## 1.0 INTRODUCTION

This Pre Feasibility Report (PFR) has been prepared as part of the application for grant of Terms of Reference (ToR) for carrying out Environmental Impact Assessment and Environmental Management (EIA/EMP) studies for the proposed expansion of Tummalapalle Uranium Project of Uranium Corporation of India Ltd. (UCIL) from 9.0 lakh TPA to 13.5 lakh TPA without increase in the project area (973.61 ha). The project also envisages expansion of the existing ore processing plant commensurate with the increased ROM production. The project area is located in Vemula Mandal of YSR district of Andhra Pradesh.

Tummalapalle project area measures 973.61 ha. The mine and associated ore processing plant have been planned over 813.61 ha area in Tummalapalle, Mobbuchintapalle, Bumayigaripalle and Rachakuntapalle villages (Velpula and Medipentla mandals) whereas tailing disposal has been planned over 60 ha in Kottalu village (Vemula mandal), 6 km west of the plant site. A township is being set up over 100 ha in Mobbuchintapalle village.

In pursuance of Government of India policy vide Environment (Protection) Act, 1986 new projects or expansion of any existing plant necessitates statutory prior Environmental Clearance in accordance with the objectives of National Environmental Policy as approved by the Union Cabinet on 18$^{th}$ May, 2006 and MoEF&CC's EIA Notification dated 14.09.2006, by preparing a EIA / EMP report. As part of the process of scoping for the EIA / EMP studies the project proponent has to submit an online formal application to Ministry of Environment, Forests and Climate Change (MoEF&CC) in the prescribed format (Form I) along with a Pre Feasibility Report.

Ministry of Environment and Forest, Govt. of India had granted Environmental Clearance for the mine and associated ore processing plant with rated capacity of 0.9 Mt/yr vide letter no. J – 11015/394/2006-IA.II (M) dated 21$^{st}$ Feb, 2007.

The lease was granted to UCIL on 19.12.2007 over 813.41 ha for 30 years by Department of Mines & Geology, Government of Andhra Pradesh vide order no. Proc. No. 2627/M/2007 (Ref: UCIL's letter no. UCIL/TMPL/ML/04/2007 dated Dt. 5.12.2007 and 7.12.2007). Mining plan for 0.9 Mt/yr rated capacity has been approved by Atomic Minerals Directorate for Exploration and Research (AMD).

While taking necessary actions prescribed by MoEF&CC, UCIL has decided to submit an application to MoEF&CC and has engaged the services of MECON Limited a Public Sector Undertaking under the Ministry of Steel, Govt. of India to prepare a Pre-Feasibility Report as the first step for seeking Environmental Clearance for the Tummalapalle Uranium Ore mine.

This report contains information on the proposed expansion of the project.

The report including this introduction chapter includes:

- Introduction of the Project / Background Information
  - Identification of the Project and the Project Proponent
  - Brief Information of the Project

- Need for the Project and its Importance to the Country or Region
- Demand and Supply
- Import vs. Indigenous Production
- Export Possibilities
- Domestic / Export Market
- Employment Generation

- Project Description
  - Type of Project including Interlinked and Interdependent Project
  - Location
  - Details of Alternate Site
  - Size and Magnitude of Operation
  - Mine Description
  - Raw Materials
  - Resource Optimization / Recycling and Resource
  - Site Services
  - Wastes

- Site Analysis
  - Connectivity
  - Land Form, Land Use, Ownership
  - Land use
  - Existing infrastructure
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  - Climate
  - Social infrastructure available

- Planning Brief
  - Planning Concept
  - Land Use Planning
  - Assessment of Infrastructure Demand
  - Amenities / Facilities

- Proposed infrastructure
- Resettlement and Rehabilitation Plan
- Project Schedule and Cost Estimate
- Analysis of Proposal (Final Recommendation)

ACKNOWLEDGEMENT

MECON wishes to place on record its deep appreciation for the trust reposed in MECON by UCIL and for the active interest and help extended by UCIL officials.

## 2.0 INTRODUCTION OF THE PROJECT / BACKGROUND INFORMATION:

### 2.1 IDENTIFICATION OF PROJECT AND PROJECT PROPONENT:

Uranium Corporation of India Limited (UCIL) is a Public Sector Enterprise under the Department of Atomic Energy incorporated on 4th October 1967. UCIL is at the forefront of the Nuclear Power cycle.

UCIL's existing operations are spread over Jharkhand and Andhra Pradesh. UCIL is operating seven underground mines (Jaduguda, Bhatin, Bagjata, Turamdih, Narwapahar and Mohuldih in Jharkhand and Tummalapalle in Andhra Pradesh). UCIL also owns one opencast mine at Banduhurang in Jharkhand, which is the first and so far the only opencast uranium mine in India. UCIL also operates uranium ore processing plants at Jaduguda and Turamdih in Jharkhand and Tummalapalle in Andhra Pradesh to extract the uranium present in the ore. The uranium present in the ore is extracted as magnesium-di-uranate (at the Jaduguda and Turamdih plants) or as sodium-di-uranate (in the Tummalapalle plant) also known as "Yellow Cake". The yellow cake is dispatched to Nuclear Fuel Complex, Hyderabad for further processing.

Tummalapalle Uranium Project is located at about 70 km away from Kadapa (the district headquarters of YSR district) in Andhra Pradesh. The project area is spread over 973.61 ha in Vemula Mandal of YSR district of Andhra Pradesh. The project area comprises of agricultural land (432.76 ha), barren land (475.85 ha) and grazing land (65.00 ha). The deposit was taken up for development in 2007 after the successful indigenous efforts of establishing the processing technology (alkali leaching under pressure) to extract uranium from carbonate host rock. The lease was granted to UCIL on 19.12.2007 over 813.41 ha for 30 years by Department of Mines & Geology, Government of Andhra Pradesh vide order no. Proc. No. 2627/ M/2007 (Ref: UCIL's letter no. UCIL/TMPL/ML/04/2007 dated Dt.5.12.2007 and 7.12.2007).

It is proposed to increase the production of ore from Tummalapalle mine from the existing level of 0.9 Mt/yr to 1.35 Mt/yr without increase in the ML area. It is also proposed to increase the capacity of the associated ore processing plant commensurate with that of the mine..

Mining Plan for 1.35 Mt/yr capacity is approved by AMD vide letter No. AMD/MRG/UCIL/MMP/813.412Ha/2013 dated 24.07.2013. The estimated project cost is Rs. 720 crores. The overall life of the operations is expected to be for more than 30 years. However, the reserve up to a depth of 275m is expected to last for 22 years at the expanded capacity.

