Development of Carbonate Hosted Uranium Mineralization in India

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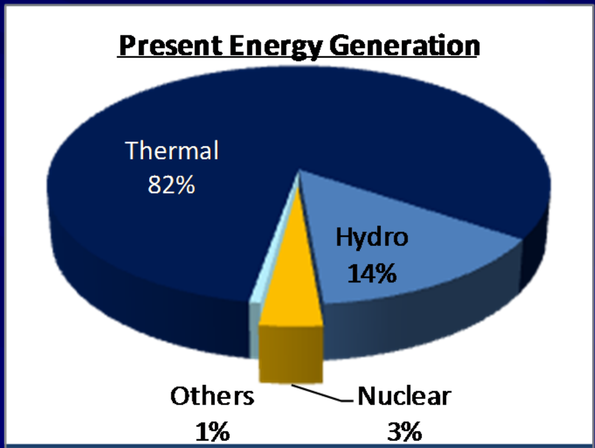
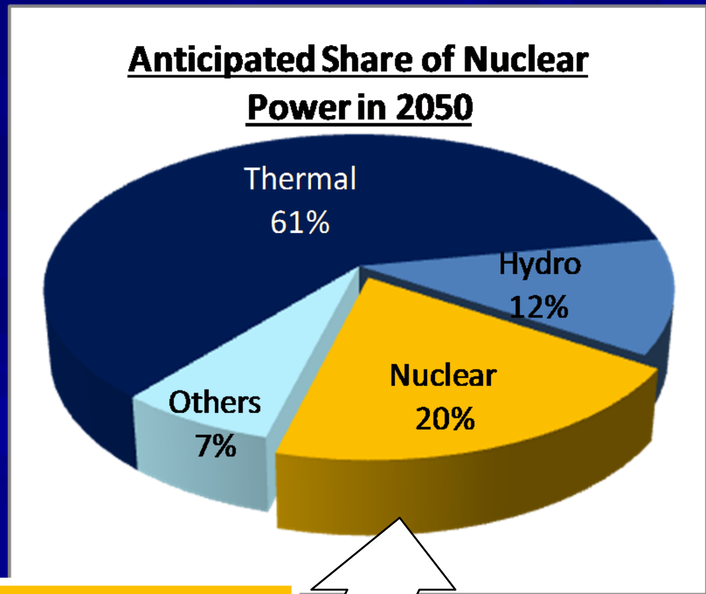
Nuclear Energy in India

- Clean, abundant and affordable source of energy
- Small volume of waste generation

Provides a modest share of India's current electricity production.





YEAR	Capacity (MWe)	
	Pessimistic	Optimistic
2030	48,000	63,000
2040	104,000	131,000
2050	208,000	275,000

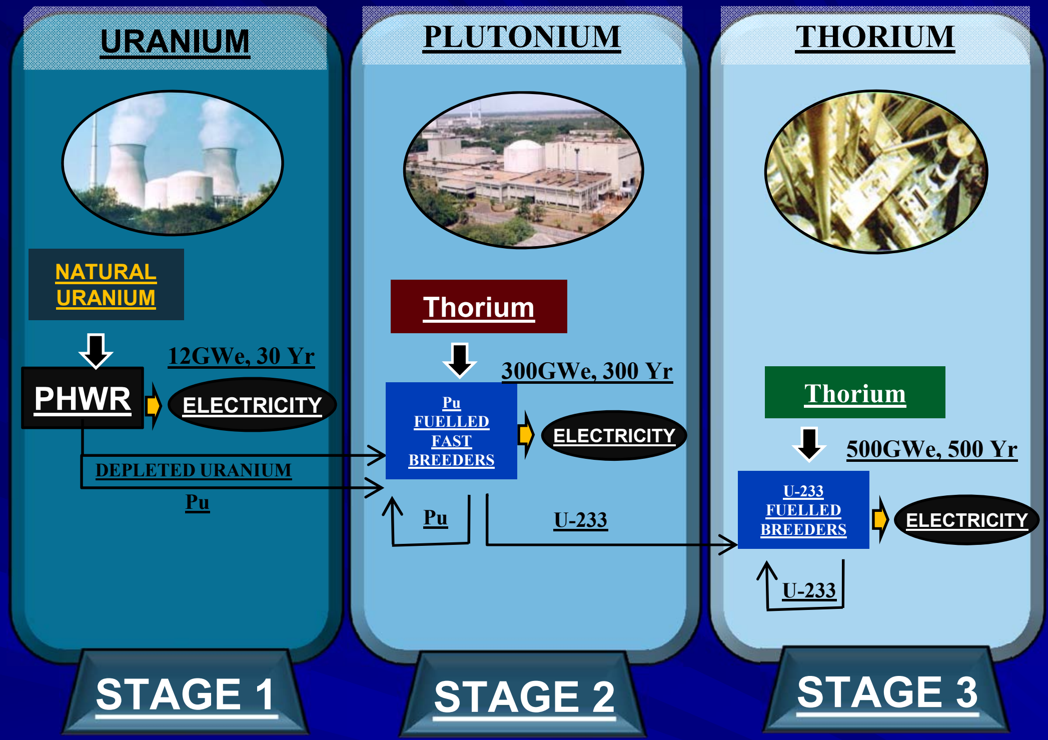
India's Three Stage Nuclear Power Program

