INDIAN METALS & FERRO ALLOYS LIMITED

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Ref.No.IMFA/MPC/20/41
Date: 15.07.2020

To

The Member Secretary (Non- Coal Mining)
IA Division
Ministry of Environment, Forest & Climate Change
Indira Paryavaran Bhawan, Jor bagh Road, Aliganj
New Delhi- 110003

Sub: Reply of ADS generated on 01.07.2020 for the project "Sukinda Mines (Chromite) by M/s Indian Metals & Ferro Alloys Ltd with expansion of production from 3.51 LTPA to 6 LTPA, change in mining technology from opencast to opencast & underground and establishment of chrome ore beneficiation plant (COBP) of 40 TPH over a lease area of 116.76 ha located at Village- Kaliapani, Tehsil- Sukinda, District- Jajpur, State- Odisha"

Ref: 1. File no.:- J-11015/204/2015-IA.II (M)
2. Proposal No. IA/OR/MIN/114264/2007
3. 18th EAC meeting (Non- Coal Mining) dated 22.06.2020 at Agenda no. 2.1

Dear Sir,

With reference to the ADS generated online on 01.07.2020 by MoEF&CC, we are hereby submitting the point-wise reply of queries generated in ADS.

Sl. No.	ADS queries	Reply
1.	Compliance of Standard Terms of reference as published by Ministry for beneficiation activity.	TOR compliance of Beneficiation Plant is enclosed as **Enclosure I.**
2.	Status of extension of mining lease copy of letter if any issued in this regard needs to be submitted.	Mining lease has been granted by Govt. of Orissa for 30 years which was executed on 04.09.1999. As per MMDR Act 2015, the validity of the mining lease is extended upto 03.09.2049. However, formal application for extension of mining lease has already been submitted to the State Government. Copy of lease deed is attached as **Enclosure II.**

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3.	The Committee is of the view that PH was conducted on 23.06.2017 and the modified mining plan that was placed in PH was approved on 23.09.2016. Thereafter, two review of mining plan was approved and PP needs to submit whether there are any changes made in the recently approved mining plan or not. The copy of recent mining needs to be uploaded on PARIVESH and changes if any made with justification needs to be submitted. The land use mentioned at conceptual stage needs to be submitted.	There are no changes in the area of the Mining Lease (116.76 ha.), production capacity (3.51 LTPA to 6 LTPA), mining technology involving Opencast-cum-Underground Mine and Chrome Ore Beneficiation Plant (40 TPH) in the IBM approved Review of Mining Plan dated 31.10.2018, modification of review of mining plan dated 14.02.2018 and IBM approved mining plan dated 23.09.2016 on the basis of which Public Hearing was held on 23.06.2017. We are enclosing herewith: 1) Table showing comparison of the production capacity of all three approved mining plans enclosed as **Enclosure III,** 2) Affidavit mentioning that there is no change in all the three mining plan as **Enclosure IV,** 3) Copy of recent mining plan dated 31.10.2018 as **Enclosure V** 4) land use at Conceptual Stage as **Enclosure VI.**
4.	PP in the mining plan is mentioned that the mined out area of band-1 will be backfilled, but it is not clear from the same whether IBM has allowed dumping over the mineralised area. Further in EIA report the impact due to additional material handling for backfilling is not mentioned. It is not clear whether the dump will be re-handled or waste material from opencast and underground will be directly backfilled in the band-1. Therefore, a letter in this regard that IBM has approved the proposal of backfilling considering the fact that the band-1 is having minerals at the time of backfilling. In addition to this cumulative impact due to all the activities needs to be submitted.	Mining in Band I is proposed to continue till the ultimate pit limit (-2) mRL. After completion of open-cast mining, the mined out area of Band I will be backfilled upto 114 mRL by the overburden to be generated during opencast mining of Band II and waste to be generated from underground developments of band I. Since the mine plan has been duly approved by IBM wherein overburden dumping has been mentioned and incorporated in the plans & sections, hence the arrangement of dumping the overburden on the exposed mineral at the bottom of the mined out area as per conceptual plan has the consent of IBM. Underground workings are proposed after leaving a safe parting of 248 m below the ultimate opencast pit limit of Band I i.e. (-2) mRL based on scientific study carried out by NIRM, Karnataka and duly approved by IBM.