## 2.2 BRIEF INFORMATION OF THE PROJECT:

The project falls under Category 'A' [Sl.no. 1(a) and 2(b) of Schedule: "List of project or activities requiring prior Environmental Clearance"] of MoEF&CC notification dated 14th September, 2006, Amendment Nov.-2009 & April -2011 of the Ministry of Environment & Forest, New Delhi.

Ministry of Environment and Forests, Govt. of India had granted Environmental Clearance for the project (the mine and associated ore processing plant) with rated capacity of 0.9 Mt/yr vide letter no. J – 11015/394/2006-IA.II (M) dated 21st Feb, 2007.

The lease was granted to UCIL on 19.12.2007 over 813.41 ha for 30 years by Department of Mines & Geology, Government of Andhra Pradesh vide order no. Proc. No. 2627/ M/2007 (Ref: UCIL's letter no. UCIL/TMPL/ML/04/2007 dated Dt.5.12.2007 and 7.12.2007). Mining plan for 0.9 Mt/yr rated capacity has been approved by Atomic Minerals Directorate for

Exploration and Research (AMD) and Mining Plan for 1.35 Mt/yr capacity is approved by AMD vide letter No. AMD/MRG/UCIL/MMP/813.412Ha/2013 dated 24.07.2013.

Peak industrial water demand for the expanded project has been estimated to be 7100 $m^3$/day, whereas potable water demand has been estimated to be 1185 $m^3$/day. Of this 2285 $m^3$/day will be met by utilizing treated mine discharge and other effluents and the balance 6000 $m^3$/day will be drawn from Chitravati River.

## 2.3 NEED FOR THE PROJECT AND ITS IMPORTANCE TO THE COUNTRY OR REGION:

Nuclear power generation in India has been planned to be increased from 4560 MWe at present to 20,000 MWe by the year 2020. This will lead to increased demand for uranium. Consequently, UCIL plans to increase the production capacity from its existing mines and also develop new mines. Expansion of Tummalapalle mine is part of this programme to facilitate the increased demand of uranium for India's nuclear power industry.

Expansion of Tummalapalle Mine will have the following benefits:

- Increase supply of uranium ore for India's nuclear power programme.
- Alternative for reducing coal dependency.
- Reduces power shortages hindering growth, foreign investment and productivity.
- Generate additional employment, both direct and indirect which will lead to economic growth of the industrial sector as well as country.
- Quality of life of local populace in villages shall improve due to company's community development programmes.

## 2.4 DEMAND AND SUPPLY GAP:

India's atomic energy programme, in spite of opportunities for import of fuel shall continue to prefer the ideal path of generating power using indigenous uranium. But, demand of fuel for nuclear reactor is not fully met by indigenous uranium. At present with 4780 MW of installed nuclear power capacity, about 32% of fuel requirement is met by imported uranium. With addition of more nuclear power reactors, demand and supply gap of uranium is likely to increase.

In the last four decades, the Indian uranium industry has established ore processing capacity of 8,500 TPD which is likely to go up to 11,500 TPD by 2018. The concentration of uranium in the ores being mined in India is lower than the internationally accepted minimum grade to be classified as ore (0.1%). Since uranium is not available freely in the world market, India has to mine and process progressively lower grades of so called ore.

Indian uranium deposits are of medium size and the country has a modest uranium resource. Only a small part of the land mass of the total of 3.28 million sq.km of Indian sub-continent is assumed to be geologically favorable for hosting uranium deposits. Of the total uranium resources identified so far, Jharkhand accounts for about 45%, And Andhra Pradesh 26%, Meghalaya 16%, Rajasthan and Karnataka 4% each and remaining in other states.

Successful implementation of indigenously developed processing technology at Tummalapalle holds the key for larger expansion programme of uranium production capability in this area.

The technologies to mine thin and low grade ore, benchmark of zero discharge, higher and purer product recovery, disposal and management of large tailings, public perception on uranium mining, availability of skilled manpower etc are crucial for indigenous uranium production scenario in coming decades.

### 2.5 IMPORT VS INDIGENOUS PRODUCTION:

Refer clause 2.4 above.

### 2.6 EXPORT POSSIBILITIES:

Uranium produced from this project will be exclusively consumed in the domestic power generation. There is no proposal for export of uranium ore from this project.

### 2.7 DOMESTIC / EXPORT MARKET:

There is no possibility of domestic and export market for uranium ore supply.

### 2.8 EMPLOYMENT GENERATION:

The expanded project will employ a total of 1225 people of whom 650 shall be deployed at the mine and 575 at the ore processing plant. (Present strength is 550 at the mine and 384 at the plant). Additional employment will be 291 only.

Majority of the unskilled and semiskilled workers will be local persons. The officers, supervisors and rest of the workers will be housed in UCIL's townships.

## 3.0 PROJECT DESCRIPTION

It has been planned to enhance the ore production from 0.9 Mt/yr to 1.35 Mt/yr from the existing underground mine. The project also envisages expansion of the existing ore processing plant commensurate with the increased ROM production. Estimated project cost of the proposed expansion is Rs. 720 crore. Mine lease area of the project shall remain same.

Initially the lease was granted to UCIL on 19.12.2007 over 813.61 ha for 30 years by Department of Mines & Geology, Government of Andhra Pradesh vide order no. Proc. No. 2627/ M/2007 (Ref: UCIL's letter no. UCIL/TMPL/ML/04/2007 dated Dt.5.12.2007 and 7.12.2007).

### 3.1 TYPE OF PROJECT INCLUDING INTERLINKED AND INTER-DEPENDENT PROJECT

The project falls under Category 'A' [Sl.no. 1(a) and 2 (b) of Schedule: "List of project or activities requiring prior Environmental Clearance"] of MoEF&CC's notification dated 14th September, 2006 in connection with Environment (Protection) Rules 1986.

### 3.2 LOCATION:

Tummalapalle uranium deposit is located in Vemula Mandal of YSR district of Andhra Pradesh at a distance of about 70 km from Kadapa, district headquarter of YSR. The nearest town is Pulivendula, which is about 15 km away (by road) towards the north-west. The deposit is covered under Survey of India Toposheet Nos. 57 J/3 and 57 J/7 between latitudes 14°18'36" N & 14°20'20" N and longitudes 78°15'16" E & 78°18' 03.3" E. The deposit is linked to Pulivendula through village roads leading to State Highway No.18, which connects Kadapa with Velidandla. The nearest railway station is Muddanurru on

South Central Railway's Hyderabad – Chennai BG Line, which is about 50 km towards the north-east. Location of the lease area is shown in Drawing No. MEC/Q75U/11/S2/01.