Nuclear Power Plants in India

- Safeguarded
- Out of safeguard

Uranium towards Energy Security

- Unique 3 stage Nu-Power Programme
- Indigenous Uranium as primary fuel towards utilization of vast Thorium reserves

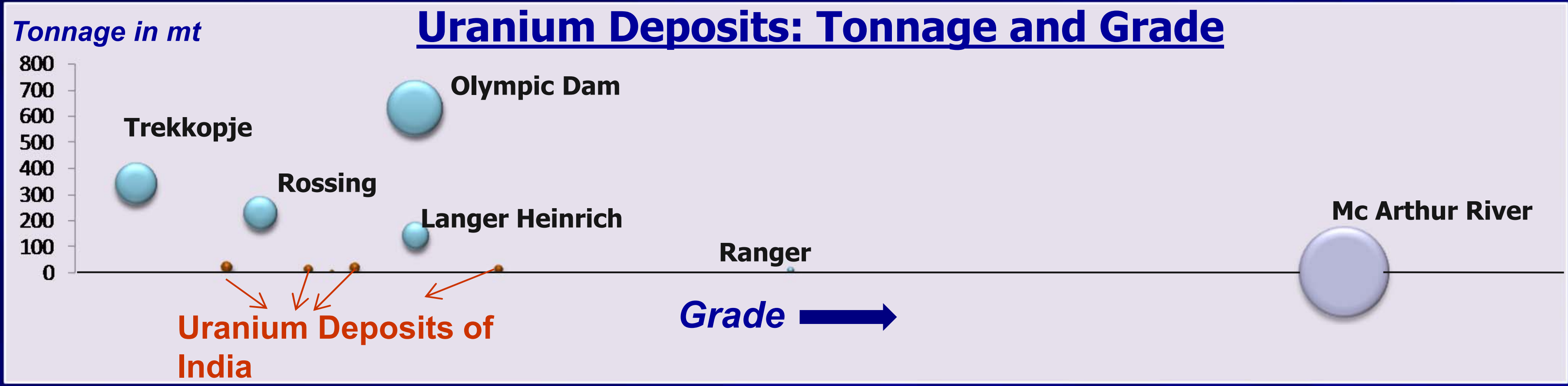


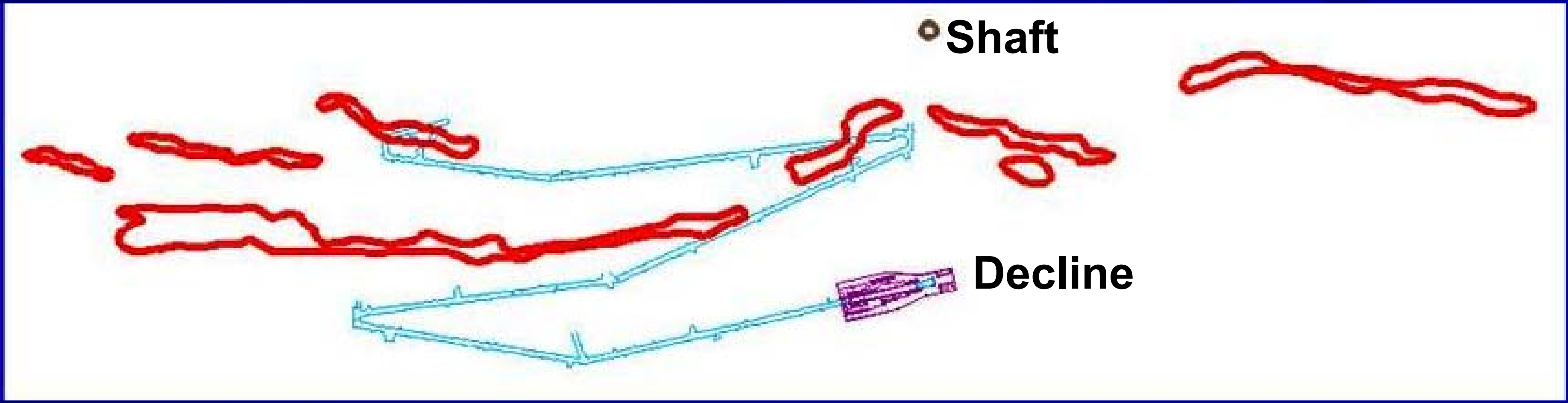
Maximizing the production of indigenous uranium through

- Efficiency in operation
- Expanding the existing production base
- Setting up new units

