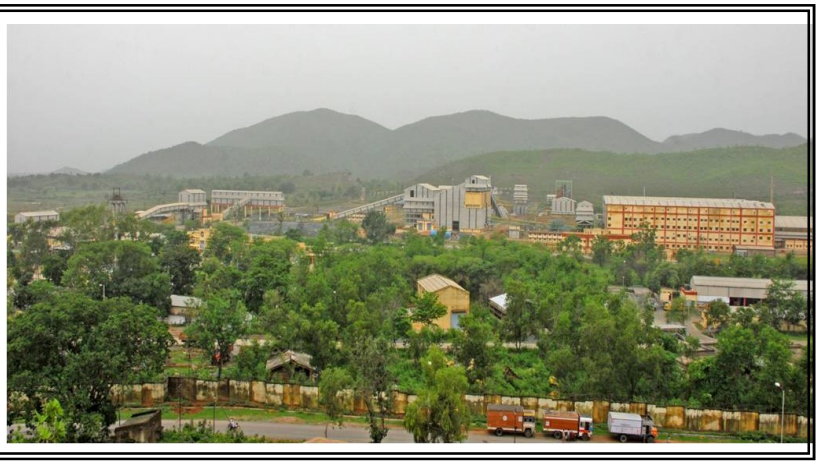
Risk Assessment
and
Disaster Management Plan

For

Turamdih Uranium Project Expansion



Uranium Corporation of India Limited
(A Government of India Enterprise)
An ISO 9001:2000, ISO 14001:2004 & IS 18001:2007 Company
P.O. Jaduguda Mines, Dist. - Singhbhum (East)
Jharkhand – 832 102

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1. RISK ASSESSMENT AND DISASTER MANAGEMENT PLAN

Mining and ore processing activities are associated with potential hazards to employees as well as the public. A worker in a mine should be able to work under conditions, which are adequately safe and healthy. At the same time the environmental conditions should be such as not to impair his working efficiency. This is possible only when there is adequate safety at workplace. Hence safety is one of the most essential aspects of the industrial activities. The emergency plan for Turamdih mine is prepared under Regulation No.190 (A) of Metalliferrous Mines Regulation 1961. This plan outlines the duties and responsibilities of each mine officials and men so that each person knows his duties in case of emergency occurrence.

2. IDENTIFICATION OF HAZARDS

There are various factors, which may lead to disaster in underground metalliferrous mine and ore processing plant. These hazards are as follows:

2.1 Risks in Mine

(a) Subsidence
(b) Inundation
(c) Surface Fire (Electrical and Oil)
(d) Roof fall

2.2 Risks in Ore Processing Plant

(a) Exposure of fumes and gases
(b) Exposure to Siliceous and low level radioactive dust
(c) Spillage of hazardous chemicals and product
(d) Spillage of radioactive slurries
(e) Failure of tailings dam
(f) The associated radiological hazards due to external exposure, inhalation, ingestion
(g) Accident at the time of transport
(h) Conditions Leading to Mal-operation and its associated risk during Mal-operation

1. Side spillage from belt conveyor carrying the ore
2. Failures of water pumping system to dust suppression system which will lead generate higher dust.
3. Chocking of dust in dust collection system, rupture of bags and failure of fan, resulting in dust generation in dry ore and pre-coat material handling.
4. Failure of pump and water spraying nozzle in wet scrubbing, result in dust generation.
5. Failure of fan and spray pump in the acid fume extraction system, result in atmospheric emission of acid fumes.

Experience of operating establishments of UCIL has revealed that most of the accident occurs due to the human failure. However, the disaster management plan has been considered for the above prevailing conditions.

3. DISASTER MANAGEMENT PLAN

Disaster management plan at mine has been prepared under Regulation No.190 (A) of Metalliferous Mines Regulation 1961. Ore Processing Plant has dedicated plan to handle the emergency situation. UCIL has defined system for communication in case of emergency. Important telephone numbers have been displayed at strategic locations.

3.1 Subsidence

Subsidence is an important aspect of underground mining activity. As Cut & fill method of mining is being practiced and rock mass is quite competent, no surface subsidence is anticipated. Operating mines of UCIL has no record for subsidence. Risk associated with subsidence is insignificant.