## 3.3 DETAILS OF ALTERNATE SITE:

Since the project envisages capacity increase of an existing underground mine and mining is a site specific activity guided by deposit geology, the question of any alternate site does not arise.

## 3.4 SIZE AND MAGNITUDE OF OPERATION:

The project area is spread over 971.63 ha. The existing rated capacity of the mine is 0.9 Mt/yr of uranium ore. The present proposal envisages increase of ore production 1.35 Mt/yr without increase of lease area. The existing ore processing plant has been designed to process 0.9 Mt/yr of ore. It is also proposed to increase the capacity of the ore processing plant to 1.35 Mt/yr of ore.

## 3.5 MINE DESCRIPTION

### 3.5.1 Geology:

#### General

Tummalapalle deposit (14°18'30"N 14°20'30"N : 78°15'16.57"E 78°16'42.67"E ) situated in the YSR district of Andhra Pradesh, falls in the Survey of India Toposheet No. 57 J/3 & 7 and is about 12km. NNW of Pulivendula town, and is well connected to Bangalore, Hyderabad and Chennai by road and rail. Kadapa, the nearest city is about 70km in the east.

Geologically the area is situated in the southwestern part of the cuddapah Basin, close to the Archean basement and mineralisation lies within Vampalle formation of Papaghni Group of cuddapah Super Group.

#### Status of exploration

The presence of Uranium mineralization was first reported in 1986. After the anomaly was located, detail ground radiometric survey was carried out in the vicinity by AMD over an area of 35 km along strike length. Initially an area of 3 km by 60 m at Tummalapalle was delineated by ground radiometric survey for further detailed work.

#### Geology and structure

The area lies in the south western part of the crescent shaped mid to late Proterozoic cuddapah basin. The basin constitutes an unmetamorphosed to slightly metamorphosed thick (1500 m.) arenaceous and argillaceous sedimentary sequence overlying the profound Eparchean unconformity. Highly metamorphosed and deformed Late Archean to Early Proterozoic granite gneisses and Dharwarian schists lie under this thick sedimentary pile. The sediments are mostly undisturbed on the SW margin of the basin while these are thrusted over by Dharwarian schists and gneisses on the eastern margin.

#### Nature of mineralization and ore body

The ore body is continuous over the entire strike length as well as downdip. Two parallel ore bands are established designated as hangwall lode and footwall lode. The ore bands are tabular, stratabound, non-transgressive in nature with limited variation in grade and

thickness along strike as well as in dip direction. The ore bands are devoid of any structural disturbance or erosional features. The hangwall lode is more uniform in grade, thickness and extent. These two bands are separated by a uniform lean zone. The dimension of ore body was earlier established over a stretch of 6.6 km along strike and up to a depth of 275 m. The average dip of the ore body is 15° to 17° due N22°E.

Exploration by AMD around Tummalapalle has established continuity of the mineralisation of both the lodes (hang-wall lode and foot-wall lode) with additional ore blocks on both eastern and western sides as strike extension of the already established ore lenses and also up to a depth of 500m nearly doubling the reserves.

### 3.5.2 Mineral Reserves:

The ore reserve has been calculated at 0.02 % $eU_3O_8$ cut off grade to estimate the residual life of mine. The exact ore reserve and grade is the restricted information as per Section 3 of Atomic Energy Act 1962.

### 3.5.3 Mining:

As mentioned earlier, Tummallapalle, is an underground mine. The whole strike length of 5.6 km of deposit is virtually divided into two parts for easy accessibility by drivages of 3 Nos. declines in apparent dip at $9^o$. The central decline will be used for conveyor transport and other two parallel declines will be used as service declines for men and materials.

#### Underground mining

The three declines of size 5m X 3m will be driven at $9^o$ in apparent dip direction from S-W to N-E direction cutting the ore body in two parts up to full depth of the ore body (275m.). The Advance Strike Drives (ASD) will be driven in strike direction from both service declines till the boundary of the ore body. The incline distance between two ASD will be 39m.

Pillars (5m X 5m) will be left against each ASD along the full strike length. The panels will be prepared at 120m length in strike direction. The panels will be worked using breast stoping method using low profile jumbo drill, low profile loader and low profile dump truck for bringing muck to the surface initially, till the conveyor is installed. 10m rib pillar will be left after 120m of panel to isolate working areas. Ramps will be driven between ASDs at $9^0$ for transporting ore to the conveyor.

The trunk conveyor will transfer ore to main decline conveyor. All the return air will be taken to a ventilation drive and will be exhausted to surface through 4 Nos. ventilation shafts (3.5m dia.) fixed with exhaust fans of $100m^3$/sec capacity each.

Open stope method will be used having pillar support and no filling is proposed. After opening, in-situ geo-mechanical property of the rock mass will be studied (by reputed institution) to finalize the pillar size and other support criteria.

The sequence of stoping will be top to bottom and away from declines, towards strike boundary.

The total recovery in H/W lode is expected to be around 70% and after examining the rock parameters, the F/W lode will be exploited to the tune of 40% recovery. The recovery of support pillars and filling by tailing sand are proposed while retreating. Wherever the

parting between H/W & F/W lode is 1m or less the H/W & F/W will be taken together. The mining parameters are given in Table 3.

Table 3: Mining parameters

| Sl. No. | Item | Description |
|---|---|---|
| 1. | Main Declines | 3 Nos. at 9$^{o}$ parallel to each other at 15m distance in apparent dip direction 5 x 3m size. |
| 2. | Ventilation Shaft | 4 Nos., 3.5m dia. located at Surface up to a depth of 35m. |
| 3. | Mining Sequence | Extraction of H/W lode followed by F/W lode & pillar extraction and filling while retreating. |
| 4. | Major equipment combination | Drill Jumbo (LP), Loader (LP), Dumper (LP), Dozer (LP) and Conveyor system. |
| 5. | Service equipment | Passenger Carriers, Lub truck, Crane truck, maintenance vehicle all L.P. |

As expected, blasted muck will be thrown into gullies and balance will be dozed by a crawler mounted dozer into gullies from where it will be loaded by loaders into dumper then crusher and subsequently all muck will be brought to surface ore bin through decline main conveyor. List of major equipment for underground mining is given in Table 4.