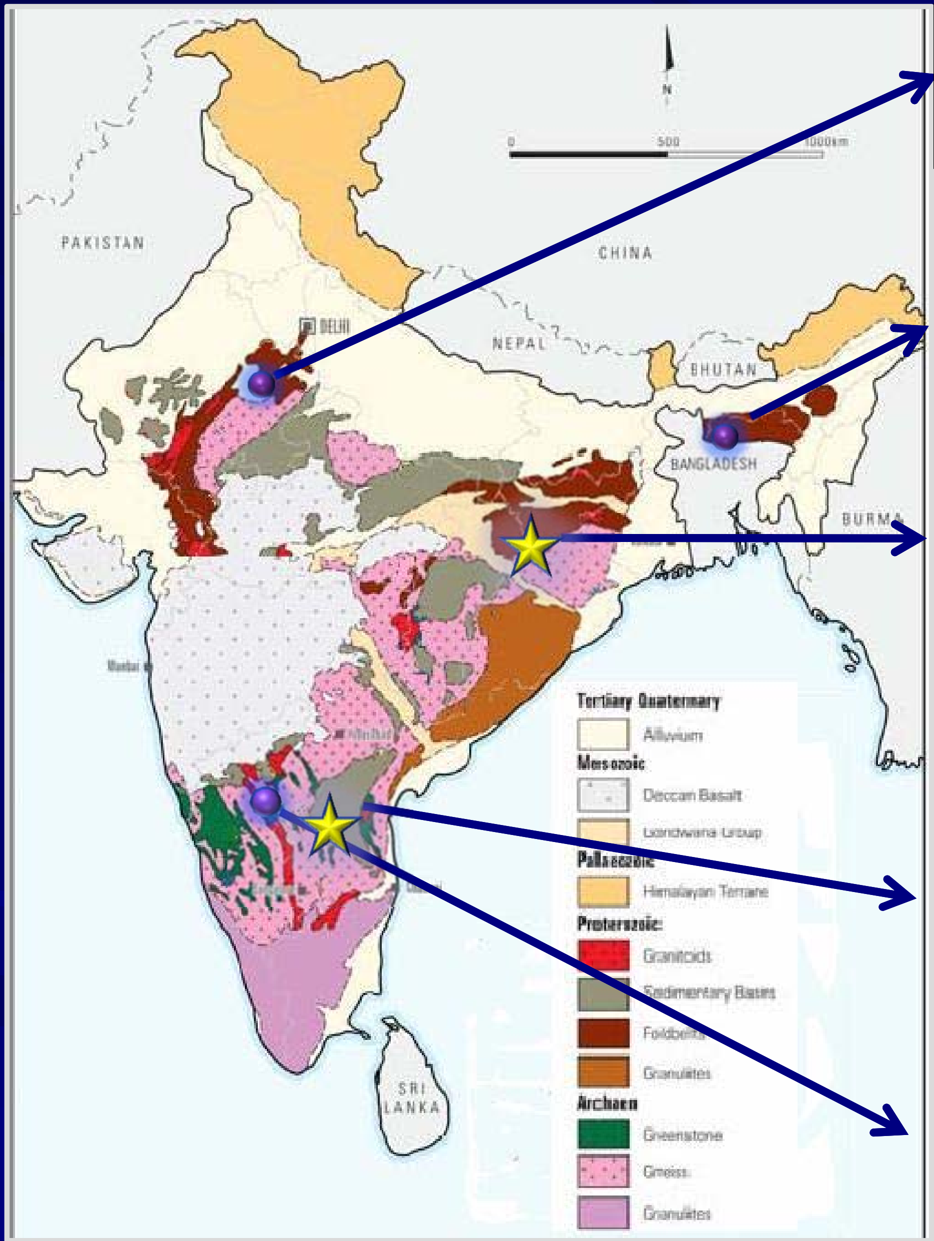
Indian Uranium Deposits & Complexities

- Indian uranium deposits are of low grade and small size
- Complex, irregular ore geometry and host rock characteristics
- Mining and processing of large quantity > small production





Uranium Deposits in India



Rajasthan
Arid climate, non-availability of water sources nearby

Meghalaya
Sandstone hosted near surface mineralization
High rainfall area (10000mm/yr)
Poor infrastructure

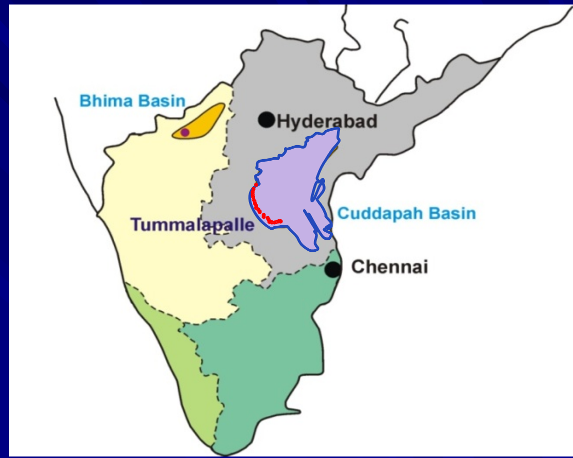
Jharkhand
Vein type irregular low grade deposits, siliceous host rock
Operating mines at Jaduguda, Bhatin Narwapahar, Turamdih, Bagjata, Banduhurang and Mohuldih; Plants at Jaduguda and Turamdih

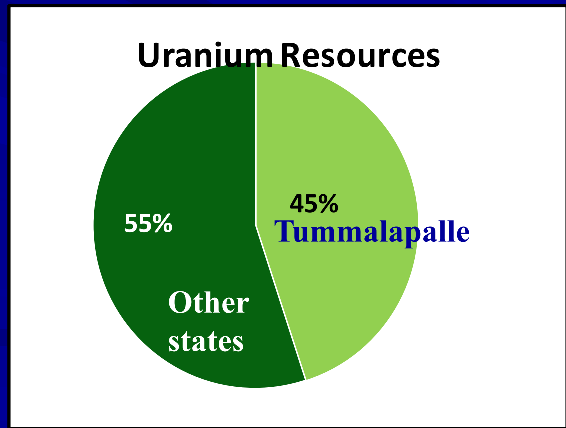
Andhra Pradesh
Carbonate host rock, large resource, narrow low grade mineralization with low dipping ore lenses
Mine and plant at Tummalapalle