3.2 Inundation

An inundation is an irruption of water from workings of the same mine or of an adjoining mine or from surface water bodies. As such, there is no surface water bodies/river exists in core zone; ingress of water is not anticipated. No cracks reaches on the surface due to underground working therefore leakages from surface has not been observed. Moreover all the openings were kept above the highest flood level of the area to prevent inundation from flooding.

3.3 Fire

Spillage of waste oil and fuel oil may resultant fire. Regular maintenance of all the electrical fitting and wiring is carried out to prevent out break of fire. All the electrical safety norms of DGMS are strictly followed. Sufficient nos. of portable fire extinguishers has been provided at strategic locations near the fuel store, waste oil storage area, fuel-filling area and DG sets to take care of any eventuality. In case of any electrical fire, the personnel on duty shall shut down the equipment and inform the shift-in-charge. Personnel trained in dealing with electrical fires will be summoned. The fire area will be cordoned off till the fire is fully extinguished and remain so until all wreckage and debris is cleared away. After necessary repairs the power will be restored. The clearance for restoration of power shall be given only by the shift-in-charge. As soon as any fire is reported, the shift-in-charge shall assume the function of disaster controller. In case of serious fire and depending on the gravity of the situation, the Mines Manager may be summoned to assume charge. Meanwhile the hospital will be informed to standby to handle casualties.

3.4 Roof Fall

The roof fall can also damage the man and material. To prevent roof fall, a systematic support system by rock-bolting is done. Pillar design is done by CIMFR and IIT Kharagpur and same is got approved by DGMS before implementation.

3.5 Exposure to Fumes / Gases

Chemical house is equipped with ventilation system which expels the fumes and gases. High efficiency filter and fume extraction systems has been installed at product precipitation area and where acid fume is expected to generate. Personnel working in these areas are supplied with masks and other safety equipments.

3.6 Exposure to Siliceous & Low level Radioactive Dust

Exposure to air borne silica dust is the major concern in ore crushing and grinding system. Radiological hazards due to long-lived α activity, radon and external gamma radiation, although these are insignificant for low-grade ores of Turamdih. Automization for various control and online monitoring system has been installed and therefore plant can be put under emergency shutdown in case of any eventuality. As the ore is handled in wet condition, risk due to dust is insignificant.

3.7 Spillage of Hazardous Chemicals & Product

Sulphuric acid and Caustic soda flakes are used in process. The following provision have been incorporated in the system for safety and safeguard of environment as per the guidelines of Atomic Energy Regulatory Board (AERB) and the Manufacturing, Storage and Import of Hazardous Chemical Rules, 1989.

a. Sulphuric Acid: In case of any spillage, an emergency preparedness plan has been made at different stages. Sulphuric acid is stored in tanks at notified area only. A dyke walls has been constructed to contain at least one (1) tank volume. Additionally out of four (4) nos. of tank, one (1) tank will be always kept empty to accommodate the spillage or rupture of tank. Additional provision has been made for neutralization of spilled acid by adding lime. Provision to dilution the spilled out acid by water has been made. Sufficient quantity of lime and water are made available at the acid storage area. Liquid discharge, if any, will be collected in sump where auto start pumping arrangement with level indicator has been installed to pump the liquid to Effluent Treatment Plant (ETP) for the further treatment. ETP has on-line pH monitoring system and accordingly corrective measures are taken. In any case, no acid will be discharged to the public domain from storage area.

b. Caustic Soda: Caustic soda is procured as packet in polyethylene lined bags & stored in central store. The material being solid in nature has no chance of escape to the public domain.

c. MDU is packed in steel drum with polyethylene lining and stored in notified area only. The possibility of spillage of MDU is remote. The storage area is properly illuminated; ventilated and proper security arrangement has been made. In case of spillage, material will be recovered in supervision of HPU of BARC. All safety gadgets shall be used to handle the materials as per AERB guidelines.

3.8 Spillage of Low level Radioactive Slurries

Tailing slurry from ore processing plant is being pumped to tailing pond for safe containments. Decanted water from tailing pond is collected in decant water pond and then sent to effluent treatment plant for treatment. Adequate supports and structural stability has been provided to the pipeline. Following arrangements has been made for prevention and control of leakage of slurry:

a. Liquid and slurry are being transferred through closed conduits

b. Material of construction of all pipeline is MSRL
c. Inspection road / path have been constructed along the pipeline
d. Standby pump and pipelines has been provided
e. Online flow meter has been installed

In case of leakage, pumping of slurry will be switched over to standby system and the damaged pipeline will be rectified.