Table 4: Major Mining Equipment for Underground Mining

| Sl. No. | Equipment | Capacity | Fleet strength |
|---|---|---|---|
| 1 | Low Profile Loader | 3.0 m$^3$ | 08 |
| 2 | Low Profile Dump Truck | 20 t | 04 |
| 3 | Drill Jumbo | 45 mm dia, 3.4m hole depth | 08 |
| 4 | Low Profile Dozer | | 02 |
| 5 | Utility Vehicles<br>1) Lube Truck<br>2) Passenger Vehicle<br>3) Crane<br>4) Bulk Explosive Van<br>5) Mechanic Vehicle | | <br>01<br>03<br>01<br>02<br>02 |
| 6 | Low Profile Bolting Machine | | 02 |
| 7 | Decline conveyor | 1000mm | 4300m |

The rated capacity of the mine (1.35 Mt/yr) shall be attained three years after obtaining all statutory clearances for the expanded capacity.

### Underground ventilation

The mine is ventilated through 3 Nos. of mechanical ventilator fans at exhaust end. Fresh air enters through declines. The fresh air will reach to farthest part of the active mine workings and pass through active man ways to exhaust through ventilation drive.

It is estimated that maximum number of persons employed in a largest shift will be around 500 and therefore the quantity of air requirement will be 5000 m$^3$/min. However keeping in view the number of diesel operated equipment working and their combined power (in hp),

the estimation of fresh air requirement for respective mine has been made [0.075 $m^3$/sec per kW of cumulative hp]. This will enable dissipation of not only the noxious fumes of diesel equipment but also dilute radon content of air to acceptable limit, as per the prevalent practice at existing underground mines of UCIL. Wherever, required the auxiliary ventilation will be provided.

As the mining is carried out by declines, drives and breast stoping, it is estimated that at a time 25 faces will be working. Assuming all the headings requiring the forced ventilation a total number of 25 fans with suitable ducting will be required.

### 3.5.4 Mineral Processing:

The proposed plant at Tummalapalle will treat dolomitic limestone based uraniferrous ore from captive mines at Tummalapalle. Technology has been developed indigenously with technical inputs from BARC, AMD and UCIL. The plant will process 1,350,000 t/yr of uranium ore to produce sodium-di-uranate (SDU). 43,187 t/yr of Sodium-sulphate will also be produced as a by-product, which will be sold.

Primary crushed ore from the mine shall be brought by a series of belt conveyors and unloaded in the Run of Mines (ROM) ore bin. Ore will be extracted from the bin by vibrating feeders and discharged to a belt conveyor, which will be feeding the ore to the secondary vibrating screens prior to secondary crushers in the fine crushing section. Final size reduction of ore to (-)25mm shall be done in Fine Crushing.

Fine ore will be stored in two separate fine ore bins of each 750 t capacity. Fine ore will be reclaimed from each compartment of bin by vibratory feeders and will be discharged to rod mill feed conveyor. The conveyor will be equipped with a weightometer to record and control the rod mill feed. Controlled water will be added to the primary mill proportional to solid tonnage feed rate. Combined primary and secondary mill discharge will be pumped to hydro cyclones for classification. Classification circuit will consist of variable speed pumps and hydrocyclone. Underflow from hydrocyclone will be further classified round in the ball mill. Overflow from the cyclones shall be fed to the neutral thickener through launder. Necessary water for cyclone feed dilution will be added to the combined mill discharge sump. Cyclone overflow will be fed to the neutral thickener for dewatering. The cyclone overflow at 80-85% passing (-) 200 Mesh will flow to thickener by launder.

Clear water from Thickener overflow will be collected in a tank for recirculation to grinding section. Thickener underflow at approximately 50-55% solids by weight will be extracted by variable speed pump and delivered to an agitated filter feed surge tank.

Neutral filtration system will comprise two horizontal vacuum belt filters each of 110 $m^2$ with one repulper. There will be a dedicated filter feed pumps (with VFD) for each filter.

Filtrate will be recycled to Grinding circuit. Dewatered cake at moisture content of 20% by weight will be guided through a chute to the repulper. Two pumps will deliver the repulped slurry to leaching section. The slurry is then conditioned with $Na_2CO_3$ & $NaHCO_3$ (reagent) in additional reagent adjustment tank to maintain the optimum reagent concentration in the leach feed. The entire area spillage and floor washings will be recycled to the neutral thickener.

The preconditioned leach feed from neutral filtration section will feed to one (1) no. of newly installed autoclave feed tank. One autoclave will be installed in the new place situated at the immediate vicinity of existing leaching building. There will be six (6) (in actual four compartments with first two (2) imaginary compartments) compartments in each autoclave. Leach slurry will flow from one compartment to another compartment by gravity overflow. Leaching in the autoclave is carried out under the following conditions:

1) Pressure: 9 bar (g),
2) Temperature: 130-140$^{o}$C.
3) Residence time: 7 hours.
4) Medium: Alkaline.
5) Leach feed solid concentration: 50-55% (w/w).

Mechanical agitators (six nos.) will be mounted in the autoclave to expedite the leaching reaction. There will be two pumps to feed autoclave from autoclave feed tank through spiral heat exchangers at desired pressure. Leaching section has been designed for a throughput of 74.8 TPH ore.

The leached slurry from autoclave (@130-140$^{o}$C) will pass through three spiral heat exchangers to preheat the leach feed prior to feeding the autoclave. Saturated Steam at 12.5 -15 Kg/Cm$^2$g will be used during start up only for heating . Oxygen as required to complete the reaction would be added in the autoclaves at 12.5-15 Kg/Cm$^2$g. The reaction being exothermic, helps in maintaining the alutoclave temperature without additional heating. Partially cooled leached pulp from the spiral heat exchanger will be fed to autoclave let down vessel for depressurization of autoclave discharge slurry. Operation of leaching section will be continuous & automatic. The autoclave will be enclosed within a bund wall. The bunded area will be graded to a sump from which normal spillages will be pumped, along with leached pulp filter area spillage and cloth wash, to a high rate spillage thickener. Thickener overflow will be recycled as floor wash and leach pulp filter cake repulping purpose. Spillage thickener underflow will be delivered to leach or filter feed surge tanks depending on the residual uranium in the spillage solids.

The vent from autoclave will pass through the venturi scrubber. The flue gas carried over through the vent will be scrubbed by pure water and the clean gas will be released to atmosphere through stack.

Leach filtration system will comprise four additional 110 m$^2$ horizontal belt filters with individual vacuum system and repulpers (one for two filters). There shall be four stage counter-current washing for each filter. These additional four filters will be located in the new building located at the immediate vicinity of existing chemical house.

