

SUSTAINABLE MINING AND GEOINFORMATION

Prof. Basanta Kumar Prusty

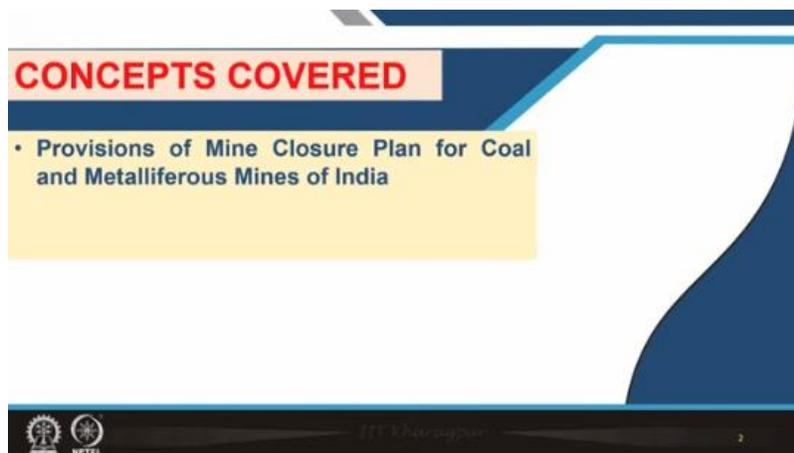
Department of Mining Engineering

Indian Institute of Technology Kharagpur

Week – 09

Lecture 44: Mine Closure Plan-I

Welcome, student, to our class on Sustainable Mining and Geoinformation. Today is the lecture number 44, which is on a new topic, and the topic name is Mine Closure Plan. We shall discuss this topic during two lectures: today's lecture and next lecture. In both these lectures, we shall cover the topic of mine closure plan. If we want to link this topic to the title of our course, that is, sustainable mining, during our previous classes, we have discussed that mining industry has an environmental impact during its active phase and also after the completion of the mining project or we call, after the closure of the project. So, earlier we did not have a regulation about how to close the mine in a proper way, and what are the different measures that should be carried out after the closure of the mine, so that the adverse environmental impacts are managed properly. Now it is a legal requirement as per our current mining environmental legislation. We have to close our mine as per an approved mine closure plan. So, what are the provisions of the mine closure plan? We shall discuss during today's class.



In today's class, we shall cover the provisions of the mine closure plan for both coal and metalliferous mines in India.

Preamble

- Central Govt. vide *Notification No. GSR 329 (E) dt. 10.04.2003 and No. GSR 330 (E) dt. 10.04.2003* amended the *Mineral Concession Rules, 1960 and Mineral Conservation and Development Rules, 1988* (2017) respectively.
- As per above all existing mining lessees are to submit "**Progressive Mine Closure Plan**" along with *financial sureties* within 180 days from date of notification.
- Mining lessee is also to submit "**Final Mines Closure Plan**" 1 yr prior to the proposed closure of mine.
- "Progressive Closure Plan" and "Final Closure Plan" should be in format and guidelines issued by *Indian Bureau of Mines/ Coal Controller's Office* and are to be submitted to *IBM/ CCO* along with prescribed financial sureties.




The introduction part or the preamble: The Government of India via notification number: GSR 329E dated 10th April, 2003, and number: GSR 330 dated 10th April, 2003 amended the mineral concession rules, 1960, and the mineral conservation and developmental rule, 1988, which was amended in the year 2017. Both these rules were amended, and as per the amendment, it was mandated that all the existing mining lessees have to submit two types of closure plans to the designated authority. The two types of closure plans are the progressive mine closure plan and the final mine closure plan. The existing mining lessees have to submit the progressive mine closure plan along with financial sureties within 180 days from the date of notification. There are two parts: part one is that the mining company or the mining lessee has to submit a progressive mine closure plan to the designated authority. The designated authority for metalliferous mines is the Indian Bureau of Mines, and for coal mines, it is the Coal Controllers Organization (CCO). The mining companies have to submit the progressive mine closure plan, and there is a second type of mine closure plan, which is known as the final mine closure plan. The mining lessee has to submit the final mine closure plan one year prior to the proposed date of closure of the mine. So, how will this mine plan be prepared, how will it be submitted, and what are the procedures for approval? The companies have to prepare the progressive closure plan and the final mine closure plan as per the format and guidelines provided by the Indian Bureau of Mines for Metalliferous Mines. As per the format of the Coal Controllers Organization, CCO, they have to prepare this plan for the coal mines. And the plans, once prepared, have to be submitted to IBM and CCO along with prescribed financial securities. The adverse environmental effects will continue even after the mine closure, and they require certain treatment, particularly reclamation of the land and treatment of the water. They will continue after the closure, and the treatment will require certain expenditure. As per the polluter pays principle, the payment for the reclamation and treatment has to be made by