3.9 Failure of Tailings Dam

Probable external events leading to failure of tailing dam are:

Case 1-Breach in the tailings dam
Case 2-Ingress of rain water into the tailings pond area due to extremely heavy rainfall
Case 3-Earthquake higher than the design consideration
Case 4-Sabotage activities

Following arrangements has been made for prevention and control of failure of Tailing Dam:

(a) **Design of Dam**: Out of various methods in practice for design & construction of tailing dam, UCIL has adopted the safest method called downstream method of construction. Though it is the costliest method, UCIL has adopted the same for safety consideration. Ring discharge of slurry at about 50 % (w/w) solid content has been adopted for uniform distribution of grain size, even distribution over the area and minimum hold up of effluent in the impoundment area. The embankments have been designed to withstand liquefaction even in totally filled condition. A typical X-section of dam is enclosed in **Figure 2.**

(b) **Construction of additional Check Dam:** In addition to the main dam, a check dam at downstream side has also been constructed for control measures. This is with a view that if main dam fails; the slurry coming out of tailing pond will be arrested and contained in the area between the main dam and check dam and it will not enter to the public domain. The design of main dam as well as check dam has been approved by the regulatory authority (AERB).

(c) **Control of ingress of rainwater:** The region may experience heaviest rainfall of 327.7 mm/day for 1000 years return period as computed by Liebleim's Technique & Gumble's distribution based on daily rainfall data

of meteorological department Patna for a period 1991 to 2008. Garland drains towards the north & south sides of pond along the hill have been constructed to divert the rainwater of the catchment area away from the tailing pond. While designing the garland drain, rainfall for 1000 years of return period has been considered and approved by AERB. Additional garland drain has been constructed at 172 mRL from western side of tailings dam for divert the rainwater of catchments between 198 mRL & 172 mRL and avoid entry of additional water into the decant water pond.

(d) **Liquid collection and conveyance system:** A Decant water pond (DWP) of capacity 30000 m^3 has been constructed between check dam and main dam to collect decant water. It is a RCC construction and properly designed and approved by AERB. The possibility of seepage of effluent from the area is remote. A pump house is constructed adjacent to DWP and suitable pumps with two sets pipelines have been installed to transfer effluent for DWP to ETP. A pumping system to transfer of about 375 m^3 /hr of additional liquid over and above the maximum discharge from process plant exists in the system.

(e) **Inspection & monitoring:** Regular inspection and monitoring is carried out for tailing pond area by dedicated qualified engineers and necessary action is being taken. In order to assess health of the dam, instruments like piezometer, settlement gauge, and inclinometer have been installed.

(f) **Safety:** Entire area has been fence and notified as prohibited area under section 3(D) and 27 of Atomic Energy Act 1962. Public notice has been displayed for prohibition of area for public use. Entire area is guarded by CISF.

(g) **Seismic consideration:** The embankments have been designed and constructed with downstream method incorporating the factor of safety for seismic condition as per Zone-II and blasting affect of neighboring opencast Banduhurang mine. The effect of blasting conducted in the Banduhurang Mine, which is located at a distance of about 1 km from the tailing dam, has been investigated, as shown below:

$$\mathbf{v = K (D/ Q^{1/2})^{-\beta}}$$

Where,

v = Ground particle velocity in mm/sec
Q = Charge per delay in kg
D = Safe distance from blast point in meter
K & β = Field Constants

As per case study conducted by CMRI for open cast mine

K = 289 & β = 1.11

For v = 10 mm/sec and D = 650 meter

Q_{max} = 991 Kg/delay

The actual maximum charge per delay is 652 kg, which is less than 991 kg. Hence Blasting in Banduhurang mines will not have any adverse effect on the tailing dam.

As per IS: 6922

$$v = K_1 (Q^{2/3} / R)^{1.25}$$

Where,

v & Q are as described in para a) above.

K_1 = 1400 for hard rock

R = Distance from Blast Point in meter

Here Q = 652 kg & R = 1000 meter

Hence v = 55.27 mm/sec

For hard rock the safe ground particle velocity is 70 mm/sec. Hence the tailing dam will not be affected by blasting in Banduhurang Mines.