Karnataka
Fracture controlled mineralization hosted in siliceous and carbonate host rocks

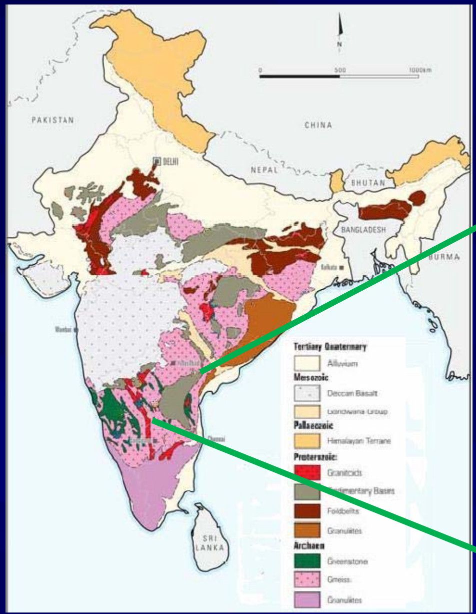
Tummalapalle Uranium Project, Andhra Pradesh

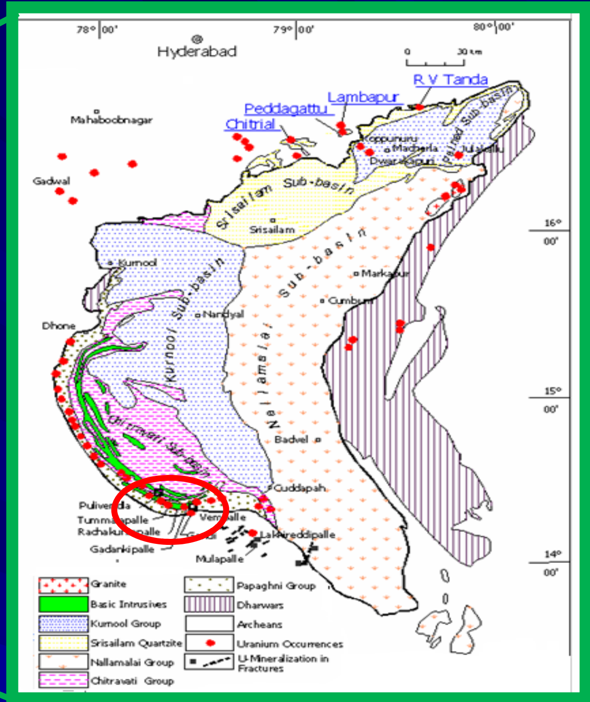
- Mineralization known over a stretch of 160km, strike length of 15 km already identified
- 7.6 km length already under development
- Underground mining
- Alkali leaching under pressure (indigenous technology)
  - Mine production started
  - Innovative mining technology with three declines and conveyor hoisting system
  - Unique processing technology
  - Process recovery and other issues are being streamlined
- 45% of Indian uranium resource in carbonate host rock. A small part (~ 20%) is under development towards establishing the technology

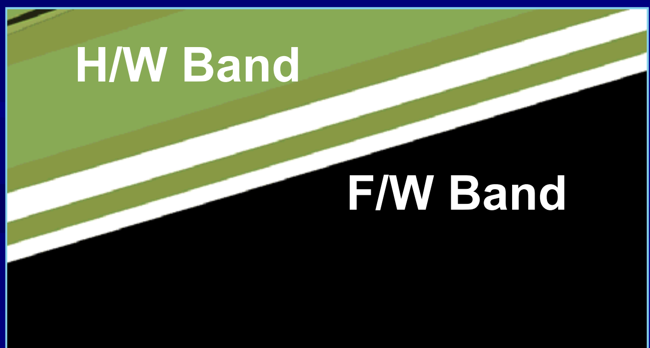




Geological Map of Tummalapalle Deposit







- Proterozoic basin – Known for other minerals too
- Two well defined lodes with uniform ore geometry
- Dip: 15 – 17 degree

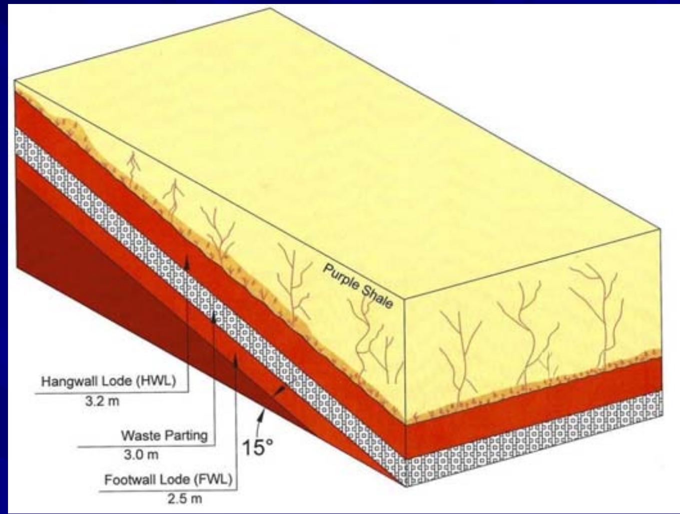
Status of Mining in Tummalapalle

- Mine production 3000 tpd
- Sufficient ore stockpiled

- Poor rock quality above HW Lode
- Present mining at FW Lode only

Attempt to access HW Lode in deeper levels (60m, 100m & 120m depth)

- Water flow noticed, drilling in HW indicates poor rock strata
- More Rock mechanics / Geotechnical studies planned – engaging mining research organisations.



