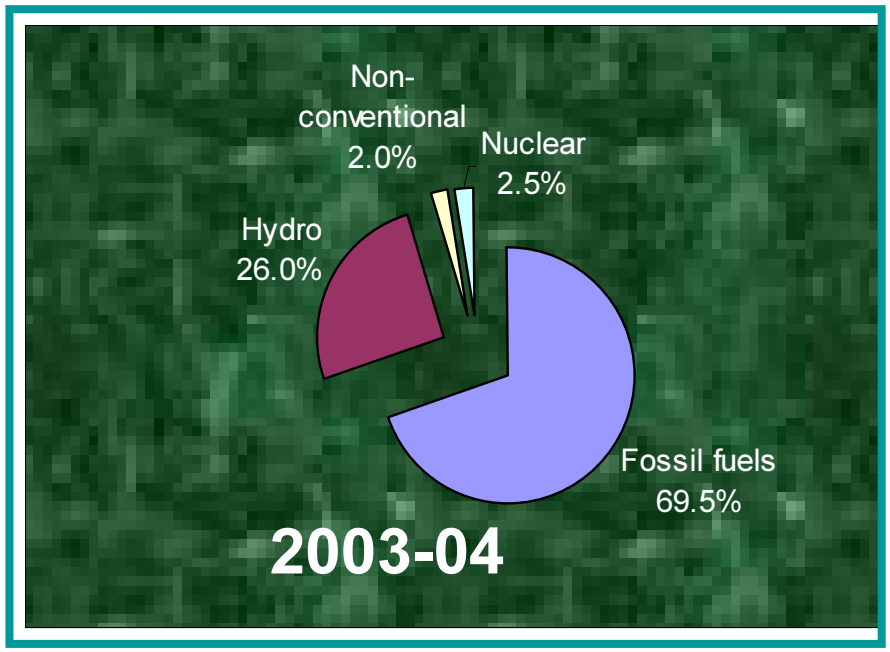
Poor capacity factor

Diffused and intermittent source

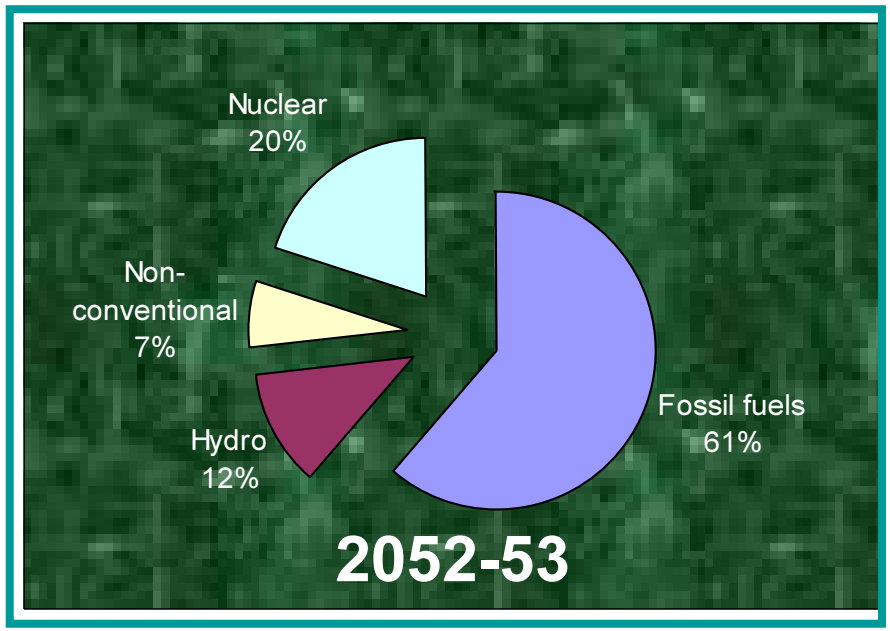
"..... We must break the constraining limits of power shortages, which retard our development. Nuclear energy is not only cost effective, it is also a cleaner alternative to fossil fuels....."

Dr. Manmohan Singh,
Kalapakkam,
23rd Oct,2004

Energy Security for India



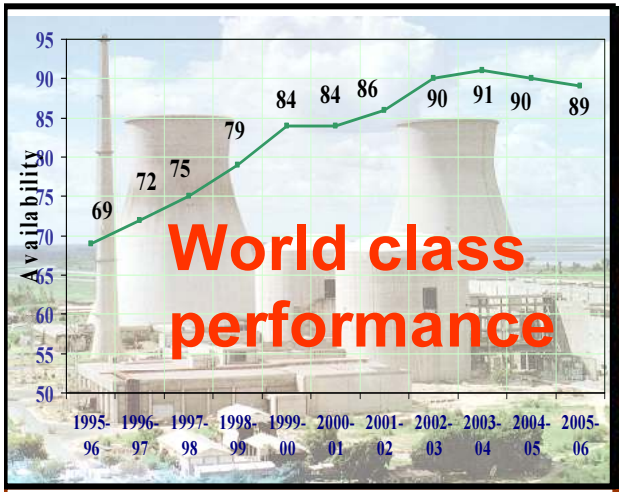
Total:112.10 GWe



Total:1344 GWe

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

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 ≅ 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 ≅ 530,000 MWe

Stage - III
Thorium Based Reactors

- 30 kwth KAMINI- Operating
- 300 MWe AHWR- Under Development

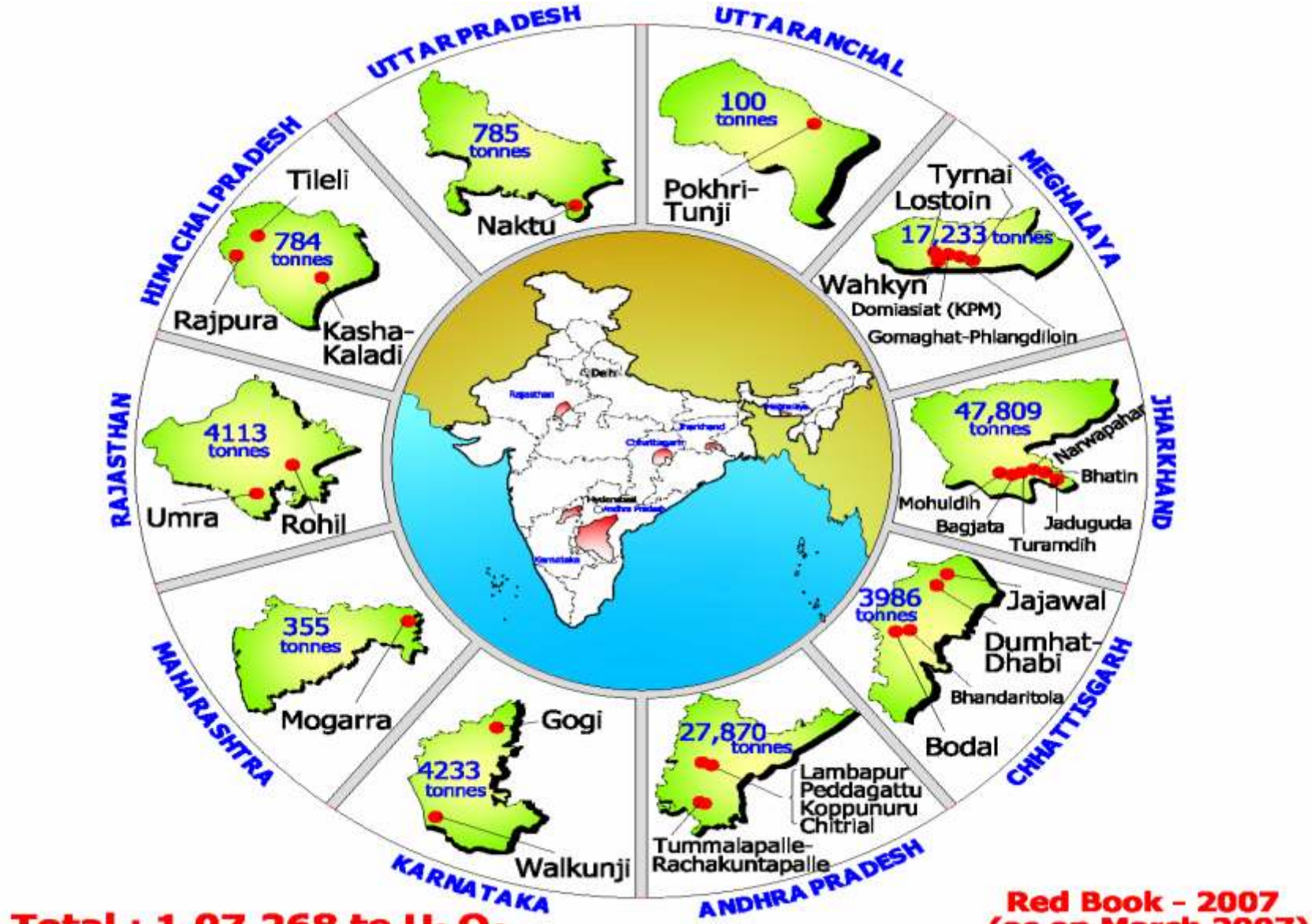
POWER POTENTIAL IS VERY LARGE

Availability of ADS can enable early introduction of Thorium on a large scale.

Indian Nuclear Power Programme

REACTOR TYPE AND CAPACITIES	CAPACITY (MWe)	CUMULATIVE CAPACITY (MWe)
➢ *15 PHWRs and 2 BWRs reactors at 6 sites under operation, Tarapur, Rawatbhata, Kalpakkam, Narora, Kakrapar and Kaiga*	*4,120*	*4,120*
➢ *3 PHWRs under construction at Kaiga (2x220 MWe), RAPS-5&6(2x220 MWe)*) to be) completed) during) XI Plan	*660*	*4,780*
➢ *2 LWRs under construction at Kudankulam(2x1000 MWe)*)))	*2,000*	*6,780*
➢ *PFBR under construction at Kalpakkam (1 X 500 MWe)*))	*500*	*7,280*
> *Projects planned till 2020 PHWRs(8x700 MWe), FBRs(4x500 MWe), LWRs(6x1000 MWe), AHWR(1x300 MWe)*	*13,900*	*21,180*
> *TOTAL by 2020*		*21,180 MWe*