the mining company. The mining company has to submit financial securities for the execution of the final mine closure plan. Both the plans and the financial securities will have to be submitted to the IBM or the CCO office.

Preamble

- Mine closure encompasses *rehabilitation process* as an ongoing programme designed to *restore physical, chemical and biological quality disturbed by the mining to a level acceptable to all concerned.*
- **Aim of the Mine Closure Plan:** Mine must leave the area in such condition that rehabilitation does not become a burden to the society after mining operation is over. It should aim to create a **self-sustained ecosystem.**
- Mine closure operation is a **continuous series of activities** starting from the beginning of the initiation of mining project.
- Final mine closure plan shall be considered to have its approval **9 months before** date of proposed closure of mine.

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We will discuss more about the content of the plan, and the second part is the financial obligation on the part of the mine. So, the mine closure plan encompasses mostly the rehabilitation process, which is an ongoing program designed to restore physical, chemical, and biological quality disturbed by the mining activity. We have discussed previously what the environmental impact of a mining project is. You know that the mining project will have an adverse environmental impact on physical resources like air, water, soil, etc. Chemical quality parameters, soil quality, and water quality will all be degraded. Biological resources, flora, fauna, and biodiversity are adversely affected by mining activity. Now, when the mining is closed, It is our objective that after the closure of the mine, the physical, chemical, and biological quality of our environment should be restored to an acceptable standard, if not the pre-mining standard. The objective of the mine closure plan is to carry out the rehabilitation process to restore the physical, chemical, and biological quality of the ecosystem. Aim of the mine closure plan: the basic philosophy is that the mine must leave the area in a condition so that the rehabilitation does not become a burden to society after the mining operation is over. Rather, the burden of the rehabilitation should be on the mining company. The mining company should take responsibility for rehabilitation so that after the closure of the mine, it is a self-sustained ecosystem where the physical, chemical, and biological resources of the ecosystem are brought to an acceptable standard. The mine closure operation is not a one-time operation. It is a series of operations.

It is a continuous operation that has been going on since the beginning of the mining project. The final mine closure plan shall be considered for approval at least nine months before the proposed date of closure of the mine.



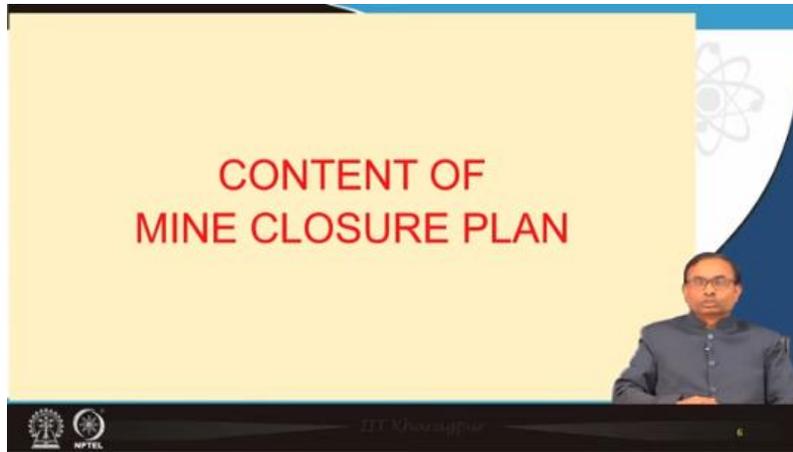
Regulatory Requirements for Mine Closure