Mine Entry

Three declines.

- **Centre decline for Conveyor**
- **Decline East & Decline West for transport of man and material**
- **Declines at 9° in apparent dip direction**
- **Declines in ore with excavation size 4.5m X 3m**

Mine Development

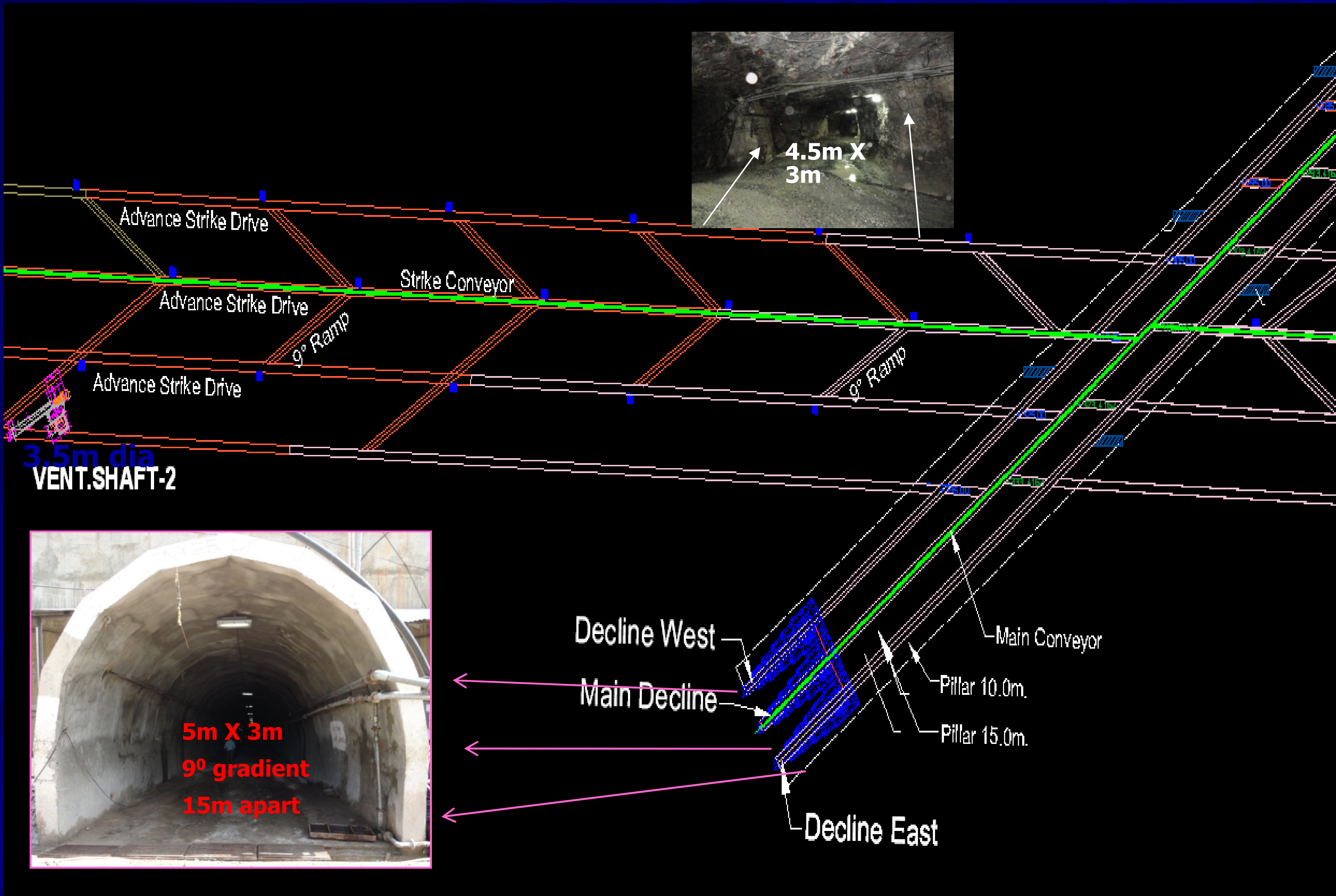
Advance Strike Drive (ASD)

- ASDs are driven in strike direction from both service declines up to orebody boundary
- Vertical interval of levels 10 m.
- Top most ASD serves as ventilation drive