STATUS OF URANIUM RESERVES IN INDIA



Total : 1,07,268 te U_3O_8

Red Book - 2007
(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

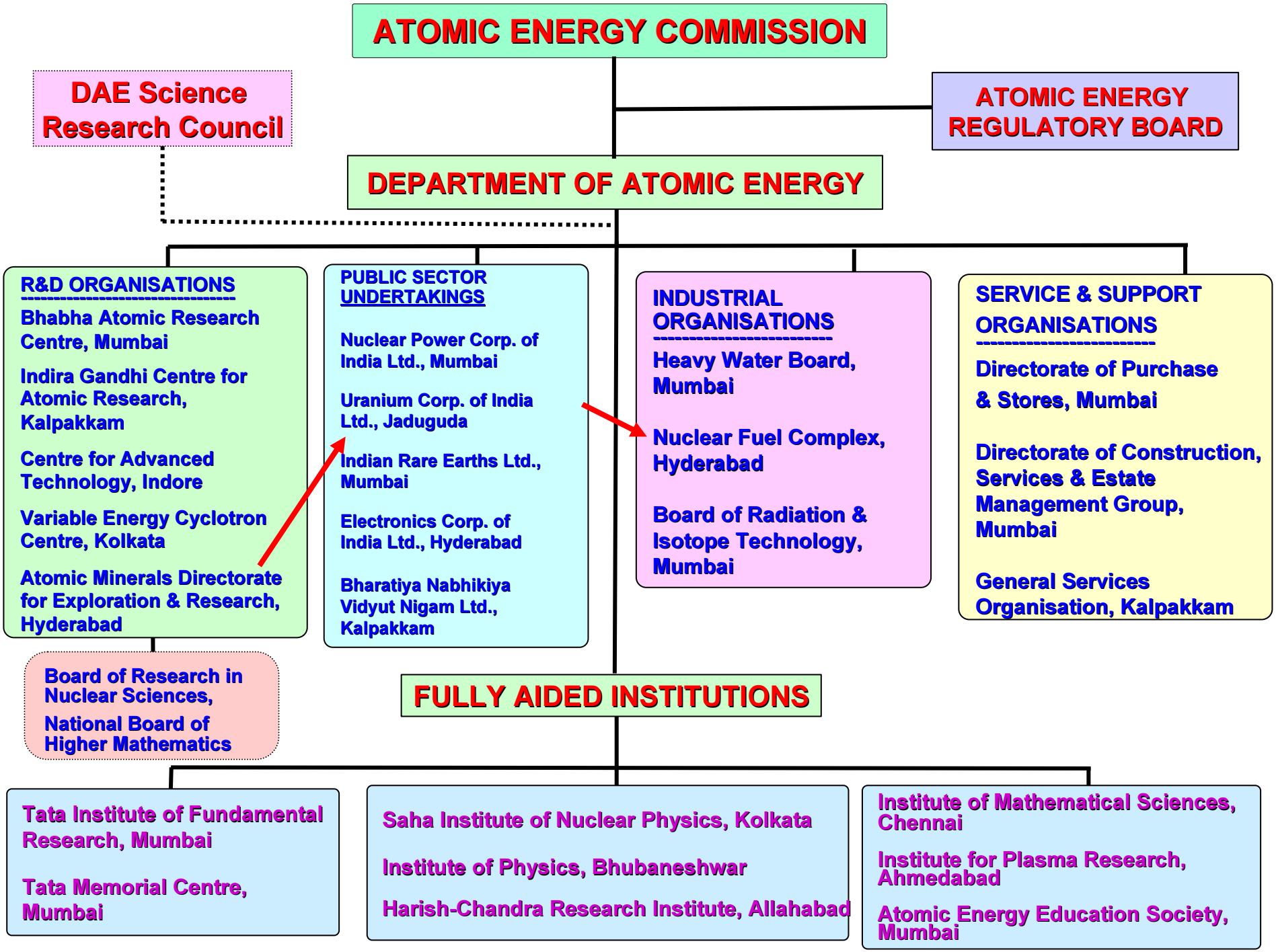
Set-up in 1967

Operating:	**Five underground mines** **One openpit mine** **Two ore processing plants**
Constructing:	**One underground mine** **One mega mining and processing project**
Planning: **(next 5 years)**	**Two mega mining & processing projects**

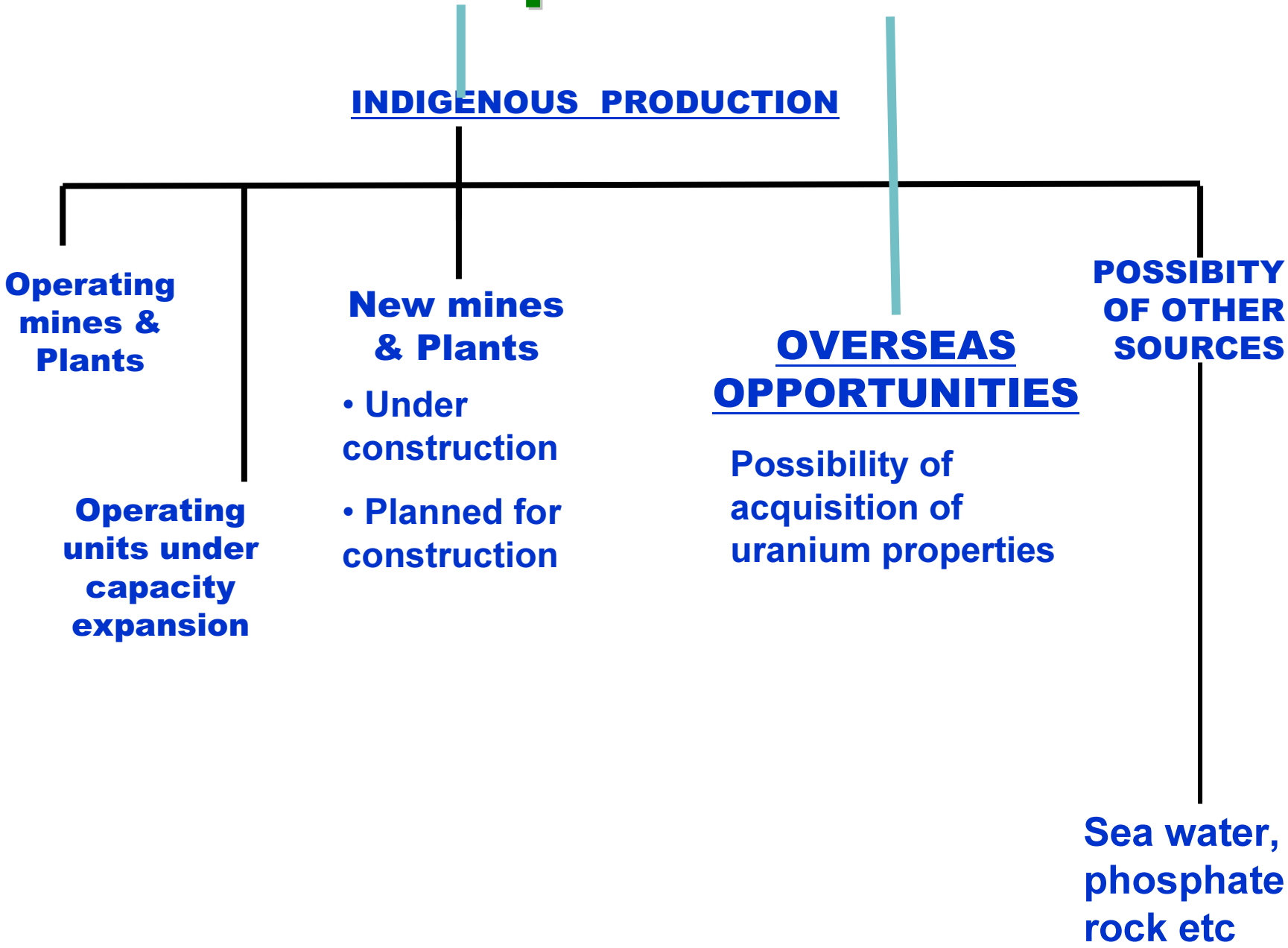
Net worth:

240 million USD

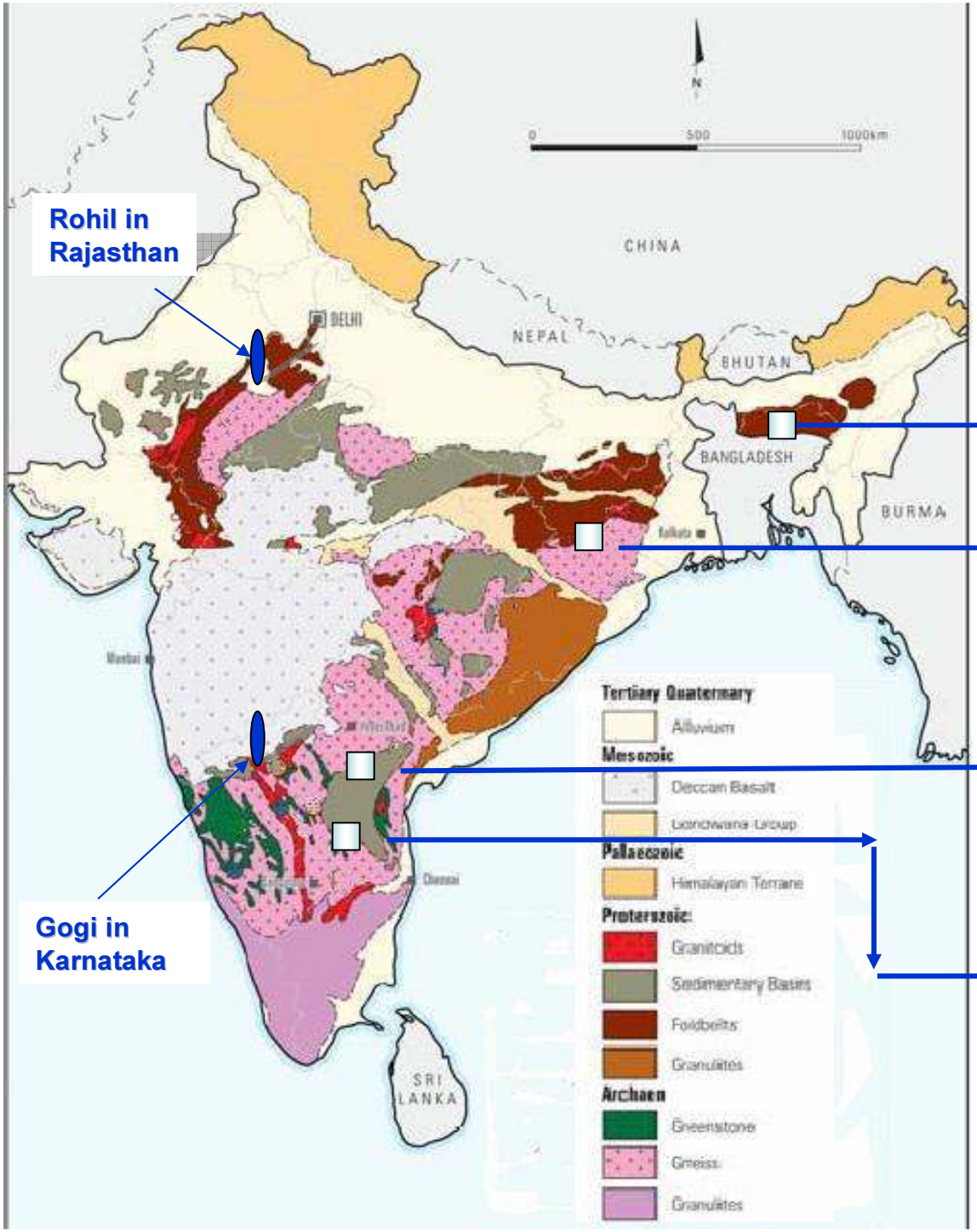
Manpower: 4600


ATOMIC ENERGY COMMISSION
DAE Science Research Council
ATOMIC ENERGY REGULATORY BOARD
DEPARTMENT OF ATOMIC ENERGY
R&D ORGANISATIONS
Bhabha Atomic Research Centre, Mumbai
Indira Gandhi Centre for Atomic Research, Kalpakkam
Centre for Advanced Technology, Indore
Variable Energy Cyclotron Centre, Kolkata
Atomic Minerals Directorate for Exploration & Research, Hyderabad
PUBLIC SECTOR UNDERTAKINGS
Nuclear Power Corp. of India Ltd., Mumbai
Uranium Corp. of India Ltd., Jaduguda
Indian Rare Earths Ltd., Mumbai
Electronics Corp. of India Ltd., Hyderabad
Bharatiya Nabhikiya Vidyut Nigam Ltd., Kalpakkam
INDUSTRIAL ORGANISATIONS
Heavy Water Board, Mumbai
Nuclear Fuel Complex, Hyderabad
Board of Radiation & Isotope Technology, Mumbai
SERVICE & SUPPORT ORGANISATIONS
Directorate of Purchase & Stores, Mumbai
Directorate of Construction, Services & Estate Management Group, Mumbai
General Services Organisation, Kalpakkam
Board of Research in Nuclear Sciences,
National Board of Higher Mathematics
FULLY AIDED INSTITUTIONS
Tata Institute of Fundamental Research, Mumbai
Tata Memorial Centre, Mumbai
Saha Institute of Nuclear Physics, Kolkata
Institute of Physics, Bhubaneshwar
Harish-Chandra Research Institute, Allahabad
Institute of Mathematical Sciences, Chennai
Institute for Plasma Research, Ahmedabad
Atomic Energy Education Society, Mumbai

Uranium Requirement of India



URANIUM MINING CENTERS OF INDIA (Existing & Proposed)



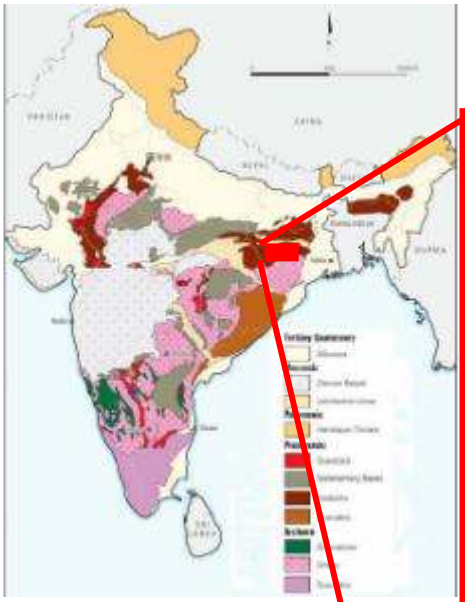
WEST KHASI HILLS DISTRICT IN MEGHALAYA

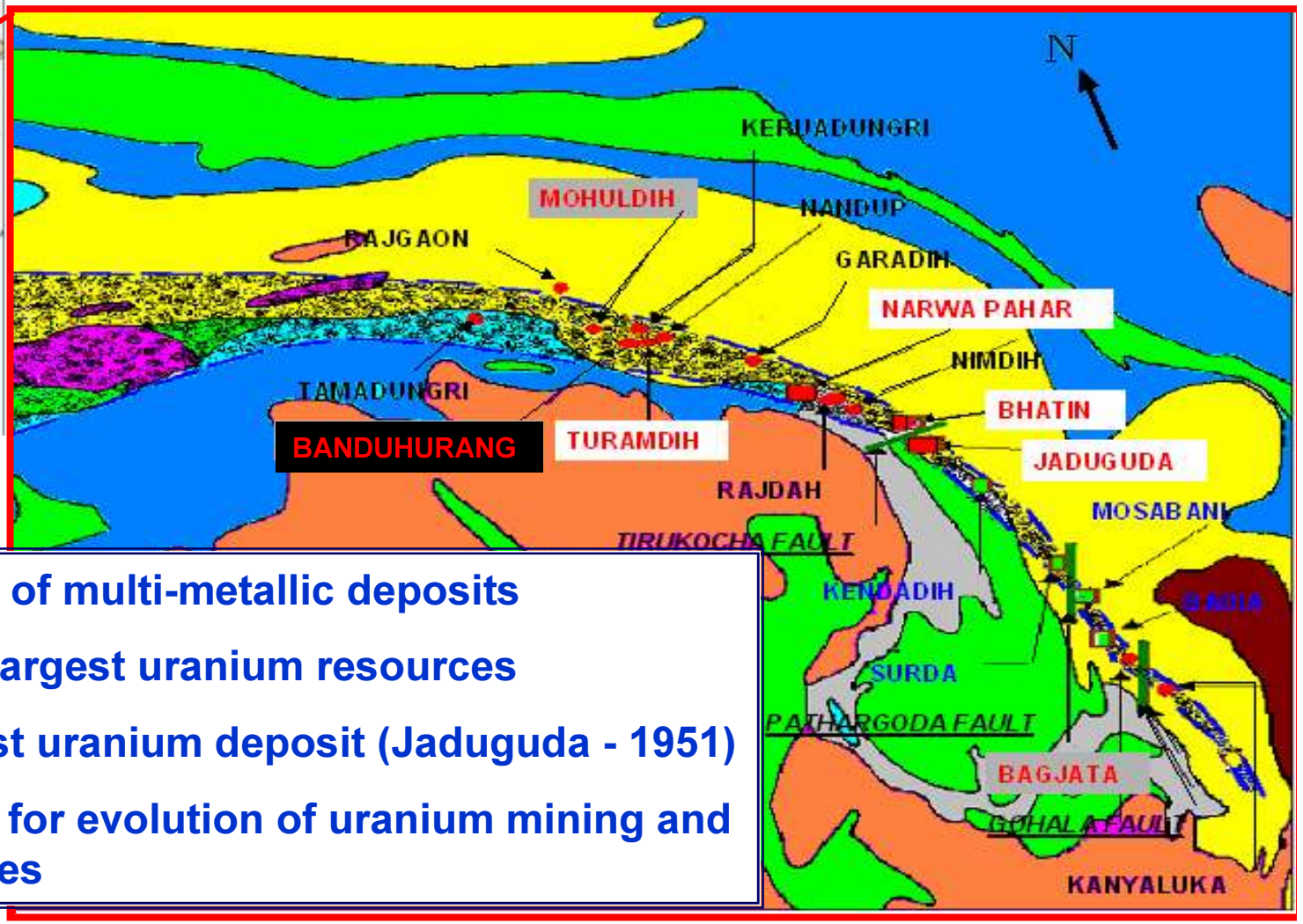
SINGHBHUM BELT IN JHARKHAND

NALGONDA DISTRICT IN ANDHRA PRADESH

CUDDAPAH DISTRICT IN ANDHRA PRADESH

SINGHBHUM SHEAR ZONE





- ❑ 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

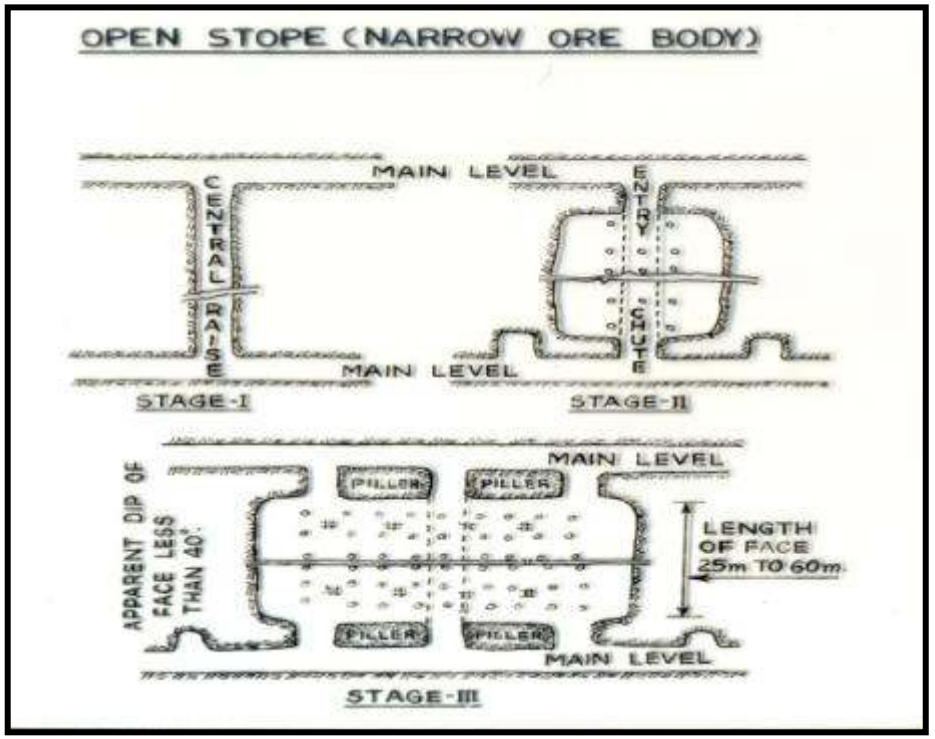
- BHATIN UNDERGROUND MINE - A small deposit with limited life and depth persistence
- Commissioned in 1986 (200m depth)

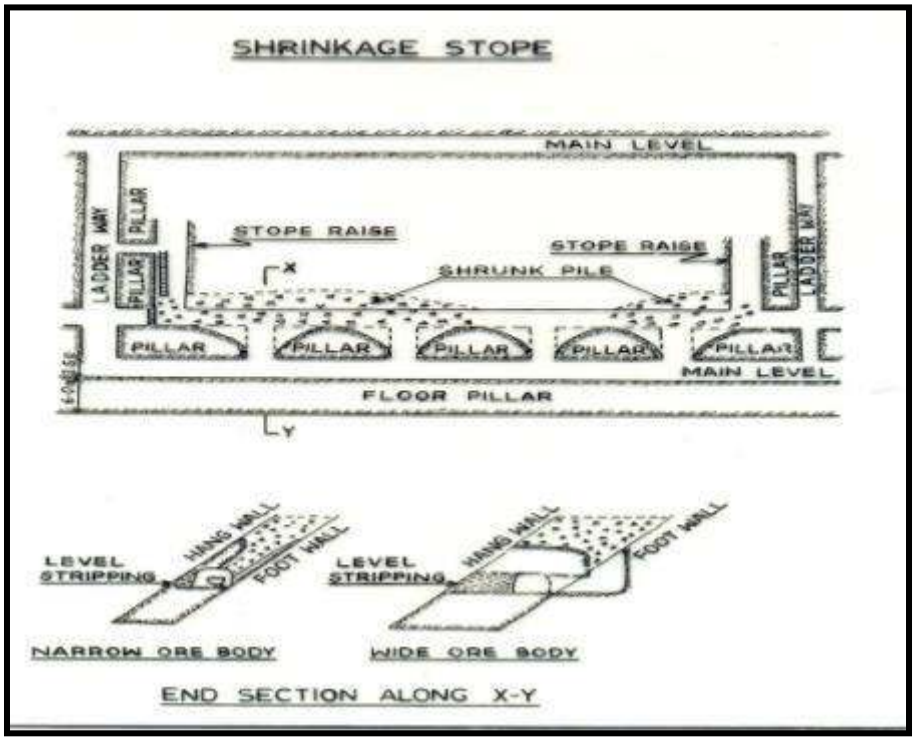
- NARWAPAHAR MINE - A large mechanised mine with trackless equipment
- Entry through decline (7^0) and vertical shaft
- Operating since 1995