- **Amendments to Rules:** The Central Government amended the Mineral Concession Rules, 1960, and Mineral Conservation and Development Rules, 1988 (Amended in 2017) through Notifications No. GSR 329(E) and GSR 330(E), dated 10.04.2003.
- **Mandatory Submission:** Existing mining lessees must submit a "Progressive Mine Closure Plan" along with prescribed financial sureties within 180 days of the notification date.
- "Final Mine Closure Plan" must be submitted 2 years before the proposed mine closure.
- **Compliance Requirements:** Both plans must adhere to the format and guidelines provided by the Indian Bureau of Mines (IBM)/ CCO.
- **Approval Process:** The Progressive and Final Closure Plans, along with financial sureties, should be submitted to the Indian Bureau of Mines (IBM)/ Coal Controller Organisation (CCO) for coal mines.

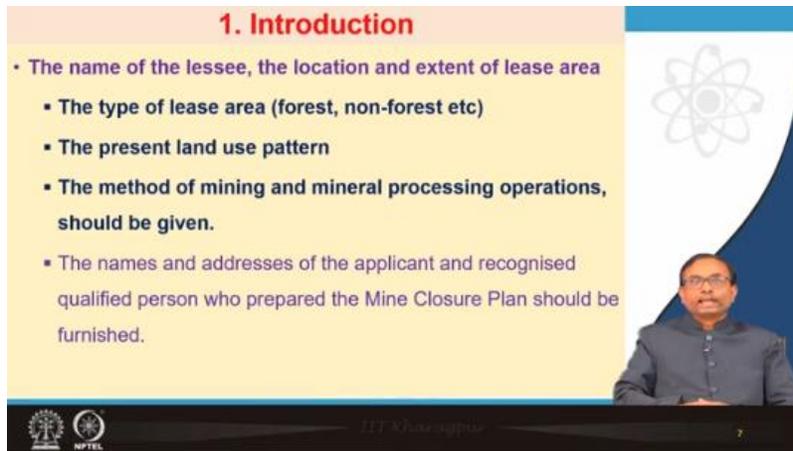
Mine closure plan mentioned in Rules 21-27 of MCD Rules, 2017.

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So, regulatory positions with respect to mine closure. The central government amended the Mineral Concession Rule 1960 and the Mineral Conservation and Development Rule 1988, which were amended in 2017 through a notification. Mandatory submission: existing mining lessees have to submit a progressive mine closure plan along with the financial securities within 180 days of the notification. The final mine closure plan must be submitted at least two years before the proposed mine closure, and it has to be approved at least nine months before the proposed date of closure. Compliance: The plans have to adhere to the format and guidelines of the Indian Bureau of Mines or CCO. Approval processes: the progressive and final closure plan, along with the financial security, should be submitted to IBM or CCO, which are the authorities for approving the mine closure plan as it is, or they can add some recommendations, some suggestions which will be incorporated, and then the plan can be approved. Some regulatory requirements are mentioned in rules 21 to 27 of the Mine Conservation and Development Rule 2017.



Now we come to what the content of the mine closure plan is. The content of the mine closure plan is according to many circulars issued by the Ministry of Mines and the Ministry of Coal. The format is similar in both cases. We will discuss the general format, which has several parts. We will discuss them one by one.



Section one, introduction: It contains the name of the lessee, location and extent of the leased hold area, type of lease area, forest type or non-forest type, what is the present land use pattern, what is the method of mining, what is the mineral beneficiation or mineral processing operation, the name and address of the applicant and recognized qualified person who prepared the mine closure plan.

1.1. Reasons for closure

The reasons for closure of mining operations:

- Exhaustion of mineral
- Lack of demand
- Uneconomic operations
- Natural calamity
- Directives from statutory organisation or court etc.

Reason for closure should be mentioned.



The reason for the closure of the mine should also be mentioned. What is the reason for the closure of the mine? Whether it is the exhaustion of the mineral resources, mineral resources have been completely exhausted, whether it is the lack of demand so mining cannot operate, whether it is uneconomic operation, or natural calamity, or any statutory order from a statutory authority like the court or CPCB, etc. The reason for the closure of the mine should be mentioned in the application.