Ramp

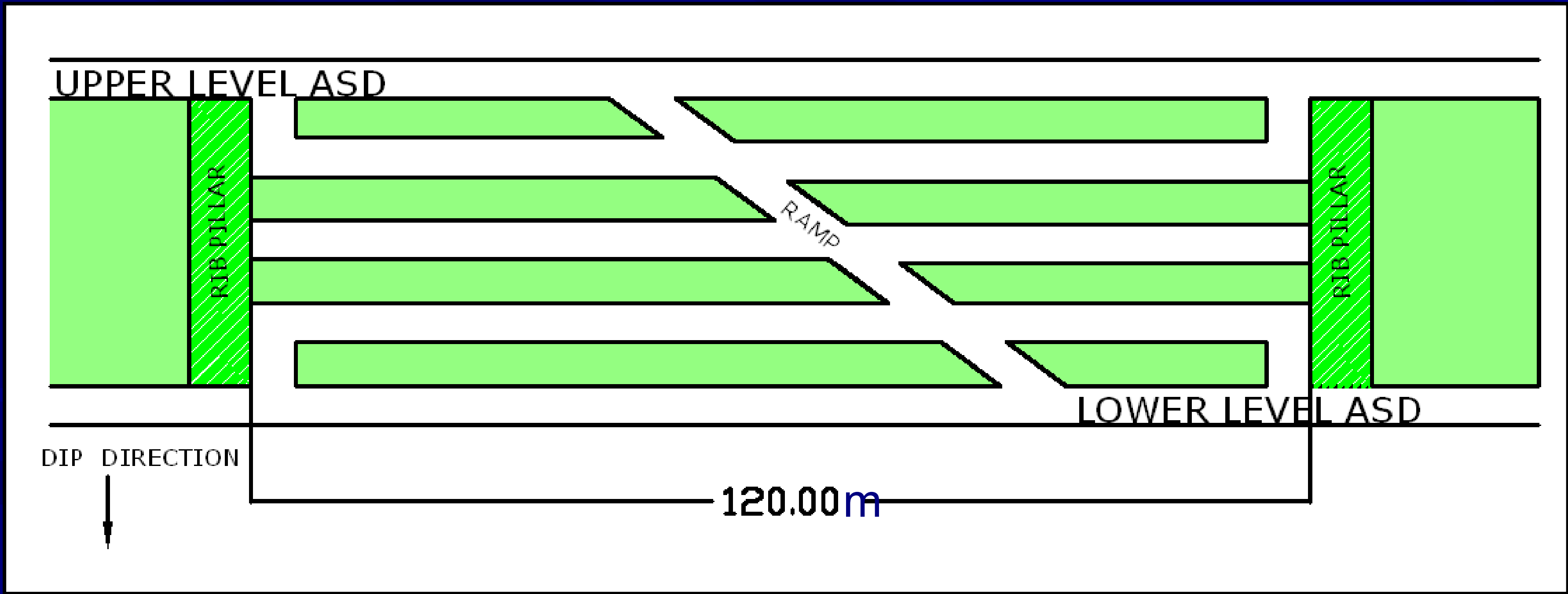
- Ramps are driven in apparent dip of 9^0 to connect upper and lower ASDs
- Movement of trackless equipments
- Initial free face for panel extraction

Mine Development



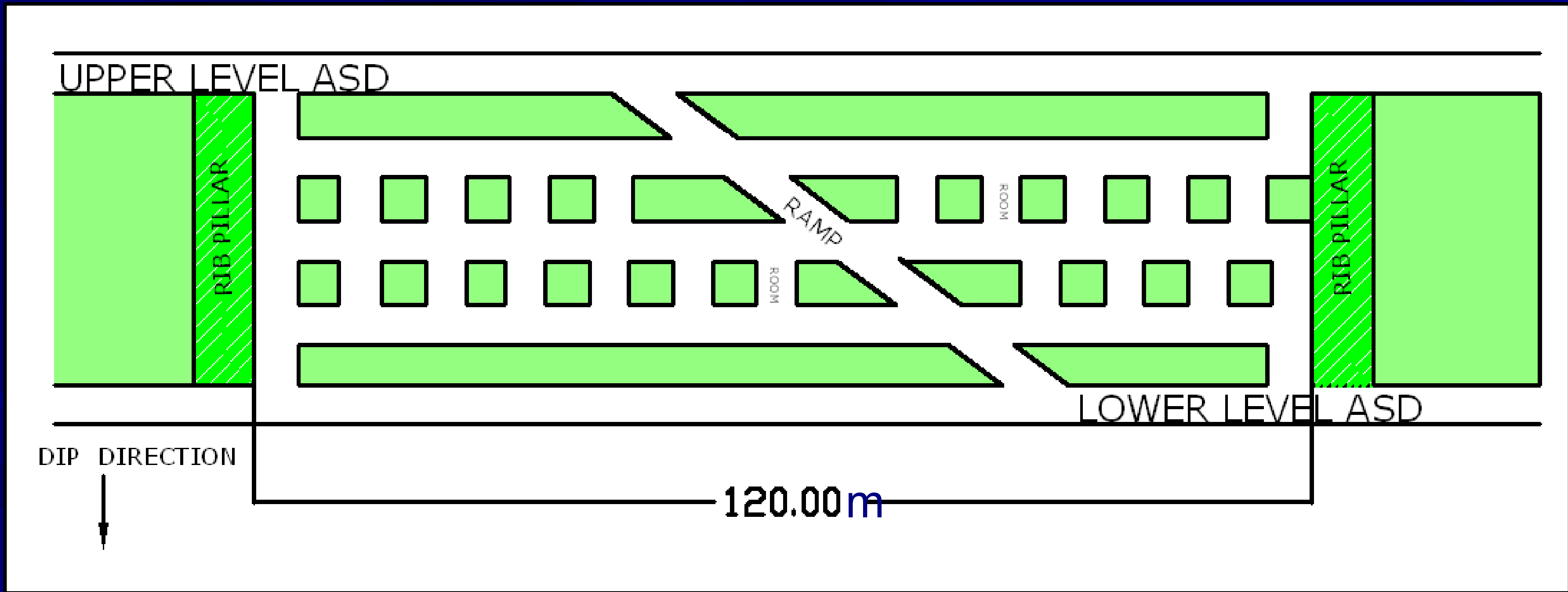
Mining Method

- Ramps are developed in apparent dip(9°) direction between two levels which act as a base for stope development.
- On either side of the ramp, stope drives of dimension (4.5x3m) are developed up to the limit of the length of panel (120m)



Mining Method

- After development of the ASDs, drives will be connected to form room of 4.5m and pillar of 5m width respectively.
- The method provides adequate support to the roof and good recovery of ore.