Leached pulp will be fed to each filter by dedicated leach pulp filter feed pump to each filter's feed tank. Feed slurry will be mixed with flocculent injected into individual filter feed tank. Chutes will guide filter cake at approximately 20% moisture content to repulpers. There will be two repulper tanks, one per each two (2) consecutive filters. Each repulper will be provided with two pumps to transfer the repulped slurry to the hydro cyclones for sand slime separation. The hydro cyclone overflow shall be taken to the tailing thickener. Pumps will be monitored by nucleonic density gauge to automatically control the addition of tailing thickener overflow & recycled water from ETP thickener overflow to repulper to maintain the density at around 30-35% (w/w) solids by weight. Industrial water (heated to 60-65$^{o}$C by 0.5 bar (g) live steam in cake wash water tank) will be used (@ 0.33 m$^3$/ton of

ore). About 30% of mother liquor from leach pulp filtration will be bled to product precipitation via clarification and the rest of filtrate will be recycled to neutral filtration section to achieve the proper dilution requirement. A bund wall will enclose the filter area with the floor graded to a sump for collection of any spillage to be treated in the spillage thickener. The thickener overflow will be recycled for filter cloth washing and filter floor washing.

. For precipitation of uranium from the leached filtrate, a high clarity of feed solution is needed. This will be achieved through a clarifier and precoat filtration using vacuum drum filters. To cater the additional load of clarifier an additional filtrate clarifier overflow tank & unclarified pregnant solution tank shall be envisaged. An additional pre-coat drum filter will also be envisaged to serve the additional load. Pre-coating arrangement shall be done and all arrangement for handling precoat material, slurry formation and feeding to precoat filter shall be provided. Clarified pregnant liquor will be stored in clarified pregnant liquor tanks prior to feeding to plate type heat exchangers for preheating and precipitation. A separate pumping & piping system shall be envisaged to cater the additional unclarified & clarified liquor handling system.

There shall be separate new stream in SDU precipitation system consisting of six tanks having effective volume of 60 $m^3$ each. Additional piping & pumping system shall be envisaged to cater the additional load in precipitation system. The addition of sodium hydroxide (45% w/w) to carbonate and bicarbonate solutions will first react with the bicarbonate ion and then, in the presence of excess caustic soda, at a pH of 12 or above, will cause the Uranium to hydrolyse and to precipitate. Precipitation operation is continuous.

Part of the wet SDU cake will be redissolved and added proportionately to CPL to attain a grade of about 2.5 gpl for precipitation of SDI. The SDU precipitation system will consist of eight nos. mechanically agitated precipitation tanks in series, a thickener to thicken corresponding precipitate and HBF ($5m^2$). The HBF is used for dewatering washing of SDU cake to make it amenable to SDU drying. Caustic Soda will be dosed to first two precipitation tanks. The overflow from the last precipitation tank will gravitate to product precipitation thickener. Thickener underflow will be partly withdrawn to store in holding tank prior to filtration. About a third of The cake from product filter will be repulped in the repulper tank @30% (w/w) solid to feed to the dryer. Two thirds of the SDU cake will be taken for redissolution to enhance the feed grade to precipitation.

Product filtration and drying system consists of a 5 m3 HBF, an electric air heater, spray dryer, cyclones (optional), bag filter, HEPA filter and SDU powder packing system. Repulped SDU slurry @30% (w/w) will be fed to dryer feed tank. The SDU slurry will be pumped through a screw pump to spray dryer through rotary atomizer. The preformed SDU will be dried to about less than 2% moisture by weight in the spray drier heated with electrically heated air ($500^oC$). Dried product from spray drier shall be pneumatically lifted and extracted by cyclone (optional) and bag filter system. Clear air after passing through bag filter & HEPA filter will be exhausted to atmosphere through stack/chimney.

The packing area will be enclosed in glass enclosure to provide a secondary protection against radioactive dusts.

SDU will be stored in a small local store prior to shipment to the main product store. This filtration and drying section will normally operate for two shifts per day and the operation will be remote automatic except drums loading onto and unloading from the roller conveyor.

Sodium Sulfate will be formed due to oxidation reaction of sulphide (Iron Pyrites-$FeS_2$) present in the ore. This solution will also contain Sodium sulfate, sodium carbonate and Sodium hydroxide. Entire SDU filtrate and product thickener overflow will be subjected to causticization. Additional $Na_2SO_4$ recovery system with necessary equipment shall be envisaged to cater the additional load.

The feed coming from causticization area shall be cooled by Ethylene Glycol to $0^oC$ prior to the freeze/vacuum crystallization section, as the solubility of $Na_2SO_4$ is minimum at $0^oC$. The crystallized sodium sulphate slurry from crystallizer will pass through a hydro-cyclone cluster. The underflow from cyclone will pass through centrifuge. The overflow from cyclone and filtrate from centrifuge will be stored in filtrate tank, from where the mother liquor ($32^oC$) will be sent to grinding section. The crystallized slurry from centrifuge will go Glauber Salt melting tank, where the Glauber Salt will be melted. The crystallized slurry will then go to neutralization tank, where 98% $H_2SO_4$ will be dosed to convert the residual $Na_2CO_3$ present in the slurry to $Na_2SO_4$. The generated $CO_2$ gas will now be vented to atmosphere. Now this neutralized slurry is freeze crystallization. The concentrated slurry is then passed through the hydro-cyclone and centrifuge. The concentrated cake centrifuge and cyclone will then go to drying section.

Additional sand slime separation system shall be envisaged to cater the additional load. Repulped slurry @33% (w/w) from leach pulp filtration system will be pumped to sand-slime separation cyclone. The coarse underflow, which will be used for sand filling in the underground mine will be collected in an underflow storage tank from the hydro cyclones. This coarse fraction of the slurry will be pumped back to the mine for back filling. The cyclone overflow will gravitate to Hi-rate tailing thickener. The underflow from the tailing thickener will be extracted by one of the two variable speed pumps and delivered to tailing thickener underflow tank. From the tank it will be pumped to tailing pond by a series of slurry pumps.

The process flow sheet of the plant is depicted in Fig. 1.