1.2. Statutory obligations

•**Legal and Statutory Obligations:** Lessee's compliance with statutory requirements, including conditions imposed during lease execution, approval of mining plan, and directives from the IBM, Ministry of Environment, Forests and Climate Change (MOEFCC), or Pollution Control Boards.

•**Compliance Documentation:** The lessee's adherence to imposed conditions should be outlined, with relevant documents (approvals/compliance certificates) attached as annexures.

1.3 Closure plan preparation: The names and addresses of the applicant and recognised qualified person who prepared the Mine Closure Plan should be furnished.



Section 1.2: It has to be mentioned whether there is any statutory obligation on the mine. So, lessee's compliance with statutory obligations like the IBM or MOEF, or the pollution control board. They might have put some statutory obligation that has to be complied with by the mine. These have to be mentioned in the mine closure plan, and how these statutory orders are going to be complied with should also be mentioned. Compliance document, lessee's adherence to the imposed conditions, and statutory conditions should be outlined in the relevant document, like approvals, compliance certificates, plans, and sections. Everything should be provided in the annexure.

2. MINE DESCRIPTION

- **Geology:** Topography and general geology indicating rock types, chemical constituents of the rocks / minerals including toxic elements at the mine site.
- **Reserves:** Mineral reserves available category wise in the lease area as per last mining plan approved along with balance mineral reserves including quality at the proposed mine closure including its quality.
- **Mining Method:** Mining method followed to win the mineral, extent of mechanisation, mining machinery deployed, production level etc.
- **Mineral Beneficiation:** The mineral beneficiation practice, brief description of beneficiation process.



Dr. Chakrabarti

10

Section 2 is about the description of the mine. So, first, geology, topography, and general geology indicating the rock type, chemical constituents of the rock or mineral, including toxic elements at the mine site, should be mentioned. Then the reserve position should also be mentioned, that is, the category-wise mine reserves that are available as per the last mining plan approved, and along with what the balanced reserve is that exists now? Because some mining has already taken place. So, what is the balanced mineral reserve, along with the quality information that should be mentioned? Mining method, information about what the mining method is, whether it is open cast, whether it is underground, whether it is a stopping method, whether it is the board and pillar method of mining or high wall method, etc. The method of mining, the machinery that is deployed, production figures, everything should be mentioned. Mineral beneficiation: whether the mine has a mineral beneficiation plant, where mineral beneficiation or coal washing is taking place. Some details about the mineral beneficiation processes should be provided in the mine closure plan.

3. IMPLEMENTATION OF MINING PLAN

- Review of various proposals committed in the mine plan with emphasis on those for protection of environment in the approved Mining Plan, Progressive Closure Plan, vis-a-vis their status of implementation.
- Highlight the areas, which might have been contaminated by mining activities and type of contaminants that might be found there.
- The reasons for deviation from the proposals if any with corrective measures taken should also be given.



Dr. Chakrabarti

11

Section 3: Implementation of the mining plan. Section 3 will review how the various proposals that were committed under the mining plan or under the progressive mine closure plan were executed, or not. What proposals were put forward in the plan and how it was executed, and vis-a-vis the status of the implementation. Whether the plan was implemented fully or there is some lag, and if there is some gap, what is the reason for the gap, all these things should be mentioned. Highlight the areas which might have been contaminated by the mine waste. The reason for deviation from the proposal which was suggested in the mine plan, what is the reason for deviation, how much deviation, what is the reason for the deviation? What are the corrective measures that will be taken to remove the deviation should be mentioned in the mine closure plan.

4. CLOSURE PLAN

4.1 Mined-Out Land:

- Describe the proposals to be implemented for reclamation and rehabilitation of mined-out land including the manner in which the actual site of the pit will be restored for future use.
- The proposals should be supported with relevant plans and sections depicting the method of land restoration / reclamation / rehabilitation.

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12

Mined-out land: Describe the proposals to be implemented for the reclamation and rehabilitation of the mined-out land, including the reclamation of the pit, actual site, and after the restoration, what kind of land use will be there that will be mentioned. Proposals should be supported by relevant plans, sections depicting the method of land restoration, reclamation, and rehabilitation.