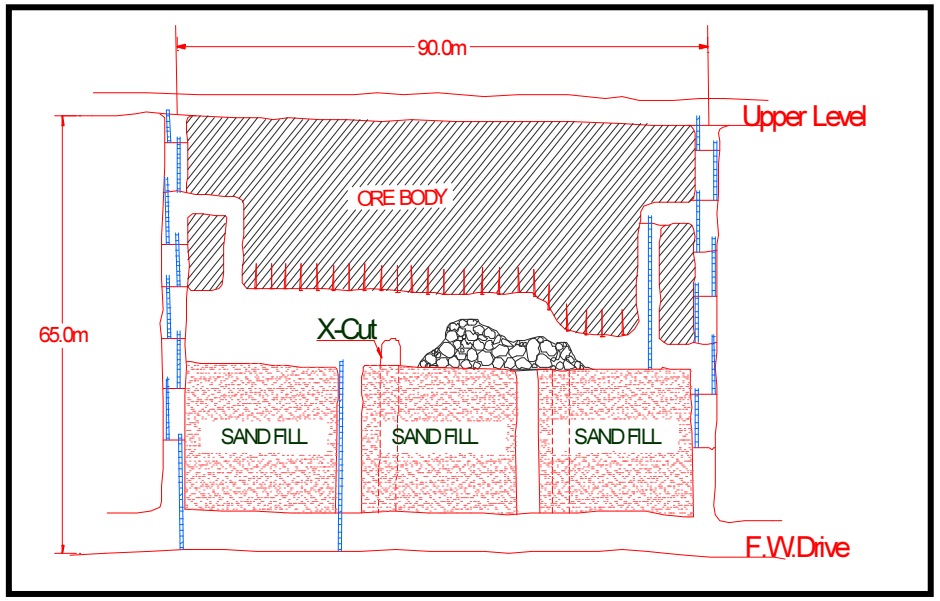
- TURAMDIH MINE – In operation since 2003
- Mining technology similar to Narwapahar

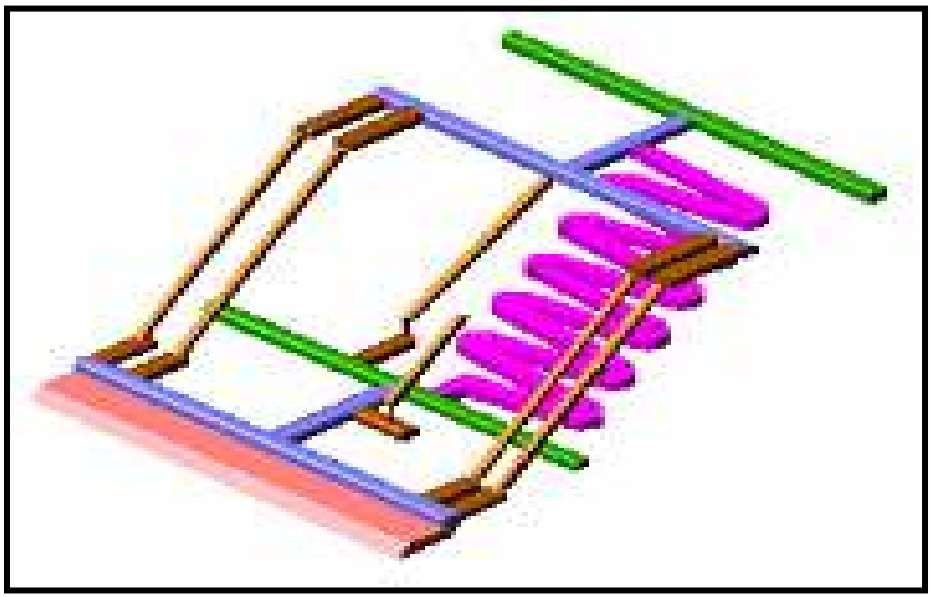
- BANDUHURANG MINE – Commissioned in 2009
- The first opencast uranium mine of the country