Safety measure of the tailing pond is shown in **Slide 1.**

(h) **Emergency planning:** Emergency planning has been prepared for various scenario as follow:

Case 1: Breach in the tailings dam

1. The person noticing the release of slurry shall inform the shift supervisor of UCT - 2 in Central control room by telephone. Subsequently information will be communicated to In-charge Turamdih Mill, In-charge Civil, Section In-charge, In-charge Health Physics Unit of Turamdih, Safety Officer of Turamdih & Director (Technical) about the incident.
2. The shift supervisor shall ensure immediate stoppage of discharge into the tailings impoundment area from all the tailings disposal pumps.
3. The shift supervisor shall inform CISF to blow emergency siren.
4. The coordinator will inform:

(a) In-charge (P & IR), Turamdih for informing the District Authorities & Police about the incident and requesting them to caution downstream population to remain alert and to keep rescue team prepared for relief operation at short notice.

(b) Inform C.M.O., UCIL for making ready all the hospitals of UCIL for any emergency.

5. The technical committee will take suitable decision and action to avoid further breach of the dam and to minimize the outflow of the slurry from the breached portion. They will also be responsible for planning and implementation of necessary repair work.
6. In-charge Mill will also inform about the incident to other related agencies and Regulatory bodies.
7. Round the clock physical inspection of check dam constructed for retaining the breach material will be continued till closure of the breach and evacuation of the breached material.
8. In-charge, HPU, Turamdih will collect ground water samples from adjoining area in the downstream for further needful.

Case 2: Ingress of rain water into the tailings pond area due to extremely heavy rainfall.

1. The pump operator of Talsa pump house will inform the shift supervisor on event of failure to maintain the required free board level of 1.5 m in the decant water pond in spite of running all available pumps , pipeline and placement of sleepers in the spillway as per the instruction given in the plant operation manual during heavy rainfall situation.
2. The shift supervisor shall inform the section In-charge about the situation and stop discharge of slurry into the tailings pond from all pumping system.
3. The Section -in-charge will immediately inform In-charge Civil Mill, In-charge HPU and Safety Officer about the situation and the full team shall rush to the site for actual assessment of the site condition.
4. In-charge Mechanical and In-charge Electrical, Talsa pump house shall also rush to the site for assessment of situation and health of facility under their control.
5. In-charge Mill shall apprise Director (Technical) about the ground situation.
6. Director (Technical) will constitute a technical and site management committee headed by him and will nominate a coordinator. This committee will be responsible for arranging materials, vehicles, infrastructure, and lighting, medical facility etc. for managing the accident scenario and also for implementation of management plan.
7. A rescue team will be kept ready at the site to attend to any need.
8. A siren of 4 km installed on the pump house will be blown to alert the population in the downstream depending upon the development at the site.

9. Coordinator will also inform the In-charge (P& IR), who in turn shall inform the concerned District Authorities and Police about the situation for advance planning of evacuation, rescue operation, announcement etc.
10. A site control room with facility of communication will be set up in the Talsa Site Room.
11. Life saving jacket, boat, torchlight, ladder etc. shall be kept ready in the site control room.
12. Sample from the decant water pond will be drawn periodically and analyzed for activity, pH, sulphate and chloride with the increasing level of decant water pond.
13. Decision of pumping out the content of decant water pond beyond the check dam area in the downstream by portable pumps based on the analytical value (if found within permissible limit) may be taken by a committee comprising of In-charge HPU, Director (Technical) and local representative of district authority to protect inundation of the pumping system and complete stoppage of transfer of content to Effluent Treatment Plant.
14. On event of discharge of content of decant water pond to downstream supply of drinking water by water tankers shall be continued till advice of stoppage from the In-charge of HPU-,Turamdih.
15. Information as per requirement of regulatory board, district authority will be given by In-charge, Turamdih Mill.

Case 3: Earthquake higher than the design consideration

The dam has been designed to withstand seismic condition for Zone II with margin for safety. On event of very high earthquake, severity of damage as per the following three conditions may take place.

Case (a)- Only main dam may damage partly and the outflow material is contained within the check dam.

Case (b)- Main dam may damage severely and check dam remains intact but outflow material spills over check dam and goes to public domain.

Case (c)- Both main dam and check dam gets damaged severely and slurry outflows to public domain to a larger distance.

In all the three above cases it is assumed that

1) There is no fatality to the operator.
2) Installed communication facilities are intact.
3) The mill and colony area are intact.

In case of 3 (a) management plan as mentioned under Case 1 will be followed.