4.2. WATER QUALITY MANAGEMENT

Existing surface and ground water bodies available in the lease areas and the measures to be taken for their protection:

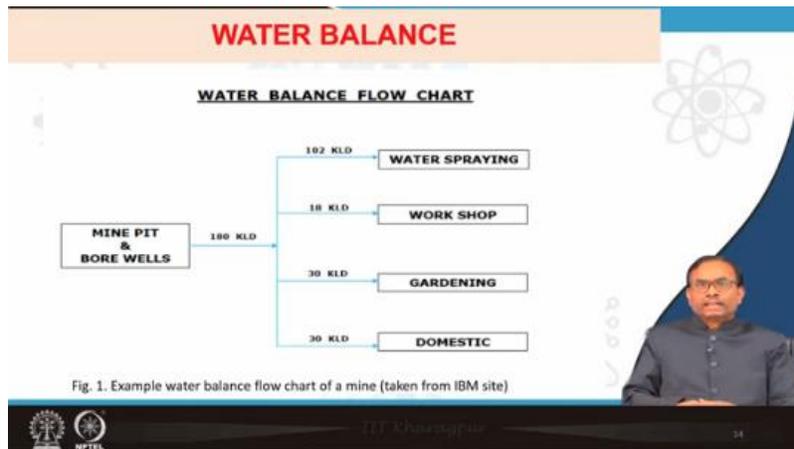
- Control of erosion
- Sedimentation, siltation
- Water treatment
- Diversion of water courses

- Measures for protection of contamination of ground water from leaching.
- Quantity and quality of surface water bodies, and corrective measures proposed to meet the water quality standards.
- Reports to be submitted: Report of hydrological study, Water balance chart, Acid Mine Drainage treatment method.

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13

Section 4.2, water quality management: Water is a main component of the mine environment. So, existing surface and groundwater bodies are available in the leasehold areas, and what measures will be taken for the protection of the water quality? So, when we talk about the protection of water bodies, what are the major features? What is the protection measure for the control of erosion? What is the protection measure to reduce sedimentation and remove siltation? What are the measures for the treatment of water for water quality? And whether any diversion of the water course will be required, that should be mentioned in Sec. 4.2. Measures for the protection of contamination of groundwater from the mining activity, from waste material, including leaching. To determine whether there will be groundwater contamination and how to protect it. The quantity and quality of surface water bodies and the corrective measures proposed to meet the water quality standard of the surface water bodies. For water quality protection, we normally carry out a scientific study, and the scientific organization will carry out the study; they will propose a solution, a technological solution, or a treatment method. All these study reports of hydrological studies, water balance studies, and acid mine drainage treatment methods. So, all these reports have to be attached to the mine closure plan.



This is an example of a water balance flow chart, which is taken from the IBM site. So, how much water is pumped out and out of that how you are using that water from the swamp water, for water spraying, for workshop, for gardening, for domestic purpose etc.

4.3. AIR QUALITY MANAGEMENT

- Description of existing air quality status
- Corrective measures to be taken for prevention of pollution of air.

4.5. TOP SOIL MANAGEMENT

- Storage
- Utilization

NPTEL 15

4.3: Air quality management: Description of the existing air quality when the mining operation is going on and what will be the air quality after the mine closure of the mine? What corrective measures will be taken. For the prevention of air pollution, as you know, in the mining area, we are mostly concerned about dust pollution, particulate matter, gaseous pollution, effluent, and gaseous effluent. How are we going to take care of the particulate matter and the gaseous effluent pollution that we will mention here? 4.5. Topsoil management: Topsoil removal, storage, and handling. How to preserve the topsoil? This is a very important part of the environmental management for open-cast mines, particularly. That will be mentioned in section 4.5.