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Sl. No.	ADS queries	Reply
		After completion of opencast mining of **Band II**, the mined out area shall be back-filled/reclaimed upto 78mRL. For 6 lakh tones of Chrome ore production, 30,000 CuM of waste will have to be handled per annum from underground workings of **Band-I** inline with the experience at our another adjacent underground mine. So, about 510000 Cum waste will be generated from underground developments of Band I during conceptual period. After completion of opencast mining of **Band II**, the mined out area shall be back-filled/reclaimed upto 78mRL to fill up the void area by about 510000 Cum waste. As this is the underground material, so plantation cannot be made over it. For which one layer of OB material is to be spread over it for plantation. So, about 15,000 to 20,000 Cum of leftover OB material from dump yard is to be rehandled for rehabilitation purpose by planting local species. Relevant pages of Approved Review of Mining Plan by IBM mentioning that backfilling is proposed in Band I & Band II are attached as **Enclosure VII.** Cumulative impact due to all the activities has been evaluated at the maximum generation of overburden of 11 Lakh Cum per annum whereas OB generation from underground operation and OB rehandling quantity from the dump for backfilling of Band II mined out area is much less till the conceptual period. Hence there will be no additional impact due to rehandling of OB. Report showing cumulative impact is enclosed as **Enclosure VIII.**

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5.	In the EC granted on 24.12.2002 it has mentioned that no forest land is involved but now PP has submitted that there is forest land for which Forest Clearance was obtained on 22.06.2018. The reason for change in land classification needs to be submitted.	The entire ML area was Non- Forest as per HAL records. Further in accordance to the MoEF&CC Circular No. F.No.8-78/1996-FC dated 10.03.2015, as per the Sabik records (as on 25.10.1980) the land schedule of the ML area consisted 115.05 ha. Of Forest land & 1.71 ha. Of Non-Forest Land. Hence the forest clearance was obtained for diversion of 115.05 ha. of Sabik Kisam forest land as on 25.10.1980 vide MoEF&CC letter no. F.No. 8-16/2016-FC dated 22.06.2018. Land Schedule is Enclosed as **Enclosure IX.**
6.	PP shall ensure that the document uploaded on the Parivesh Portal is illegible, it has found that some of the documents including past production details authenticated by DMG is not illegible.	Noted.

In view of the above details submitted as per requirements of the committee, we would request for recommendation of environmental Clearance.

Thanking You.

Yours faithfully,
For M/s. Indian Metals Ferro Alloys Limited

(Sanjeev Das)
Sr. Vice President
Head- Mining Business Unit
Authorised Signatory

Enclosure: As above

Enclosure I
TOR Compliance of Beneficiation Plant

Standards TOR Compliance for Beneficiation Plant

Sr. No.	STANDARD TOR	REPLY
1	The alternate sites considered, the relative merits and demerits and the reasons for selecting the proposed site for the Beneficiation Plant should be indicated.	For techno-economic reasons the chrome ore beneficiation plant (COBP) is proposed within the lease area. No alternative site is examined. Refer chapter 5 of the EIA report.
2	Details of the technology and process involved for beneficiation should be given	Bench scale study was conducted by IBM. Subsequently IMMT, Bhubaneshwar carried out detailed study and after examining five options including gravity and floatation method, recommended gravity separation which gave the best recovery and acceptable study. The recommended process involves crushing, screening, screw scrubber, hydrocyclone, tabling /falcon concentration Two tailing ponds are proposed for sedimentation. Filter press may also be installed as per requirement. Details of COBP technique is given at section 2.8.1 section C in the EIA report
3	Location of the proposed Plant w.r.t. the source of raw material and mode of transportations of the ore from mines to the beneficiation plant should be justified.	The proposed plant will be located within the 116.76 ha. leasehold area of Sukinda Mines (chromite) of IMFA for which EC for expansion is also under process. The area of the proposed plant will be 1.427 ha. including the area for the tailing storage area. Source of raw material for the plant will be from the subgrade dump (10-30% Cr_2O_3) located within the mine lease and sub grade ore likely to be generated during future mining. The raw materials will be transported by the dumpers/trucks from sub grade dump and mine to COBP. Detail is given at section 2.8.1 C in the EIA report. Location of proposed plant is shown in opencast conceptual plan given at plate no. 10 of EIA reports.
4	Treatment of run of mine (ROM) and or of the fines/waste dump should be spelt out.	6.12 lacs MT of sub grade ore (10-30% Cr_2O_3) is stacked which will be beneficiated from the proposed plant. In addition, sub grade generated during the course of mining will also be sent to COBP for beneficiation.