In case of 3 (b) & cace 3 (c), following management plan will be followed:

1. Procedure for communication about the incidence to internal and external authorities will be similar to case 1 & 2 mentioned above.
2. Announcement will be made in the downstream region for evacuation from the region along with warning not to use water from Seema Nalla.
3. Supply of drinking water to population in the downstream will be started immediately and continued till the situation comes under control.
4. Rehabilitation and re-engineering work of main dam and check dam will be planned and sent to AERB for their approval to start the work.

3.10 Accident during Transportation of Product

The final product (MDU) is being transported to NFC Hyderabad by road as per AERB guidelines. The material is packed in the polyethylene lined steel drums. Drums are properly staked and packed with packing materials to prevent jerk during transportation. Double walled container is being used to transport the drums which is being properly locked with vehicle. External contamination is checked by Health Unit of Bhabha Atomic Research Center before dispatch. The consignment is escorted by CISF personnel throughout the travel route. Requisite information is provided to driver and escort to take action in case of any eventuality. In case of accident the area will be cordoned and intimation to the local district authority will be given. The expert from nearest nuclear installation will be informed for necessary action.

3.11 Radiological Hazard

Turamdih uranium ore mining and processing plant dealt radioactive materials of low specific activity. The ore-grade being low, the associated hazard potentials with respect to external and internal exposures at various stages of mining and ore processing is less compared to those with the high grade ores. The comprehensive discussions, on baseline radiological data for the terrain, identification, prediction, assessment and control of the radiological impacts encountered during different stages of operations, are presented in earlier sections of this report (chapters-3 & 4). The control measures are practiced in accordance with the recommendations of International Commission for Radiological Protection and the national regulatory authority. Moreover, efforts will be made to keep the exposures as low as reasonably achievable i.e., the ALARA principle of radiation protection. A comprehensive radiological surveillance is carried out which involves measurement and evaluation of overall radiological as well as chemical constituents of the work areas, individuals and the environment. Details are enumerated in chapter 6 of this report.

3.12 Control / Containment during Mal-operation of Ore Processing Plant

Control measures during mal-operation of the plant are as under:

a. Failure of spray dryer filter mal-operation will be monitored by particulate counter to be installed at the out let of the bag filter and also differential pressure indicator tripping of the spray dryer automatically.
b. Adequate ventilation inside the process building has been provided.
c. In water suppression system, all the spray nozzles will not be out of order at a time. Since nozzles will be connected group wise, therefore, isolation of the same can be done and repaired without stopping the total water spraying in particular point.
d. In bag dust collection/wet scrubbing system, if any particular point is chocked, isolation of the same by damper could be made without stopping the system.
e. In wet scrubbing system, standby pump will be provided.
f. Spillages in grinding mill, neutral thickener, neutral filtration, acid leaching, leached pulp filtration, ion exchange, neutralization, clarification, production separation area shall be contained and recycled back to the system through thickeners.
g. Fuel oil storage area, sump pump will operate to contain the spillages/rapture, if any.
h. In the overall system standby pump and pipeline will be available in the slurry system.
i. In wet section of the plant area, water for floor washing etc. shall be available through pipe header and flexible hose with valve.
j. Spare impeller of each type of centrifugal / axial flow fans for ventilation and fume extraction system shall be procured and kept at plant to take care proper functioning of the system.
k. Use of standard codes & Design practice. For selection of material of construction of major equipment, basic criteria are abrasion and corrosion. Abrasions and corrosion control are taken in following areas:-

    - Hopper and chutes are lined with abrasion resistance liner.
    - Contact parts in crushers are specially designed with replaceable liners.
    - In grinding mill, shells are lined with rubber and the grinding ball/rods are made of high chrome steel.
    - Slurry lines are MSRL.
    - Pumps of neutral slurry shall be CSRL & casing and impeller shall be made up high chrome.

- Rollers, vacuum box, receiver, moisture trap etc. for Horizontal Belt Filters are SS-316 or MSRL.
- Acid leaching tanks and agitators are MSRL to resist both abrasion and dilute sulphuric acid corrosion.
- Repulpers are of MSRL construction.
- Acidic liquor pumps are SS-316 /CD4MCU
- In general corrosion allowance has been considered as 1.5 mm for MS/CS.
- Acid fume ducts are FRP lined
- Spray dryer and storage hopper materials of construction are SS-316L.
- Rubber lining thickness considered minimum 6 mm.
- Abrasion resistance liners considered minimum 20mm.

l. All electrical equipment and materials conform to latest applicable standard publications of International Electro-technical Commission (IEC) or equivalent standards published by the Bureau of Indian Standards (BIS) and Indian Electricity Rules.