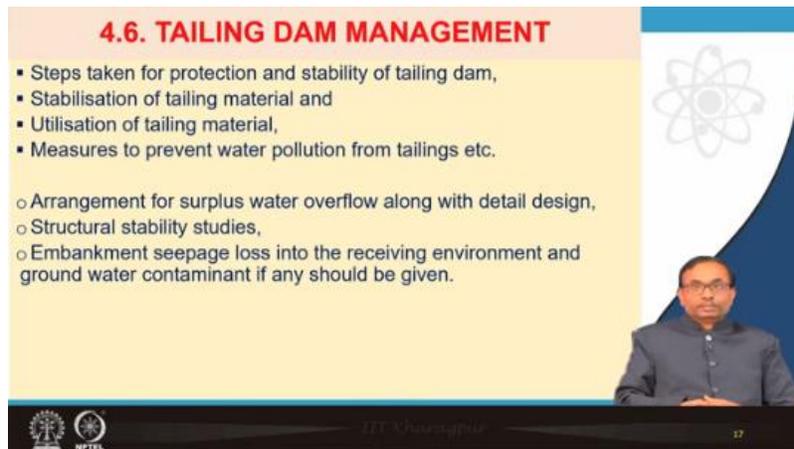
4.4. WASTE MANAGEMENT

- Type, quality and quantity of **overburden, mineral reject** etc. available and their **disposal practice**.
- If no utilisation of waste material is proposed, the manner in which the waste material will be stabilised.
- Protective measures to be taken for prevention of **siltation, erosion and dust generation** from these waste material.
- If **toxic and hazardous** elements are present in the waste material, protective measures to be taken for prevention of their dispersal in the air environment, leaching in the surface and ground water etc.

NPTEL 16

Section 4.4: waste management: We know both the underground and the open-cast method of mining produce wastes, particularly the surface mine, which produces a lot of waste in the form of overburden or mineral reject waste material. So, the quality and quantity, and what type of waste, solid waste material? How are we going to dispose of this waste material? Secondly, whether we can use or utilize this waste material for some productive uses. If we can utilize them for some productive uses, what are they, and how much can

we utilize them? Otherwise, if we cannot utilize it, how will this waste material be stabilized? Protective measures to be taken if you are storing the waste material. Most of the time, the waste materials will be in a fragmented form and from those waste material storage areas, there will be siltation, erosion, and dust generation. What are the preventive measures that will be taken to prevent siltation, erosion, and dust generation? Sometimes, toxic and hazardous elements are present in the mining waste material. So, protective measures need to be taken for their dispersal in the air, in the water body, in the groundwater, and also in the soil. So, this is very important.



4.6. TAILING DAM MANAGEMENT

- Steps taken for protection and stability of tailing dam,
- Stabilisation of tailing material and
- Utilisation of tailing material,
- Measures to prevent water pollution from tailings etc.

- Arrangement for surplus water overflow along with detail design,
- Structural stability studies,
- Embankment seepage loss into the receiving environment and ground water contaminant if any should be given.

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4.6. Tailing dam management: Steps to be taken for the protection and stability of the tailing dam. We know that particularly in metalliferous mines, the "run of mines", are taken to a mineral beneficiation plant where they are pulverized by grinders, crushers, and fine sizes are produced so that the valuable minerals can be separated and waste material can be separated. This waste material, known as the tailings, are collected and transported through a slurry transportation system to a disposal site, known as the tailings pond, which may be at a distance of several kilometers. In the tailing ponds, the tailings are disposed of, and you have the tailing dam. So, the steps taken for the protection and stability of the tailing dam. Sometimes, the tailing dam may experience failure, particularly in the rainy season, where you have excessive flooding events. The tailing dam may fail or collapse and all the tailings can spread over to the agricultural land and it will degrade the agricultural land. So, we have to take protection and we have to stabilize the tailing dam. What measures will be taken? Stabilization of the tailing material itself, utilization of tailing material. By research and development, we can convert the tailing material to useful resources, construction material, M sand, or some other precious resources, secondary resources may be extracted from the tailings. Tailings normally produce water pollution because of leaching, overflow during the rainy season and flooding season. So, what are

the measures to prevent water pollution? Also, structural stability studies of the dikes have to be carried out from time to time. Embankment seepage loss from the dike. The seepage will lead to the environmental degradation, groundwater pollution. What measures we have to take so that the seepage loss is minimized?

4.7. INFRASTRUCTURE

List of existing infrastructural facilities available:

- Roads
- Aerial ropeways
- Conveyer belts
- Railways
- Power lines,
- Buildings & structures
- Water treatment plant
- Transport infrastructure
- Water supply sources in the area etc

These infrastructure, if retained, the measures to be taken for their physical stability and maintenance.