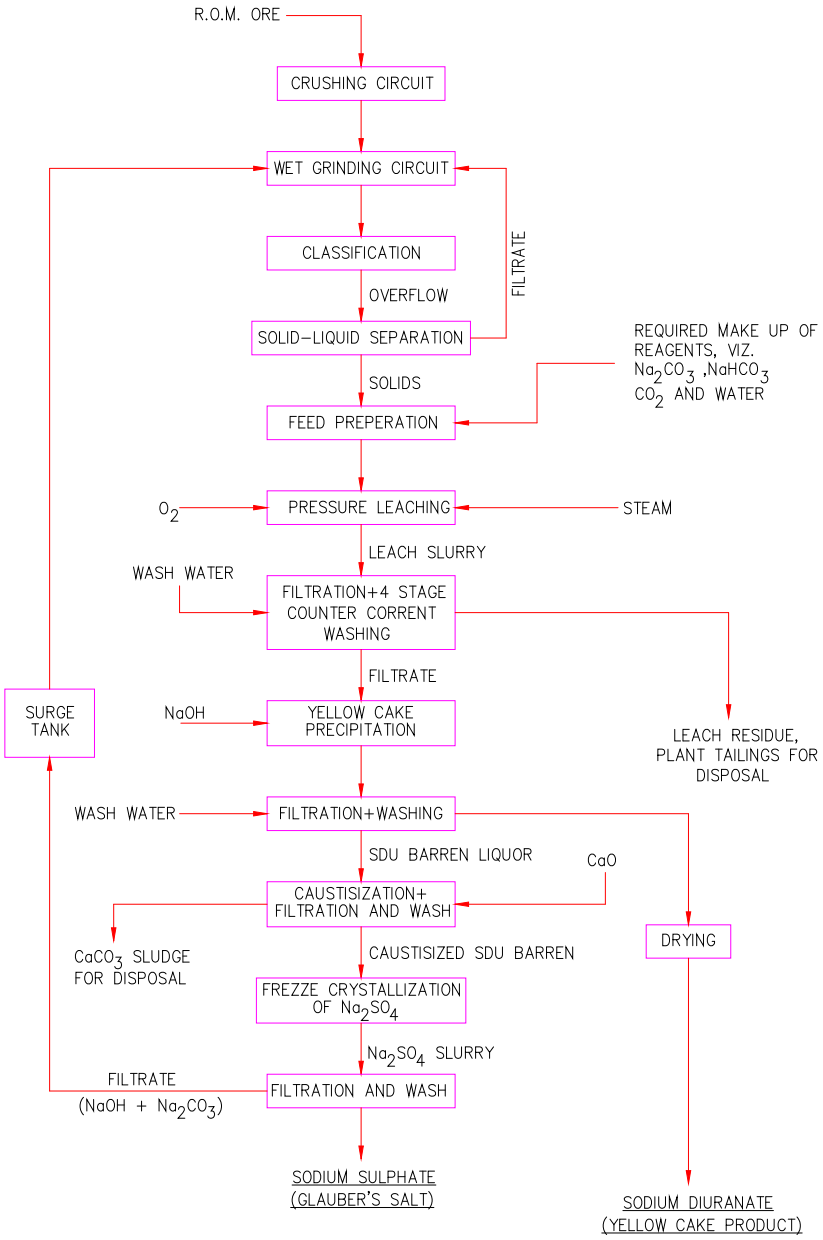


Fig. 1: Process Flow Sheet for Ore Processing Plant

### 3.5.5 Steam Generation & Fuel Oil Handling System:

There are three single fired boilers of 15 TPH capacity with generated steam pressure of 16 kg/cm$^2$ (g) and 98% dryness fraction (x). One additional boiler shall be installed to cater the additional load. LDO (Light Diesel Oil) or equivalent is used as fuel oil. The fuel oil required for each boiler is 892 kg/hr (when the air pre-heater is offline) and 863 kg/hr (when air pre-heater is online). LPG will be used as pilot fuel. The condensate from the $Na_2SO_4$ recovery area will also be admitted into the de-aerator tower to enhance the thermal efficiency. The de-aerated water from de-aeration tower will be feed to boiler via boiler feed pump. There shall be a provision of recirculation to de-aerator from the discharge of BFW pumps.

There are three fuel oil storage tanks, each of 200 kl, for the existing plant. An additional fuel oil storage tank of 200 kl and fuel oil day tank is envisaged to serve the requirements.

### 3.5.6 Mineral Transport

ROM ore from the mine will be transported by covered conveyors to the ore processing plant. Uranium concentrate (SDU) will be dispatched to Nuclear Fuel Complex, Hyderabad by specially designed road trucks.

### 3.5.7 Life of the Project

With present plan for enhancement of production capacity and deepening of the mine at a later stage (as most part of the reserve is below 275m), the overall life of the operations is expected to be for more than 30 years. However, the reserve up to a depth of 275m is expected to last for 20 years at the expanded capacity.

## 3.6 Raw Materials

The mine shall consume 4.7 t/d of explosives. Explosives will be kept in the existing magazine of 20 t capacity. The mine shall The mine shall consume 4500 l/d (i.e. 1350 kl/yr) of HSD. The HSD will be stored in a 35 kl tank.

The raw material requirements for the ore processing plant are given in Table 5:

Table 5: Annual requirement of Raw Materials & Consumables for Ore Processing Plant

| Raw material | Quantity (t) | |
|---|---|---|
| | Existing | Additional Proposed |
| 1. Lime (55% CaO) | 16996 | 8498 |
| 2. Screens | 33.3 | 16.7 |
| 3. Mill liners | 360 | 180 |
| 4. Grinding Media | 800 | 400 |
| 5. Flocculent | 120 | 50 |
| 6. Pre-coat Material | 200 | 100 |
| 7. Sodium Carbonate | 30000 | 6750 |
| 8. Sodium Bicarbonate | 2000 | 1000 |
| 9. Barium Chloride (95% $BaCl_2$) | 594 | 297 |
| 10. Liquid oxygen | 18000 | 9000 |
| 11. Ferric Chloride | 4.8 | 2.4 |
| 12. LDO | 6000 | 3000 |
| 13. Caustic soda lye(on 100% basis) | 15000 | 7500 |
| 14. Ferric alum | 86.4 | 43.2 |

The existing chemical house shall be expanded to store the additional chemicals. At present there are three (3) numbers of fuel oil (LDO) storage tanks, each of 200 kl. An additional tank of 200 kl shall be installed to store fuel for the additional boiler.

## 3.7 Resource Optimisation / Recycling and Resource

The project will require 7100 $m^3$/day of industrial water. Of this 2285 $m^3$/day will be met by utilizing mine discharge water and recycling effluents generated from various operations in the project, such as tailings pond over-flow, effluents form equipment washing and effluents from the project's canteens, rest-rooms and pit head bath.

The process of the ore processing plant has been designed so that residual caustic soda and sodium carbonate after recovery of sodium sulphate are recycled back to the process.