3.13 General Safety Features & Safety Margins in Design

In the selection of Equipment / System, safety margins have been included to take care of availability factor, design factor. Safety features have also been included in the conceptualization of layout as regard maintenance space, operational flexibility and facility for operation as per standard engineering practice.

a. In acid area, safety gadgets would be provided, including safety showers. Acid storage facility will be located within bund wall.
b. Mill personnel also will be adequately trained regarding safety aspects.
c. Advanced process control system shall be deployed with safety loops, wherever necessary.
d. Safety interlocks are provided in entire process plant and will generate alarm in the control room and the equipment will trip if the corrective actions are not taken within preset time. This will enable the stoppage of upstream equipment.
e. Adequate nos. of field instruments will be installed to monitor plant operation as well as safety of equipment. Any change in operating condition will isolate / stop subsequent stages of operation in planned manner.
f. In major process steps, valves are also remote controlled and hence changing of pump vis-à-vis suction / delivery line will be possible from remote which will avert the mal-operation of the plant.
g. Safety relief valves is provided in boiler, compressor, compressed air vessels, air blowers, vacuum line, water and steam lines, slurry and liquid lines.

h. Underground portion of the hopper building and conveyor tunnel shall be ventilated by supplying fresh and filtered air through fan & ducting. MCC and switchgear room shall be ventilated by supplying fresh air through fan & ducting and positive pressure shall be maintained by providing adequate number of back draft damper.
i. Barriers shall be provided in various point of the plant primarily to contain the spillage and isolate the same before it is recycled back into the selective places without affecting the process operation.
j. Neutral thickener and neutral filtration area barrier for spillages / wash water shall be recycled back into the neutral thickener. Part of thickener overflow water will be used for washing the floor etc. in that area.
k. Similarly, acid leaching, acid filtration, clarification & ion exchange area barrier for spillages / wash water shall be taken to avoid spillage thickener where clarified acid pH water will be again used for washing purpose.
l. Similarly, barrier in precipitation, product precipitation and filtration area spillage / wash water will be recycled through another spillage thickener for washing of that area.
m. In the neutralization area spillage water will be contained through bund / barriers and wash water will recycle back into the neutralizations tank. Dykes in sulphuric acid storage area are being kept to contain leakage of sulphuric acid in that area and put back into another empty H_2SO_4 tank.
n. Dust contained after settlement in the product spray dryer and packing area will be vacuum cleaned.
o. Each building and structure have been designed so as to provide enough space for operation, maintenance and to give the plant workers good and safe environment.
p. Sufficient lighting has been provided in all workplace.
q. Handrail has been provided at all ladder/steps.
r. Good housekeeping has been maintained at all work places.
s. All the workmen have been provided uniform & shoes. Personals are insisted to wear PPE (Gum-boots, Helmet, Respirator, ear plug/muff, hand gloves, safety belt etc.).
t. Workmen has been provided dedicated locker to keep their uniform and safety appliances. Workmen take bath before leaving the premises.
u. Bathing and cloth washing facility are available within the premises.
v. Periodic inspection, proper maintenance and timely replacement of worn out parts, training of personnel.

4. ONSITE EMERGENCY PLAN

To take care of emergencies which may occur during mining and ore processing operation an Onsite Emergency Plan has been prepared. The plan contains instructions to be followed in case of an emergency, major or serious accident, failure of system / equipment, Fire or Power failure, stoppage of ventilation fans etc.

Conditions for applying Emergency Plan:

If an emergency arises due the following causes, threatening seriously the safety of persons employed in, or property belonging to mine & ore processing plant such as:

1. Premature collapse of any working in the mine
2. Outbreak of fire
3. Explosion or fire in the ore processing plant
4. Any other major mishap

Under mentioned procedure is to be followed:

1. Any person who notices any emergency as mentioned above shall take immediate action to deal with the same if it falls within his scope and if more than one person is present there, one of them shall proceed for getting assistance and to give warning.

2. If the person notices that the emergency is of such type or magnitude that it cannot be tackled by him or if he fails to control the same as described above, he shall proceed to give warning.

3. Any person detecting such emergency shall take steps to give warning by the fastest means to the nearest available officer in- charge.