18

When the mine is closed, there may be lot of infrastructure existing in the mine. What we are going to do with that infrastructure like: roads, aerial ropeways, conveyor belt, haulage roads and railways, power lines, buildings and structures, water treatment plant, transport infrastructure, water supply sources, etc. If you want to retain this infrastructure for some public use or some other uses, then you have to make sure to take measures for their physical stability and maintenance. Because some of these structures, for example, your conveyor belt or your aerial ropeway, you cannot leave them like that. They can sometimes create public safety problems, so you have to maintain them. You have to make sure they are safe. What measures you have to take so that they are physically stable, and safe? You have to propose measures.

4.7. INFRASTRUCTURE

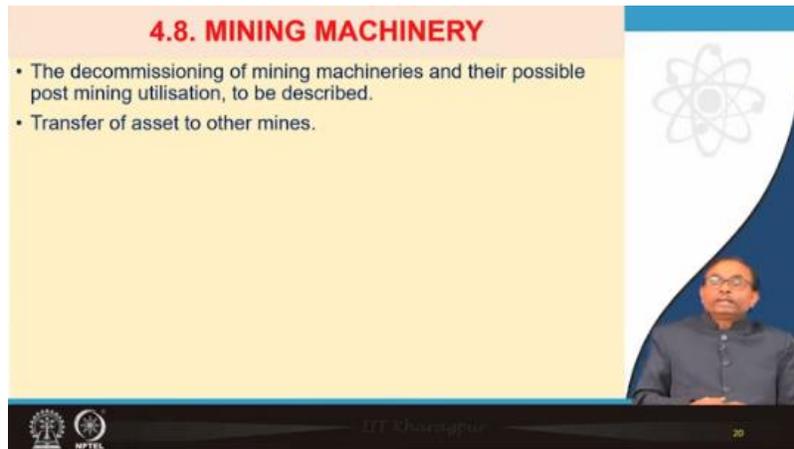
If decommissioning proposed, dismantling and disposal of:

- Building structures
- Support facilities
- Electric transmission line and cables, equipment, transformers
- Water line, gas pipeline
- Water works
- Sewer line
- Telephone cables
- Underground tanks
- Transportation infrastructure like roads, rails, bridges, culverts etc.

19

Now, if you want to decommission this infrastructure, you want to dismantle and then dispose of the building, structures, support facilities, electric transmission lines, cable

equipment, and transformer, water line, gas pipeline, sewer line, telephone cables, underground tank, transportation infrastructure like roads, rail, bridges, culverts. So, either you maintain them and give them to some other company or to community so that they will use them. Or you dismantle them so that they don't pose a safety and security problem to the local community who will be staying there.

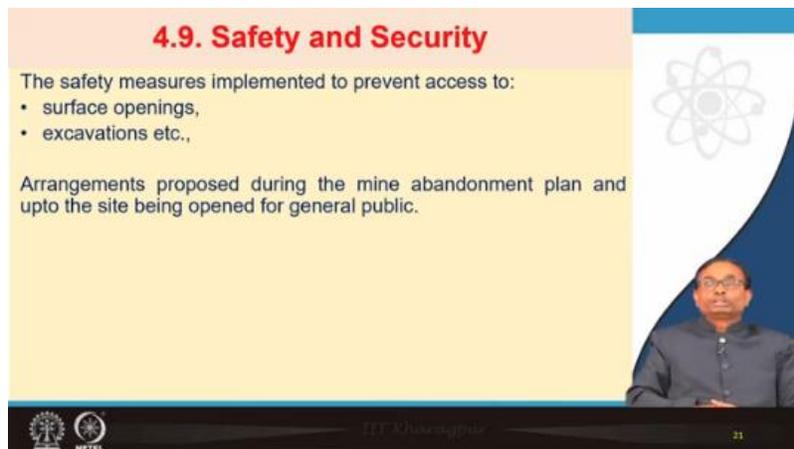


4.8. MINING MACHINERY

- The decommissioning of mining machineries and their possible post mining utilisation, to be described.
- Transfer of asset to other mines.