## 3.8 SITE SERVICES

### 3.8.1 Water Requirement:

The total peak industrial water requirement for Tummalapalle mine project has been estimated to be 8285 $m^3$/day. Water requirement for various purposes in the complex and their sources is shown in Table 6.

Table 6: Water Requirement

| Purpose | Average Demand | Peak Demand | Source |
|---|---|---|---|
| Drilling & Spraying | 330 | 330 | Mine discharge |
| Make up water for Stowing | 450 | 450 | Mine discharge |
| Dust Suppression at surface | 340 | 340 | Mine discharge & Recycled water |
| Equipment Washing | 50 | 50 | Mine discharge |
| Drinking & Pit head bath | 160 | 160 | Chitravati River |
| Mineral Processing plant | 5300 | 5300 | Chitravati River, Mine discharge & Recycled water |
| Green Belt / Plantation irrigation | 315 | 630 | Mine discharge & Recycled water |
| Fire Service | - | 150 | Recycled water (one time) |
| Subtotal | 6945 | 7260 + 150 | |
| Township | 600 | 600 | Chitravati River |
| Community Supply | 425 | 425 | Chitravati River |
| Total | 7970 | 8285 + 150 | |

Figures are in $m^3$ /day

Water will be withdrawn from the existing pumping system from Chitravati reservoir which is sufficient to meet the additional demand. UCIL has permission for drawing 6000 $m^3$/day of water from Chitravati River by the Principal Secretary to Govt., Irrigation and CAD Dept., Govt. of Andhra Pradesh, vide letter no. CE(P) / Irrgn. / KDP / TSI / 2006 dated 23.03.2006.

### 3.8.2 Power Requirement

Maximum power demand for the expanded project has been estimated to be 30 MVA. Power for the mine and ore processing plant shall be drawn from the Pulivendula Sub-station of Southern Power Distribution Company of Andhra Pradesh Ltd. Power for the township and water intake sub-stations shall be drawn from the local 11 kV supply of Southern Power Distribution Company of Andhra Pradesh Ltd. To meet emergency power supply requirement three (2 working, 1 standby) 1000 KVA DG sets have been envisaged.

### 3.8.3 Amenities

The mine has a site office. Rest shelters with drinking water facilities, toilets, bathing and washing facilities and canteen are also in place. There is a First Aid Centre with an ambulance always available. Other amenities and infrastructure, such as township, hospital, stores, workshop, community centre, schools etc. are being constructed over 100 ha about 5 km north-east of the mine on the road to Pulivendula. Township will have 603 dwelling units.

## 3.9 WASTES

The entire quantity of waste rock generated during mine operation will not be brought to the surface. These shall be utilised for filling underground voids.

The ore processing plant will be generating the following wastes:

| | |
|---|---|
| Tailings | : 1,350,000 t/yr |
| Calcium Carbonate | : 30,300 t/yr |
| ETP Sludge | : 450 t/yr. |
| Filter-media | : 36 t/yr. |

20% of the tailings will be sand (+200 mesh) and it will be used for stowing in the u/g mines. The rest of the tailings, calcium carbonate & waste filter media generated from the ore processing plant and waste water treatment plant sludge will be contained in tailings pond. Three sets of tailings pumps will be provided, each capable of handling 50 to 60% of the process plant feed design tonnage. Each set of pumps will have its own pipeline delivering tailings to the disposal site. Near the disposal pond piping will have the flexibility of realignment. Solid tailing will be retained in the tailings pond whilst effluent will be decanted to decant water pond. The decant water will be pumped back to the plant for treatment and recycling. One set of tailing disposal pumps, pipeline and other associated facilities are envisaged.

# 4.0 SITE ANALYSIS

## 4.1 CONNECTIVITY

The lease area can be approached by road from Pulivendula, which is the nearest town, about 15 km away towards the north-west leading to State Highway No.18, which connects Kadapa with Velidandla.

The nearest railway station is Muddanurru on South Central Railway's Hyderabad – Chennai BG Line, which is about 50 km towards the north-east.

## 4.2 LAND FORM, LAND USE, OWNERSHIP

The project area comprises of Agriculture Land (432.76 ha), Barren Land (475.85 ha) and Grazing Land (65.00 ha). The project area comprises of 540.85 ha government land and 432.76 ha private land. The private land is owned by 501 families. Total land has been acquired by UCIL. Under the present expansion programme, there is no proposal to lease or acquire any additional land.

## 4.3 TOPOGRAPHY

The leasehold area is located at the foot of a NW-SE trending hill range, which extends over a large distance on either side virtually bifurcating the regional topography. There are peaks at >750 mRL south and south-west of the mine lease area whereas average ground level of the lease is at 360mRL. All other remaining sides of the lease area are gently undulating except for sporadic hillocks on the western side . The undulating terrain within the lease area is at about 350 mRL and the western side hillock is at about 420 mRL.

Since the region is semi-arid, perennial streams are virtually non-existent. A number of seasonal streams flow down from the NW-SE hill ranges and the adjoining hillocks. Seasonal streams from surrounding area drain into two large impoundments near

Bechchayyagaripalli where the water is stored for irrigation. During peak season run-offs from hilly areas ultimately drain into Moganer Eru, which is a tributary of Papagni river, about 17 km from the lease area.

## 4.4 LAND USE

The leasehold area consists of agricultural land (432.76 ha), barren land (475.85 ha) and grazing land (65.00 ha). The existing land utilization in the project area is as follows:

| Sl. No. | Purpose / Type of land use | Land Utilisation (ha) |
|---|---|---|
| 1 | Decline portals | 1.05 |
| 2 | External waste dump | 0.25 |
| 3 | Area earmarked for mineral storage | 0.23 |
| 4 | Infrastructure (workshop, Adm. Buildings etc.) | 6.38 |
| 5 | Roads (built within mine and ore processing plant) | 5.20 |
| 6 | Green belt & plantations | 30.00 |
| 7 | Ore Processing Plant (including ETP and desilting pond) | 34.50 |
| 8 | * Tailing pond | - |
| 9 | * Township | 0.50 |
| 8 | Vacant area | 965.70 |
| | Total | 973.61 |

* Outside the mine lease area

## 4.5 EXISTING INFRASTRUCTURE

Mine office, Pit head bath, time office, rest rooms, Area for Field maintenance facilities, Sub-station building, Switch gear rooms, Vehicle maintenance facilities, Canteen and rest shelter, Site office, DG room, already exist within the mine lease. Weigh bridge, rest shelters will be refurbished after receiving all clearances for resumption of mining. These are adequate for the project. Other amenities and infrastructure, such as township, hospital, stores, workshop, community centre, schools etc. are being constructed over 100 ha about 5 km north-east of the mine on the road to Pulivendula. Township will have 603 dwelling units

## 4.6 SOIL CLASSIFICATION

The soil is lateritic, typical of the area. The thickness of the top soil varies from nil (due to outcropping of iron ore to maximum of 60 cm.