4. The official to whom warning of emergency is given shall send warning by fastest means to –

    (a) Other parts of the mine and plant likely to be affected by emergency so that persons may be withdrawn there from.
    (b) Manager and his deputies
    (c) In charge of ore processing plant
    (d) Time Office / First Aid Room.
    (e) Telephones where available, would be used to convey warning to different parts of the project.

5. As per gravity of the situation and if required, the steps will be taken to withdraw the persons from workings area.

6. Agent/Manager, after assessing the urgency, shall direct the time keeper about any of the actions to be taken by him as under –

    - To summon all key emergency personnel.
    - To call only such personnel as may be required to deal with the situation and shall either himself inform or take suitable action to inform the other senior officers of the company and other appropriate authorities.

7. Duty cards detailing the duties and responsibilities are available amongst the key personnel to enable them to act promptly in the call of emergency.

8. List of emergency personnel includes the following

    (a) Agent /Manager/Assistant Manager
    (b) Ventilation Officer
    (c) Mine Safety Officer
    (d) Officer In charge, Rescue
    (e) Medical Officer
    (f) Engineer (Mechanical, Electrical and Civil)
    (g) Underground Manager
    (h) Garage In charge
    (i) Surveyor
    (j) Bellman
    (k) Cap lamp Room Attendant
    (l) Time Keeper
    (m) Personal officer
    (n) Surface First Aid Station Attendant
    (o) In charge, store

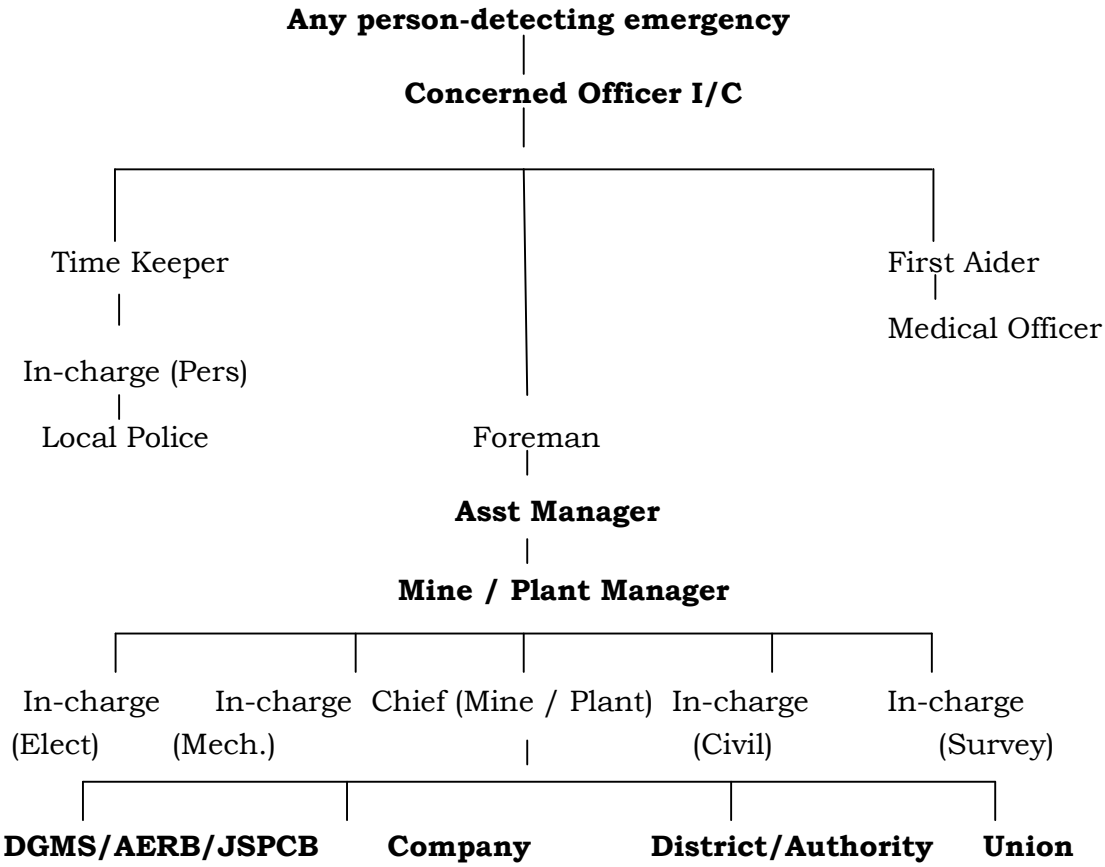
9. Manager shall authorise the key personnel in writing.