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









Cut-and-Fill Stoping

Equipment in UCIL

URANIUM ORE PROCESSING

Operates two plants in Singhbhum

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

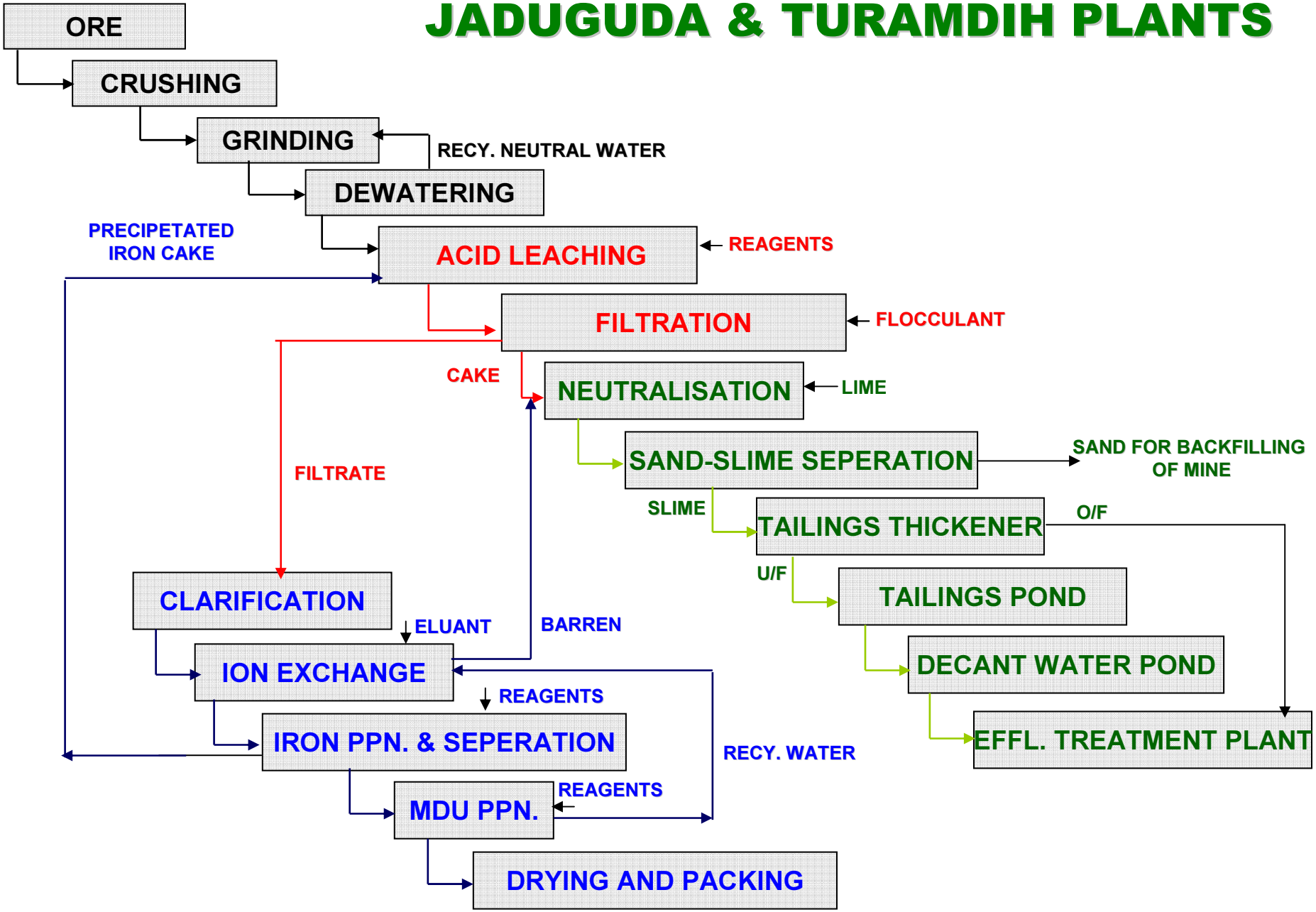
Horizontal belt filter

Pressure filter

High degree of instrumentation –

PLC based control system with Man

PROCESS FLOW SHEET
JADUGUDA & TURAMDIH PLANTS



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 MANAGEMNET

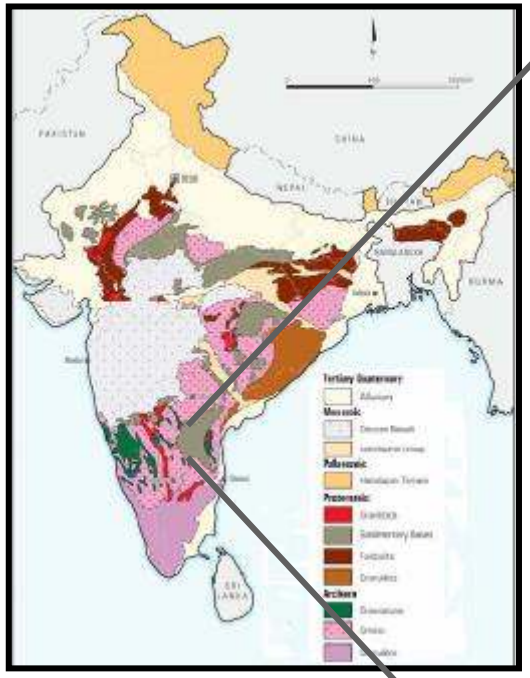
View of Tailings Pond at Jaduguda

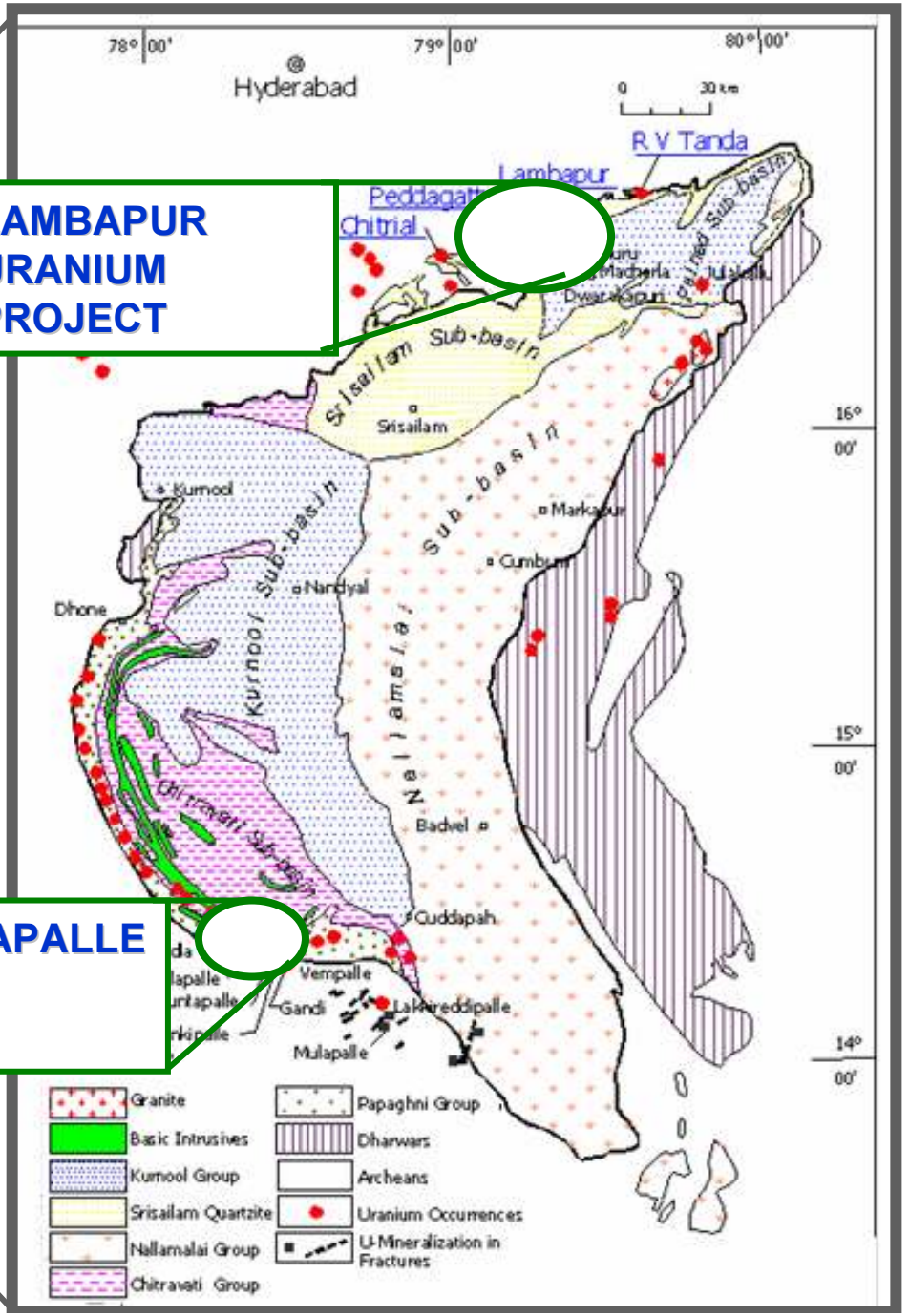
Coursing of Tailings pond water to ETP

Treatment of Effluent

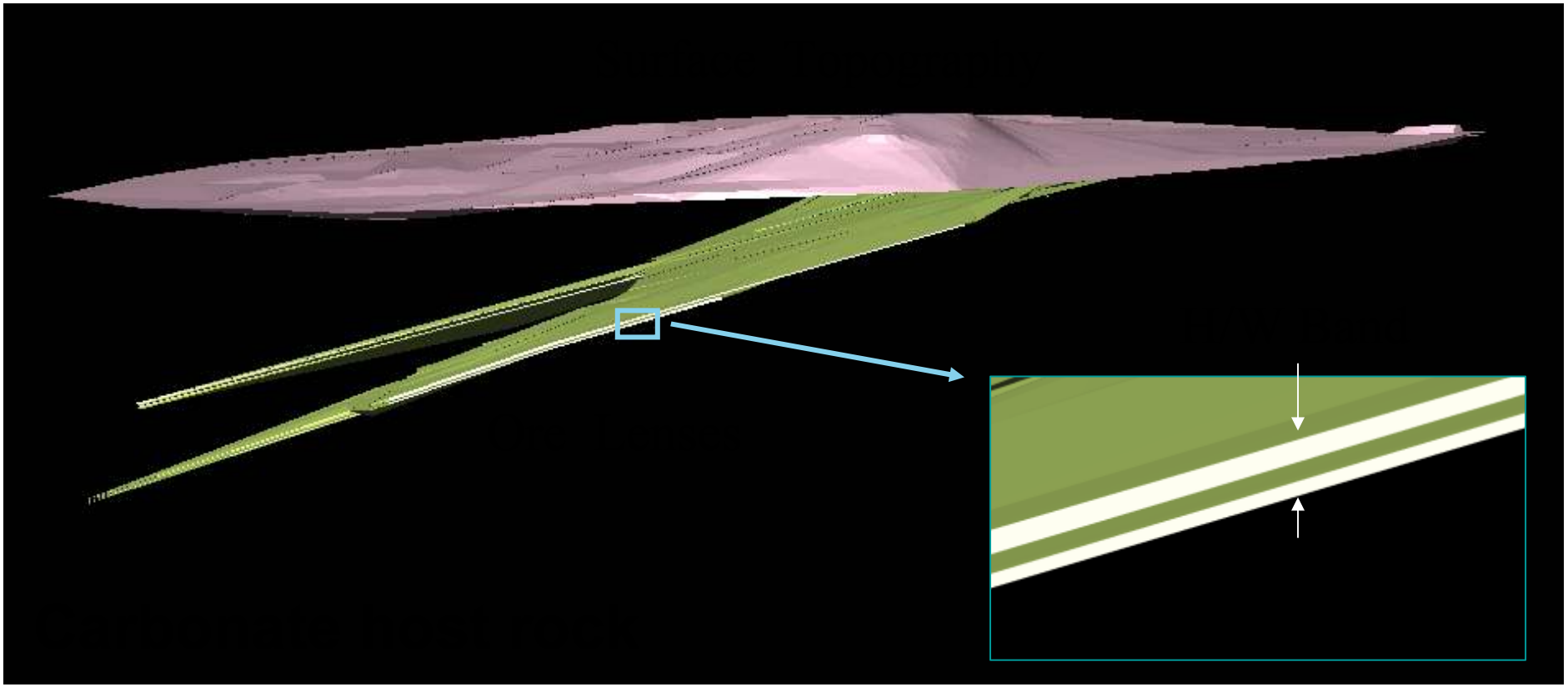
Reclamation of used Tailings Pond with soil cover and plantation