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What are you going to do with the mining machinery that was used in active mining? Whether you want to dispose them or transfer those assets to another mine or company. If you are a big company like Coal India, you can transfer these assets from one mine to another mine. But if you are a standalone mine, what do you do? You do not have other mines where the asset can be transferred. So, you either have to sell or decommission and dispose it. Whatever it is, you have to mention in the mine closure plan, what you are going to do with respect to your mining machinery.



4.9. Safety and Security

The safety measures implemented to prevent access to:

- surface openings,
- excavations etc.,

Arrangements proposed during the mine abandonment plan and upto the site being opened for general public.

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Section 4.9: Safety and security: Once your mine is closed, when there is active mining, there is a mining boundary. You have security people who don't allow other people, the grazing animals, to get inside the mine property because the mine property is a working

area. There may be some safety problems. Security people are there. But if your mine is closed, now it is a closed mine. There is no one person. No, security might not be there. So, people can enter, animals can enter, grazing animals can enter, and there may be safety and security problems. So, you have to mention what safety measures are to be implemented to prevent the general public from accessing the surface mine. Like you have a pit which is unstable, full of water maybe, a deep pit. So, people may fall down there and drown. The animal may fall down and drown. So, you cannot allow that. You have to take measures so that access to surface openings and excavations is prevented. Arrangement proposed during the mine abandonment plan, and up to the site being opened for the general public. When the mine is closed, you have to secure that area so that other people cannot come and they don't face the security problem.

4.10. Disaster Management

Give details of action plan for high risk accidents like:

- Landslides
- Subsidence flood
- Inundation in underground mines
- Fire
- Seismic activities
- Tailing dam failure
- Emergency plan proposed for quick evacuation
- Ameliorative measures to be taken etc.

Capability of lessee to meet such eventualities and the assistance to be required from the local authority to be mentioned.

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4.10: Disaster Management: When your mine is closed, but many facilities are there, the pit is there, the overburden dump is there, these can pose a risk hazard to public safety. There may be extreme climate, weather events, rainfall, or extreme rainfall, and the dump slope or the pit slope may fail. So, these may create a disaster or present an accident risk. So, you have to give a detailed action plan that will be taken for high-risk accidents. What types of accidents are possible? Like landslide, subsidence, flooding, inundation in underground mines, fire. You have overburden material containing coal or shale and it may catch fire. Seismic activity may lead to slope failure, overburden dump failure, and tailings dam failure. What are the measures or action plan for these accident risk events? Some of them, may become a disaster. An emergency plan proposed for quick evacuation, and what are the remedial measures or ameliorative measures to be taken for this accident risk event? Capability of lessee to meet such eventuality. Or any assistance will be required from the local authority, district authority, and any other industrial facility which may be present in that locality, that needs to be mentioned in the mine closure plan.

SUMMARY

This lecture session covers the background of genesis of Mine Closure Plan and discusses the technical features to be covered in the Mine Closure Plan.

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23

So, here today we stop it. But the mine closure plan topic is not complete. Next class, we will also discuss, but today class we have covered the background of the genesis of mine closure plan and discussed the technical features that are covered under the mine closure.

REFERENCES

- > Various Circulars Issued by Ministry of Coal, CMPDI, and IBM regarding Mine closure plan.
- > Circular by Ministry of Coal, No. 55011-01-2009-CPAM dt. 11 Jan 2012.
- > IBM Manual for Appraisal of Final Mine Closure Plan, 2018.
- > Circular by Ministry of Coal, No. F.No. 34011/28/2019-CPAM dtd. 16 dec 2019.
- > Circular by Ministry of Coal, No. MPS/2/2022-MPS dt. 28 Oct 2022.

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24

So, the references are various circulars issued by the Ministry of Coal, CMPDI, Indian Bureau of Mines regarding mine closure plan, and some circulars by the Ministry of Coal in the years 2012, 2019, and 2022, and the IBM manual for appraisal of final mine closure plan in the year 2018. So, these are the documents. These documents are available in the public domain. You can download these from the website, and you can go through these lectures. Next class, we will discuss the economic repercussions of the mine closure, and we will also talk about the financial assurances that are essentially a part of the mine closure plan. So, see you in the next class, that is Lecture number 45. And I thank you for a very patient hearing. Thank you.