10. Important Telephone Numbers has been displayed at important places including Time Office, Rescue Room and Shaft Plats / Entries to the levels, plant office.

All emergency situations will be dealt in prompt manner as per the requirement. Trained personnel and rescue team are available to handle the various emergency situations. External regulatory authorities will also be taken in confidence to tackle the emergency situation.

The emergency report chart is as under:

Emergency Report Chart



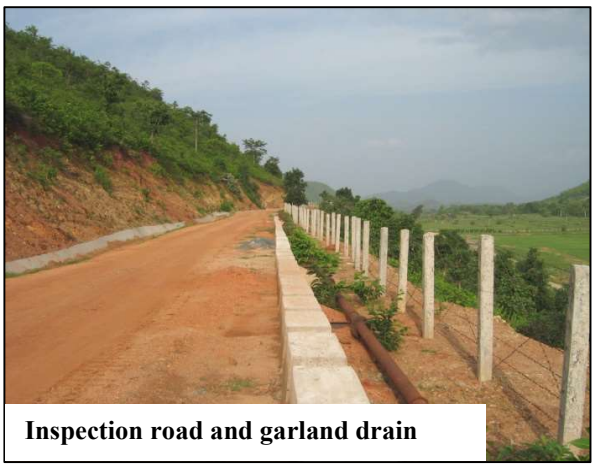
5. RESEARCH AND DEVELOPMENT PROJECTS AROUND TURAMDIH

Various R & D projects through Board of Research in Nuclear Sciences (BRNS), Department of Atomic Energy, Govt. of India has undertaken around Turamdih in collaboration with reputed technical & research institutions like IIT, ISM, CMRI and BARC etc. Various studies includes: Baseline study, socio-economic status, Demography & epidemiology, health status, bioremediation, eco-restoration study etc. List of specialized studies is depicted in table on Uranium Mining Operation

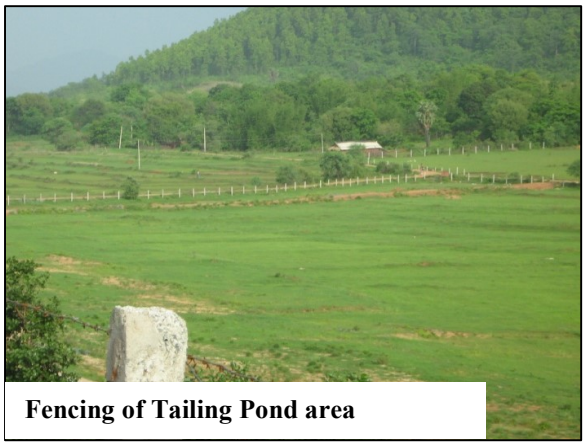
Table1: List of Research & Development Studies

Sr. No.	Title of the Project	Project & Institute
1.	Baseline studies of Bagjata and Banduhurang sites of UCIL	Indian School of Mines, Dhanbad, Jharkhand - 826 001
2.	Groundwater modelling for Banduhurang opencast uranium mine & proposed tailing pond area of UCIL	National Geophysical Research Institute, Uppal Road, Hyderabad
3.	Measurement and modelling of radon transport and distribution around tailings pond area and dwellings	Dept. of Geology & Geophysics, IIT, Kharagpur - 721 302
4.	Studies on the socio-economic status and plant & animal diversity at the proposed uranium mine site of Bagjata and Banduhurang, East Singhbhum, Jharkhand	Dept. of Botany, Jamshedpur Co-operative College, Jamshedpur, Jharkhand
5.	Analysis of microbial community structure present in Uranium mine area of UCIL, Jaduguda, Jharkhand	Dept. of Biotechnology, IIT, Kharagpur - 721 302
6.	Remote Sensing GIS based data infrastructure for baseline environment for new Uranium mining sites.	Dept. of Mining Engineering., IIT, Kharagpur - 721 302
7.	Demographic and epidemiology study of the Bagjata, Banduhurang and Mohuldih mines of UCIL Jaduguda.	Tribal Services, Tribal Culture Society, Tata Steel, Jamshedpur

Engineered conveyance arrangement



Inspection road and garland drain



Fencing of Tailing Pond area

Waste containment in TP area

Check dams for safety measures

Prohibited area: public notice

Slide 1: Safety Measures of Tailings Pond