Mining 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

Ore Composition

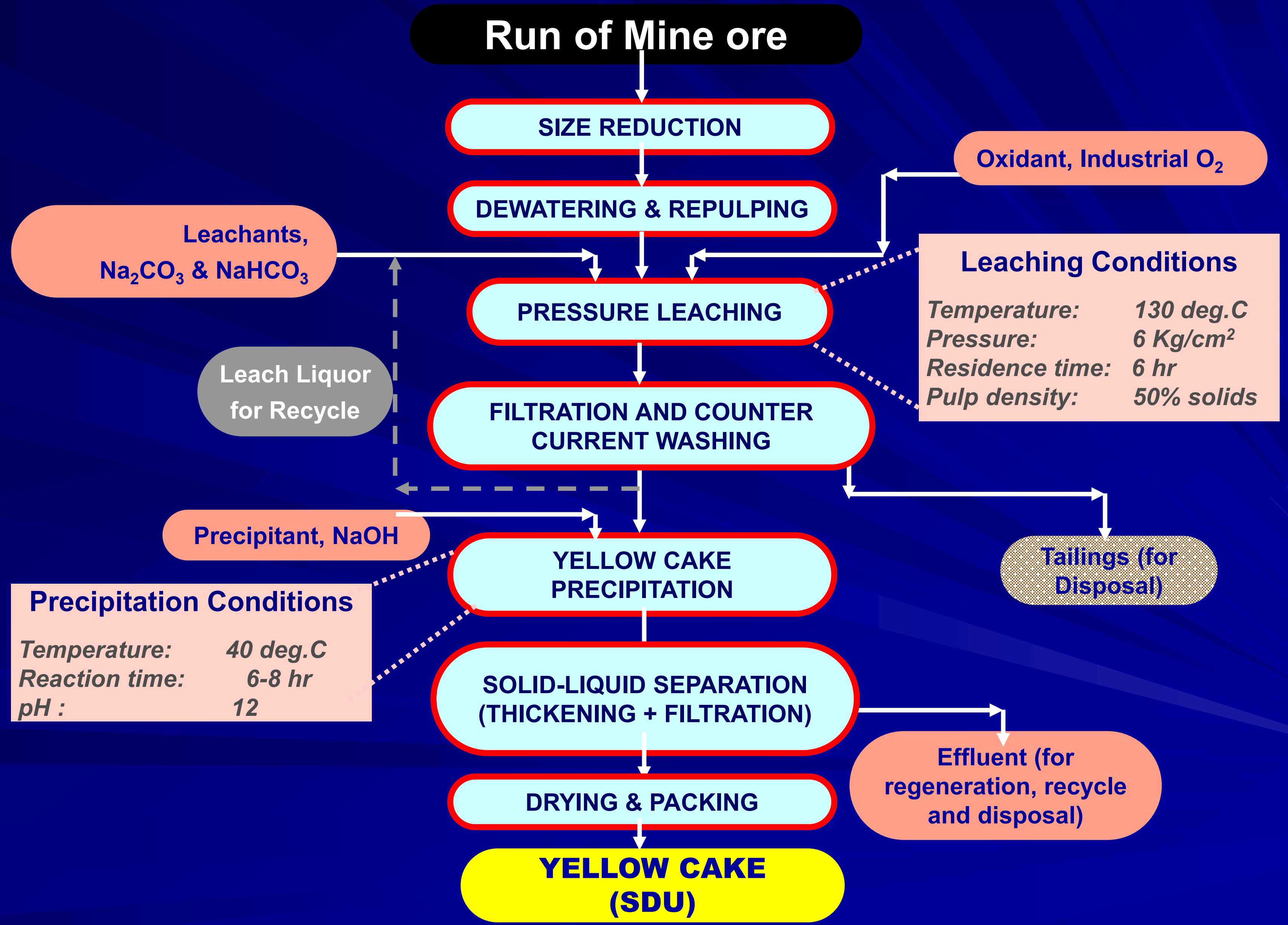
Physical beneficiation is not feasible due to the absence of discrete uranium minerals.

Constituents	in %
Carbonates	83.2
Quartz + Feldspar	11.3
Collophane	4.3
Pyrite	0.47
Chalcopyrite	0.05
Magnetite	0.15
Ilmenite	0.25
Ironhydroxide	0.27
Galena	Traces

Conventional acid leaching route is not feasible because of high Carbonate content

Pilot Plant Study of Ore

Schematic Flowsheet



Pilot Plant Study

Alkali leaching under pressure and Precipitation of Uranium as Sodium Di-Uranate (SDU) using Sodium Hydroxide

Temperature of leaching	**130 °C**
Pressure	**6 Kg/cm^2**
Residence time	**6 hrs**
Pulp density	**50% solids**
Temperature of precipitation	**40°C**
Reaction time	**6-8 hrs**
Precipitation Efficiency	**>95%**