## 4.7 CLIMATE

The study area lies in the tropical region where the climate is characterized by very hot summers, mild winters and monsoon rains. Summer is typically from March to June when monthly temperatures range from maximum 46°C during daytime to a minimum of 15°C at night. Winter is from November to February when the maximum temperature during day goes up to 40.6°C and minimum temperature at night becomes as low as 10.6°C. The average annual rainfall as recorded at India Meteorological Department's (IMD)

observatory at Kadapa (about 50 km away)is 783.3 mm. The Southwest monsoon lasts from mid June to mid November and the area gets more than 80% of the annual rainfall during this period.

## 4.8 SOCIAL INFRASTRUCTURE AVAILABLE

The nearest town, Pulivendula, has all necessary social infrastructure. In addition, UCIL is also building its own township which will have necessary facilities for its employees.

# 5.0 PLANNING BRIEF:

## 5.1 PLANNING CONCEPT:

The proposed project envisages expanding an existing underground uranium mine and ore processing plant.

## 5.2 LAND USE PLANNING:

The existing land use and the land use at the end of the project's life are as follows:

| Sl. No. | Purpose / Type of land use | Present | 5th year | End of mining |
|---|---|---|---|---|
| 1 | Area to be mined (Decline portals only) | 1.05 | 2.06 | 2.06 |
| 2 | External waste dump | 0.25 | 1.00 | 1.00 |
| 3 | Mineral storage | 0.23 | 0.23 | 1.44 |
| 4 | Infrastructure (workshop, Adm. Buildings etc.) | 6.38 | 7.59 | 7.59 |
| 5 | Roads (built within mine and ore processing plant) | 5.20 | 5.72 | 5.72 |
| 6 | Green belt & plantations | 30.00 | 65 | 360.00 |
| 7 | Ore Processing Plant (including ETP and de-silting pond) | 34.50 | 42.5 | 42.50 |
| 8 | * Tailing pond | - | 60.0 | 60.00 |
| 9 | * Township | 0.50 | 100.00 | 100.00 |
| 10 | Untouched area | 965.70 | 689.51 | 393.30 |
| | Total | 973.61 | 973.61 | 973.61 |

* Outside the mine lease area

When the reserves are exhausted, the mine will be shut down as per the Approved Mine Closure Plan.

## 5.3 ASSESSMENT OF INFRASTRUCTURE DEMAND

As mining activities is already in progress the proposed expansion programme will fulfill its most of the requirement through already existing infrastructures. UCIL exists centralized workshop, explosive magazine and other requisite infrastructures etc. will cater to the needs of Tummalapalle.

Tummalapalle project will employ 1225 persons, many of whom, especially most of the unskilled and semi-skilled workers, will be local villagers. The rest comprising of the officers, supervisors, some of the office staff, skilled and semiskilled workers may come from outside. These people will be provided accommodation in the project township, which will have all amenities. 603 quarters are proposed to be built in the township.

## 5.4 AMENITIES / FACILITIES

Limited amenities are already existing major facility has to be provided during expansion stage.

## 6.0 PROPOSED INFRASTRUCTURE:

The project sites are connected by narrow serpentine road network. The available land area is sufficient to cater the additional needs of the expanded project, hence, full-fledged additional infrastructure is proposed.

Green Belt & Plantations: At present plantation is spread over 30 ha within the lease area, which constitutes the Safety Zone. Before the lease is abandoned, plantations will be created over available areas.

CSR Activities:

UCIL is already doing jobs under Corporate Social Responsibility and jobs are taken up within villages that falls under 10 Km radius. Activities already taken up are as follows:

- Construction, operation and maintenance of RO (Water purifier plants)
- Holding of medical camps, supply of medicines to villagers.
- Computer training and distribution of books and Journals
- Scholarship for pursuing higher study
- Distribution of school bags among primary students of Govt. schools in nearby villages.
- Installation & maintenance of solar powered streetlights.

Annual expenditure towards CSR activities during last few years are as follows:

- 2015 – 16: Rs.7,27,400 (Till December 2015)
- 2014 – 15: Rs 35,96,475
- 2013 – 14: Rs. 1,28,65,26

## 7.0 REHABILITATION & RESETTLEMENT (R&R) PLAN

The project does not envisage any leasing or acquisition of private land. Hence there will not be any land oustees who have to be resettled our rehabilitated.

## 8.0 PROJECT SCHEDULE & COST ESTIMATE

### 8.1 Likely Date of Start of Construction and likely date of completion:

It has been envisaged that Tummalapalle Extension underground mine of UCIL attain its rated capacity to 1.35 Mt/yr by April 2015 i.e. 5th year of the Modified Mining Plan. However the expansion schedule is subject to receipt of all statutory clearances required for the expansion.

It has been assumed that "Zero-date" i.e. start of the expansion project, will commence after completion of preliminary works like land Identification, acquisition of Land, grant of mining lease, approval of EIA/EMP and other statutory clearances. Immediately after the clearance of EIA / EMP report by the MOEF&CC, mobilization and placement of orders for

civil works, structural works and procurement activities for infrastructure facilities will be started so that the above facilities shall be completed well before the start of the mine development works.

## 8.2 Estimated Project Cost Along and Economic Viability of the Project

The estimated capital cost of the expansion project is Rs.72000 lakhs. It is observed that the project is viable at the selling price of Rs. 17500/- per kg of Uranium $U_3O_8$ (base period 2010). Payback period of the project works out to be 14 years. The internal rate of return before tax works out to be 8.11 % for 20 years.

# 9.0 ANALYSIS OF PROPOSAL (FINAL RECOMMENDATION)

The project will have the following benefits:

- Increase the supply of uranium ore for India's domestic power generation.
- In addition it will add to revenue generation of the District / State.
- A better alternative for reducing coal dependency.
- It works to reduce paralyzing power shortages hindering growth, foreign investment and productivity.
- The mine will generate additional employment, both direct and indirect which will lead to economic growth of the industrial sector as well as country.
- UCIL shall provide, school buildings, bus shelters, medical facilities and other amenities to local villages under the company's community development programme.

Considering the above points expansion of the Tummalapalle project has become necessary and important.