CUDDAPAH BASIN





TUMMALAPALLE URANIUM PROJECT



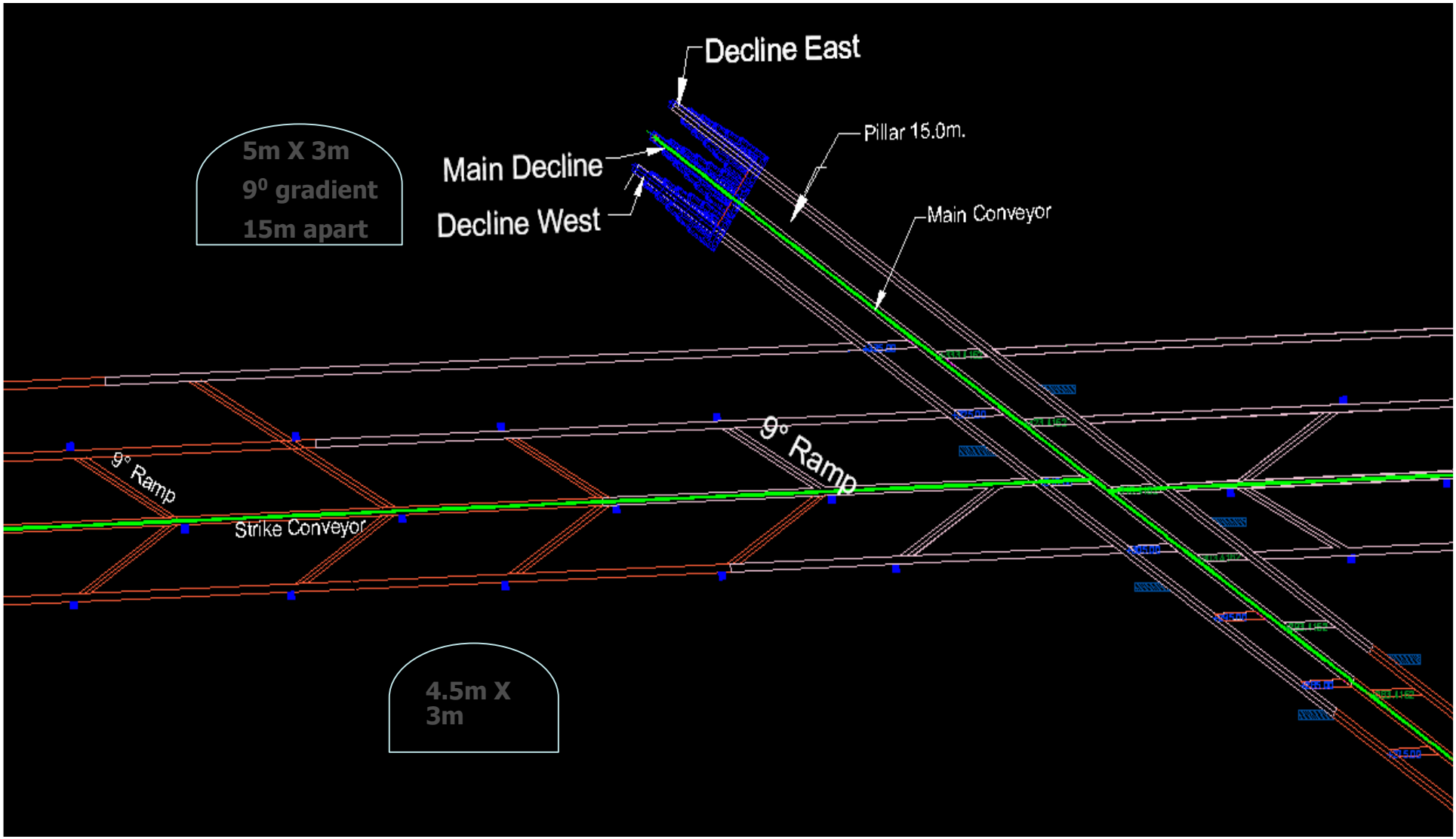
Strata bound type deposit

Strike extension: 5.6 km
Dip: 15 - 17^0
Mineralisation up to 275 m depth

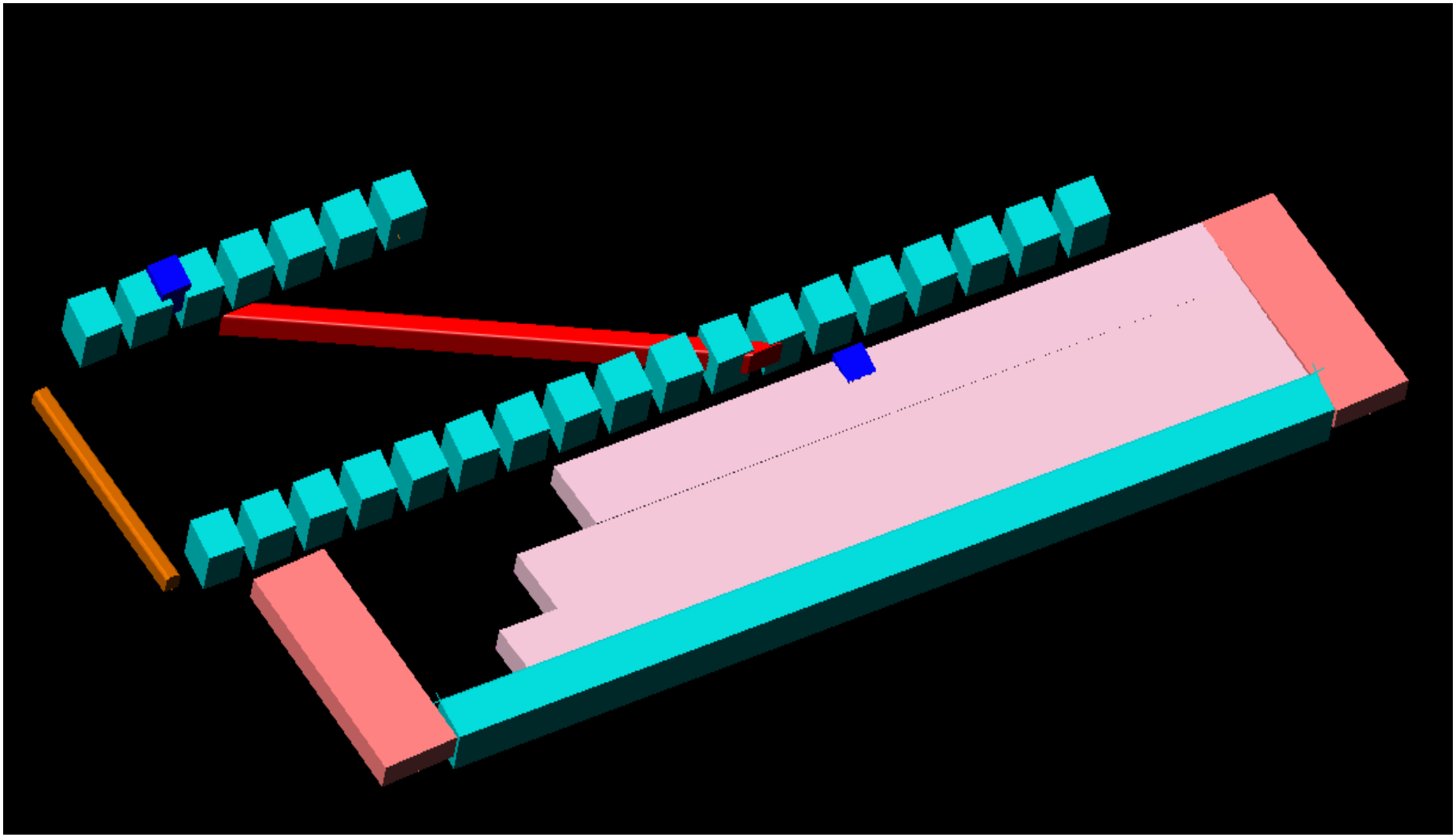
Width of lodes after block modelling: HW Lode 3.2 m
FW Lode 2.5 m

Parting between lodes: 1.5 to 3 m

MINE DEVELOPMENT AT TUMMALAPALLE



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

TUMMALAPALLE MINE ENTRY UNDER CONSTRUCTION

SCHEMATIC FLOWSHEET

Run of Mine ore

SIZE REDUCTION

DEWATERING & REPULPING

CO_2

Leachants, Na_2CO_3 & $NaHCO_3$

Oxidant, Industrial O_2

PRESSURE LEACHING

Leaching Conditions

Temperature:	*130 deg.C*
Pressure:	*7 - 8 Kg/cm²*
Residence time:	*6 hr*
Pulp density:	*50% solids*

Leach Liquor for Recycle

FILTRATION AND COUNTER CURRENT WASHING

Tailings (for Disposal)

Precipitant, NaOH

YELLOW CAKE PRECIPITATION

Precipitation Conditions

Temperature:	*40 deg.C*
Reaction time:	*6-8 hr*
pH :	*12*

SOLID-LIQUID SEPARATION (THICKENING + FILTRATION)

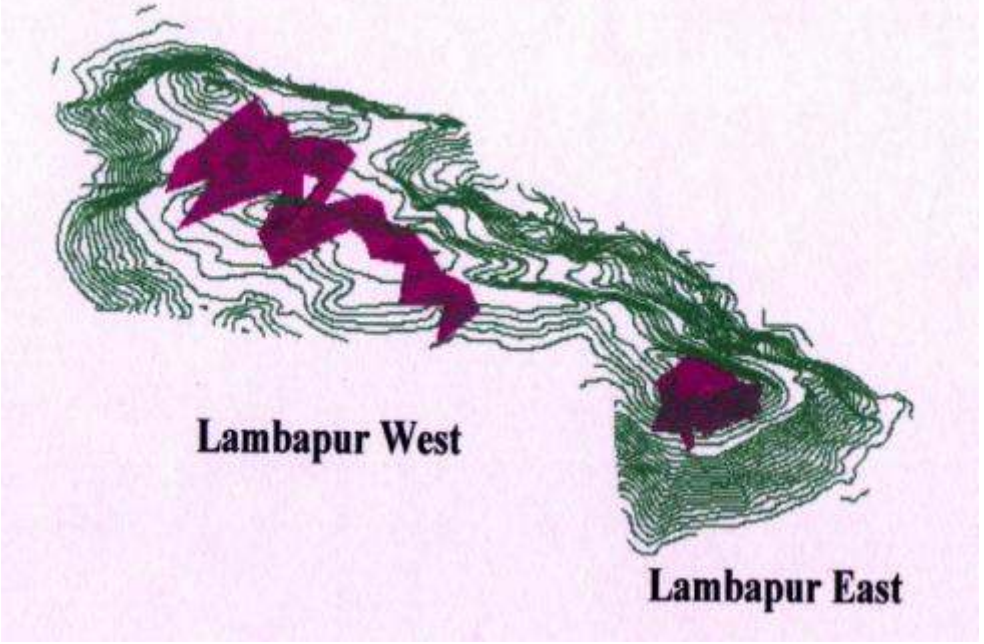
Effluent (for regeneration, recycle and disposal)

DRYING & PACKING

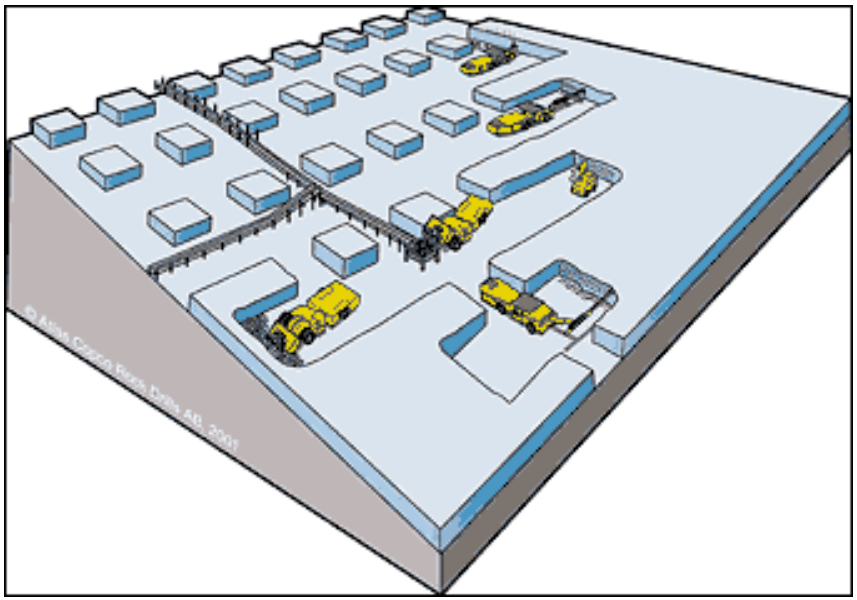
YELLOW CAKE (SDU)

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



MINING EQUIPMENT



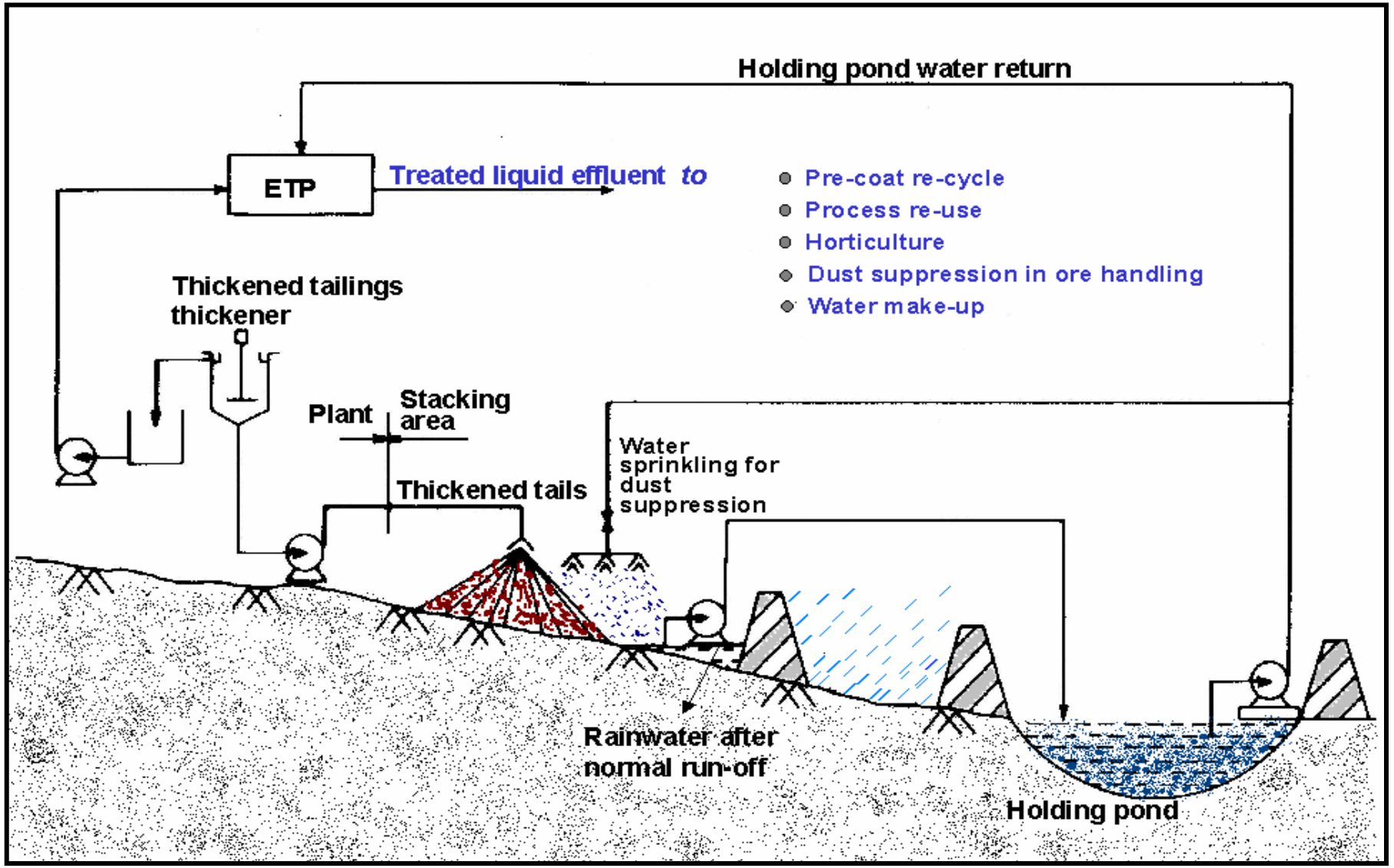
1.30 m

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)