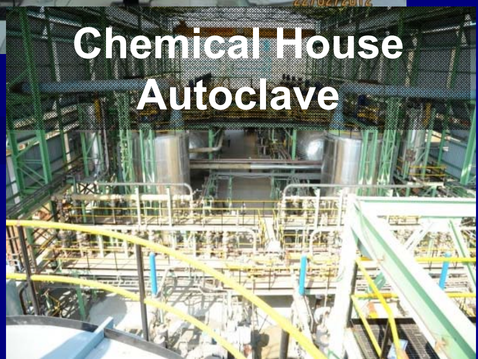
SDU Precipitation

Tummalapalle Processing Plant

Chemical House Control Room

Neutral Thickeners

Product Filter



Chemical House Autoclave

Neutral Filter

Product Packing

Advantages of the Method

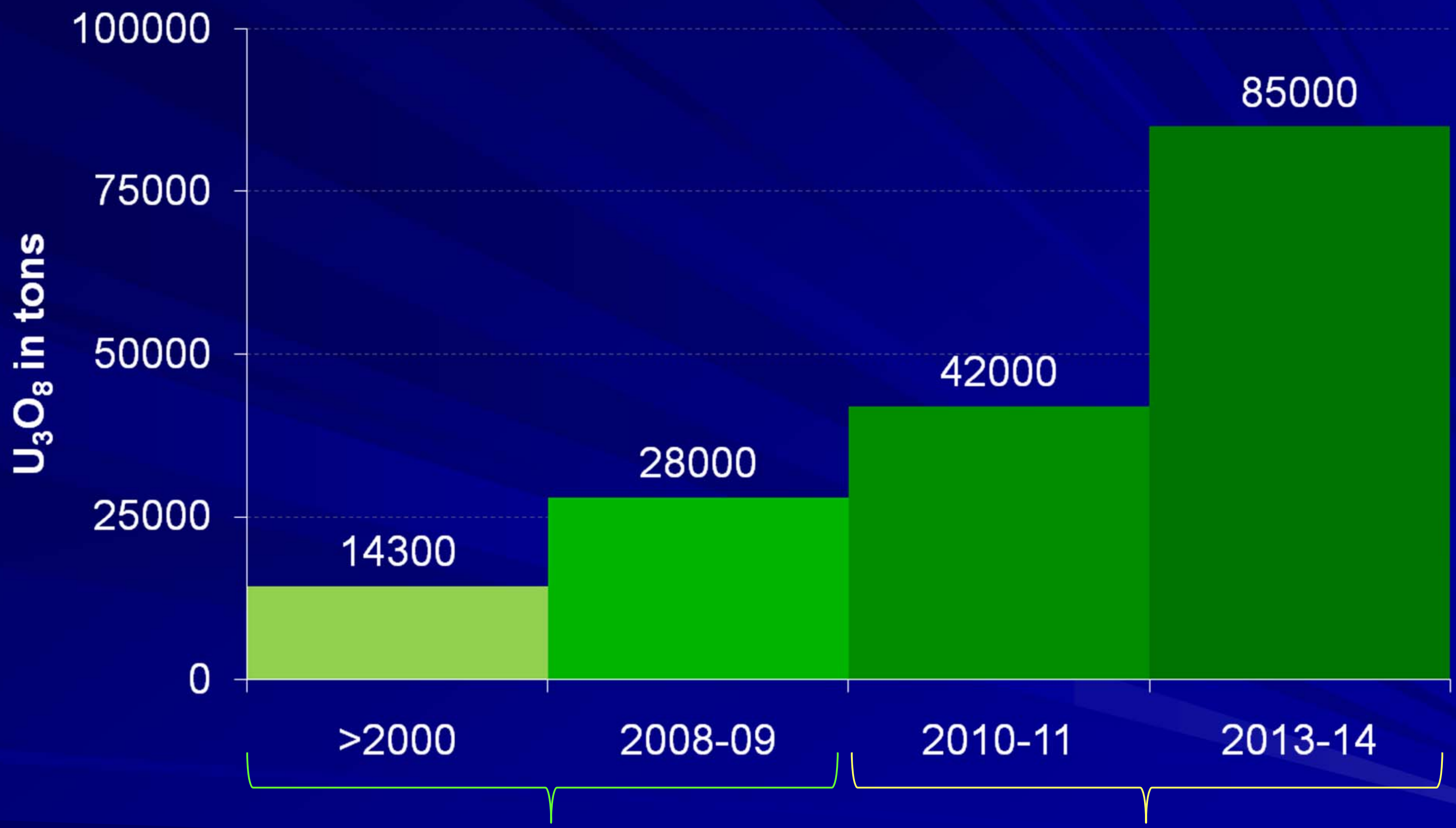
- Greater selectivity in leaching
- Omission of a number of steps in processing
- Direct precipitation from the leach liquor
- Non-corrosive leaching media
- More environment friendly

Challenges

- Achieving desired concentration in leached liquor on regular basis
- Precipitation efficiency
- Size of the product during precipitation

Success of the project will have very positive impact on indigenous nuclear fuel availability.

Uranium Resources around Tummalapalle



Tummalapalle uranium project

- Mine and Plant with 3000 tpd capacity
- Proposed expansion of mine and plant to 4500 tpd capacity.

Kanampalle uranium project

New mine and plant with 6000 tpd capacity

THANK YOU