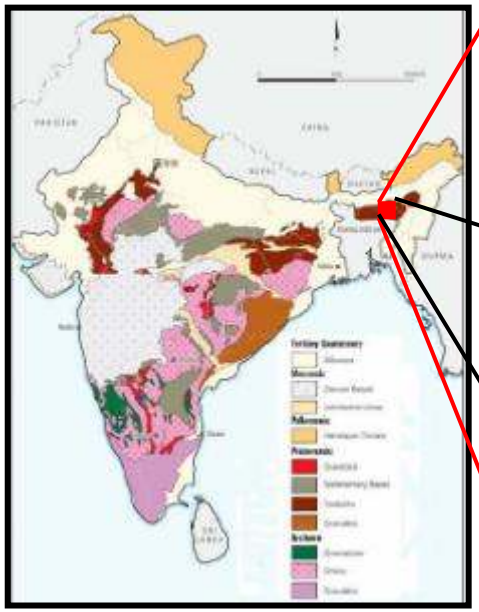
1.56 m

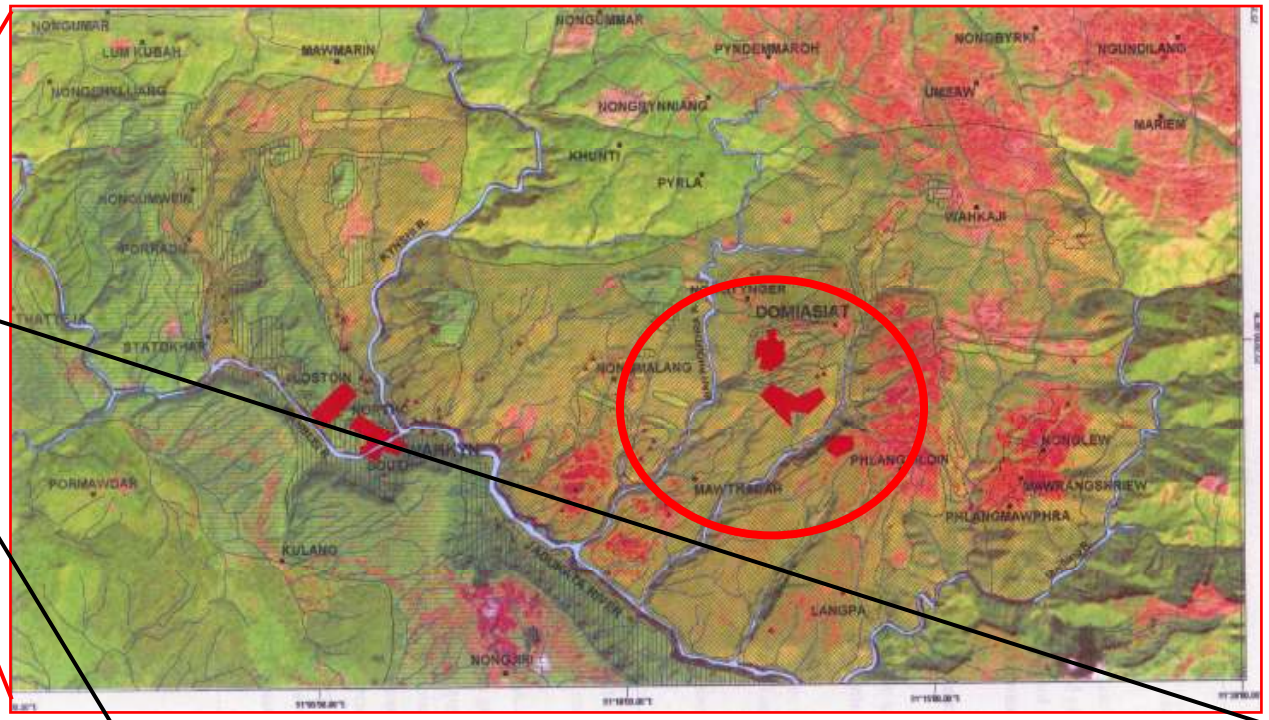
Total length: 8.73 m
Bucket: E-O-D (Eject-O-Dump)
Bucket tip height: 2.51 m
Ground clearance: 0.33 m
Tramming capacity: 6 t
Bucket volume: 2.1 m3 (2.7 yd3)
Turning radius: 5.4/2.2 m (outer/inner)

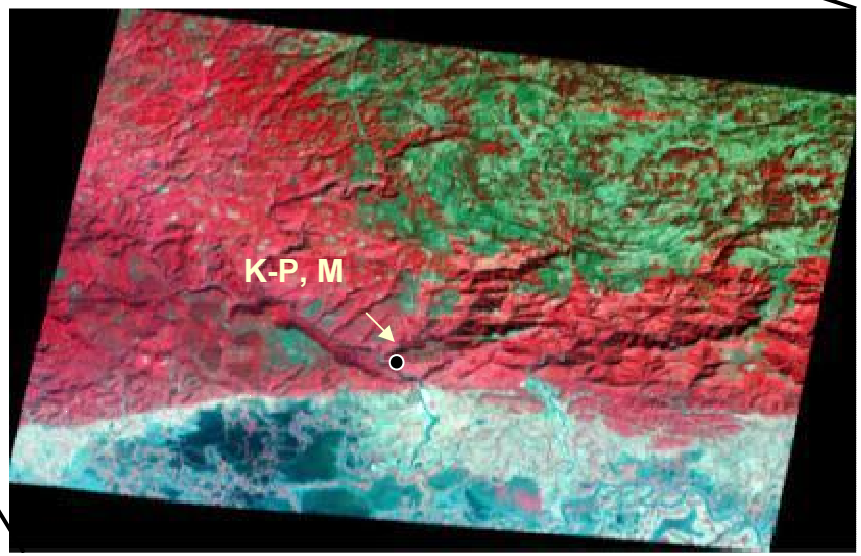
LAMBAPUR URANIUM PROJECT: CONCEPTUAL THICKENED TAILINGS DISPOSAL SYSTEM



MAHADEK BASIN

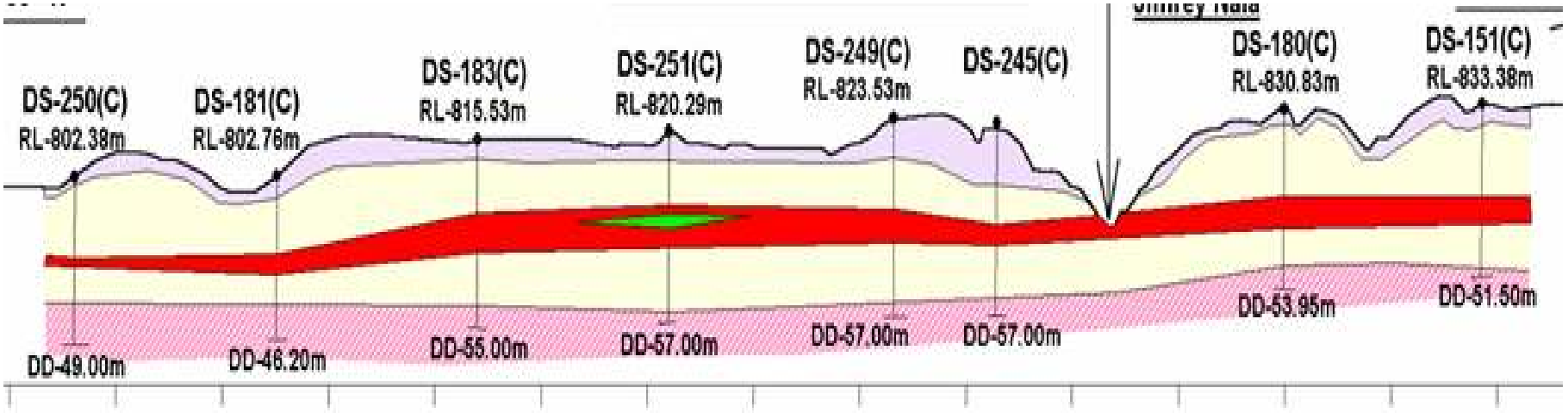






- **An inaccessible terrain**
- **Annual rainfall >10,000 mm**
- **Poor infrastructure**

KYLLENG-PYNDENGSOHIONG URANIUM PROJECT, MAWTHABAH



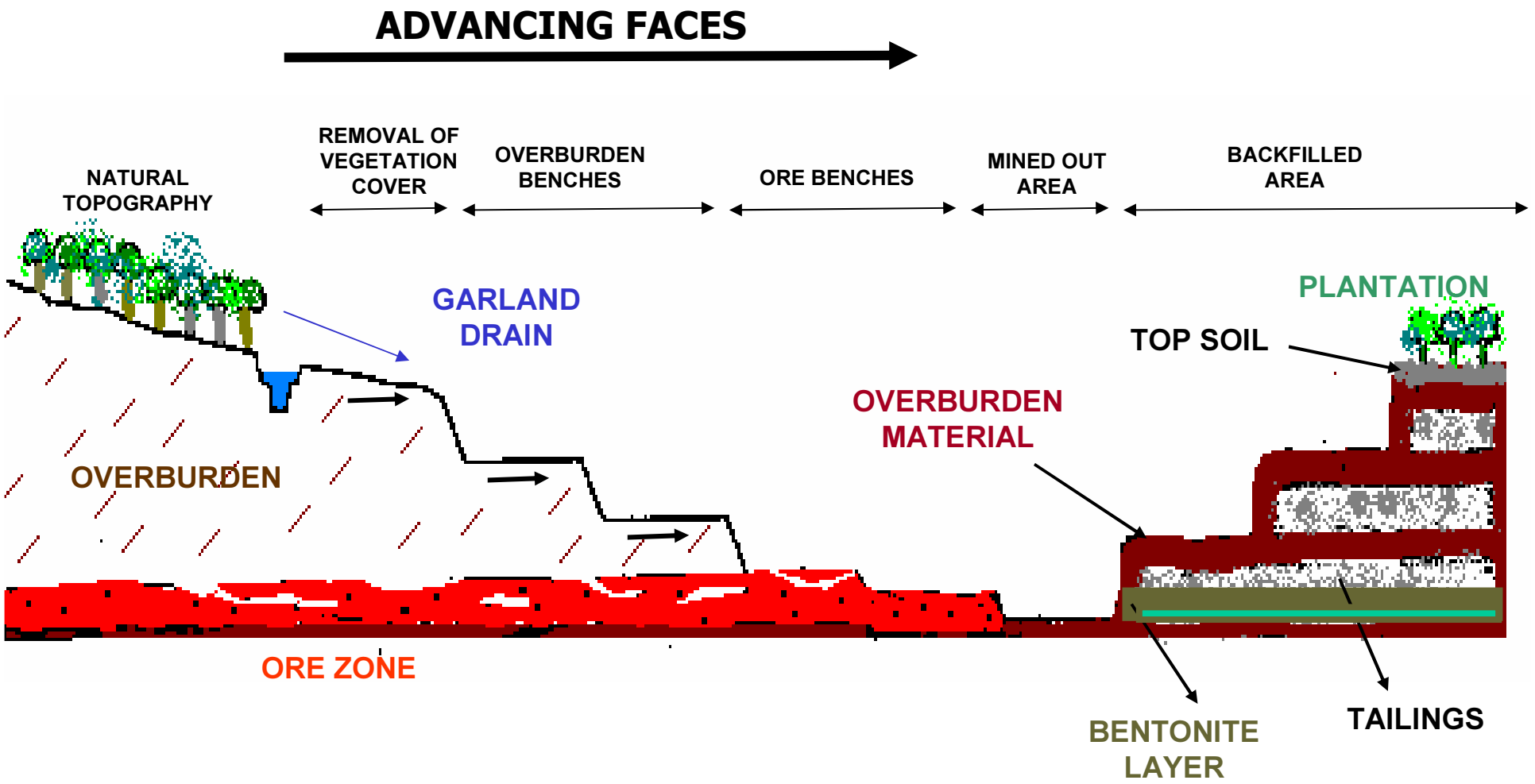
Sandstone type tabular orebody

Depth of mineralisation: 45 m

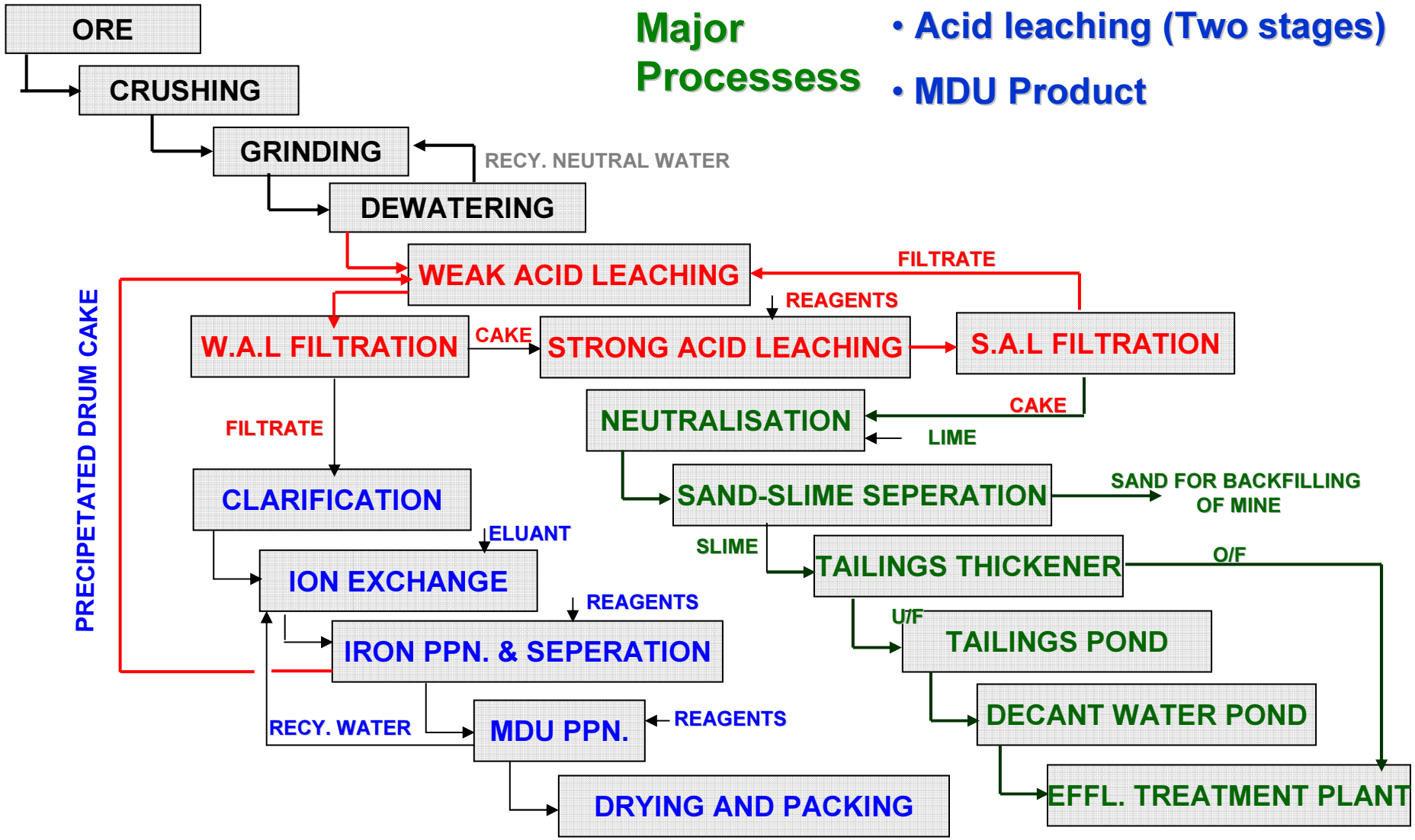
Dip: 3 – 5^0

Openpit mining planned

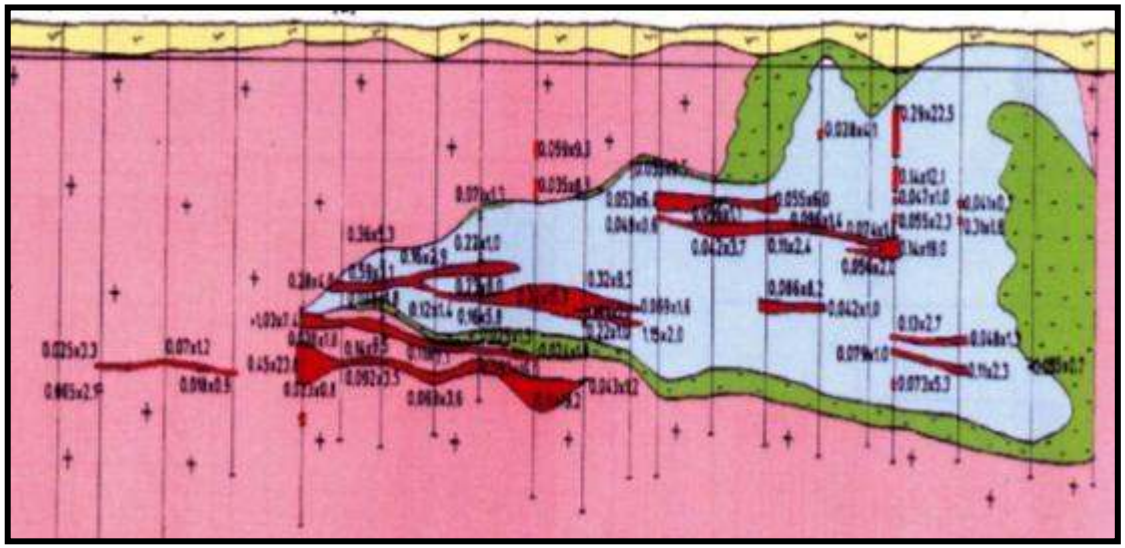
CONCEPTUAL MINING SCHEME AT KPM PROJECT



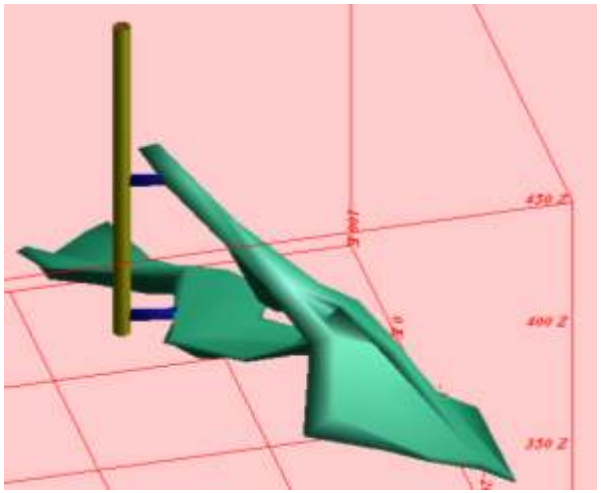
SCHEMATIC FLOWSHEET



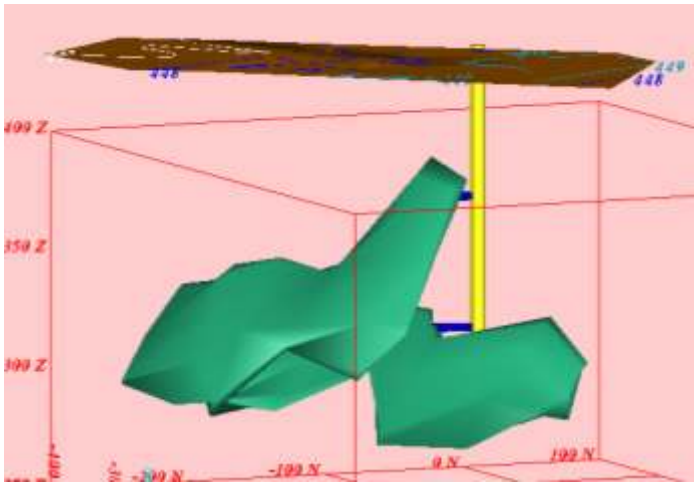
EXPLORATORY MINING AT BHIMA BASIN



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



Computerised 3-D model showing orebody and exploratory developments (under progress)



CHALLENGES AHEAD

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 RESPONSSIBILITY

UCIL

THANK YOU