		Feed capacity of the plant will be 1 lakh TPA. 25% solid waste in the form of tailing is likely to be generated every year having less than 10% Cr_2O_3 on a subgrade dump separately earmarked for the purpose within the lease area.
5	Estimation of the fines going into the washings should be made and its management described.	Entire sub grade ore having less than 10% Cr_2O_3 containing lumps as well as fines will be subjected to beneficiation. 90% of the water will be recirculated within the system and the tailing will be stacked within a lease area on a separate dump. The total quantity of solid waste in the form of tailing will be 25000 MT PA.
6	Details of the equipment, settling pond etc. should be furnished.	Details of the plant machinery and equipment is given at Annexure 3 section 2 under plant machinery & equipment in ADS reply. There are two tailing/settling ponds for COBP tailings . Details are given at chapter 2 of the EIA report.
7	Detailed material balance should be provided.	Material balance is given at figure 2-3 & 2-4 at section 2.8.1 (C) in EIA report.
8	Sources of raw material and its transportation should be indicated. Steps proposed to be taken to protect the ore from getting air borne should be brought out.	Source of raw material for the plant will be from the subgrade dump (10-30% Cr_2O_3) located within the mine lease and sub grade ore likely to be generated during future mining. The raw materials will be transported by the dumpers/trucks from sub grade dump and mine to COBP. Only source of dust in the beneficiation plant will be crusher where bag filter is proposed to be installed. Fixed sprinkler ,fixed & mobile mist gun have already been installed at the mine site, to suppress dust which may become airborne during transportation. Refer Chapter 4 & Chapter 10 for details.
9	Management and disposal of tailings and closure plan of the tailing pond, if any after the project is over, should be detailed in a quantified manner.	Approximately 25000 tonnes of tailing will be generated per annum from the COB plant which will be stored at designated place near the sub grade dump within the mine lease. The tailing pond inside the COB plant shall comprise of two separate chambers, where the suspended solids will settle in the first chamber and supernatant water will be collected in the second chamber and the same shall be recirculated to the plant for reuse. Filter press may also be installed for separation of water from the tailing.

		The tailing is likely to contain -10% Cr_2O_3. Attempt will be made to explore further recovery in future. The waste after recovery will be reclaimed to plantation.
10	The water requirement for the project, its availability and source should be furnished. A detailed water balance should also be provided. Fresh water requirements for the project should also be indicated.	The makeup water requirement for the plant is estimated to be 160 KLD which will be sourced from the treated water from the ETP already installed within the mining lease area. Water drawl permission has been obtained for the entire operation from Central Ground Water Authority dated 07.04.2016 and attached at Annexure 8 of EIA report. Water balance has been given at Annexure 7 of the ADS reply submitted.
11	A copy of the document in support of the fact that the Proponent is the rightful lessee of the unit should be given.	The beneficiation plant is being installed within the mining lease area of 116.76 Ha. which is valid upto 03.09.2049. Copy of the lease deed is given at **Annexure 1** of the EIA report
12	All documents including EIA and public hearing should be compatible with one another in terms of the production levels, waste generation and its management and technology and should be in the name of the lessee.	The EIA report and public hearing is compatible with one another in all respects.
13	All corner coordinates of the Unit, superimposed on a High Resolution Imagery/Toposheet should be provided. Such an Imagery of the proposed Unit should clearly show the land use and other ecological features of the study area (core and buffer zone).	All coordinates of the mining lease within which the beneficiation plant is proposed has been superimposed on topographical Map and is given at **Plate-2.** The area of the beneficiation plant is separately marked within the lease area. Land Use map showing various details is given at **Plate-12** of the EIA report.
14	It should be clearly indicated whether the proponent Company has a well laid down Environment Policy approved by its Board of Directors? If so, it may be spelt out in the EIA Report with description of the prescribed operating process/procedures to bring into focus any infringement/deviation/ violation of the environmental or forest norms/ conditions? The hierarchical system or administrative order of the Company to deal with the environmental issues and for ensuring compliance with the EC conditions may also be given. The system of reporting of non-compliances / violations of environmental norms to the Board of Directors of the Company and/or shareholders or stakeholders at large,may also be detailed in the EIA Report.	The company has a well laid down environment policy approved by the management. The Environment cell is headed by an officer of the rank of Sr. Vice President(Head-Mining) and has four other members in the cell comprising of V.P., Mine Manager, Manager Environment and one senior officer. Total 42 persons are in the Environment Management Cell. The Details regarding organization is given in the EIA report and details of Environmental policy is

		given in Annexure 12 of the EIA Report.
15	Issues relating to Safety should be detailed. The proposed safeguard measures in each case should also be provided. Disaster management plan shall be prepared and included in the EIA/EMP Report.	Issues relating to safety of operations within mine & beneficiation plant are addressed at Chapter 7 of the EIA Report.
16	The study area will comprise of 10 km zone around the Plant.	The topographical Map of 10 Km radius around the lease periphery has been prepared which is given at **Plate-2**, Land Use map is given at **Plate-12** of the EIA report.
17	Cumulative impact study of both Beneficiation Plant with suggested mitigation measures as per the study should be described.	Detailed cumulative effect of mining and beneficiation plant with suggested mitigation measures is given at Annexure 3 in the ADS reply submitted.
18	Location of Railway siding with its handling capacity and safety measures should be indicated.	The concentrate obtained from the beneficiation plant will be dispatched along with the high grade ROM from the mine through road and rail. Please refer to section 4.9 of Chapter 4 in the EIA report.
19	Option to provide only silo for storage of minerals instead of open stacking to avoid fugitive dust should be explored and arrangements finalized justified.	ROM from the subgrade stock yard and mine will be directly fed into the silo to avoid fugitive dust. The concentrated ore will be wet having moisture of 3-4%, therefore, it will not generate fugitive dust.
20	Land use of the study area delineating forest area, agricultural land, grazing land, wildlife sanctuary, national park, migratory routes of fauna, water bodies, human settlements and other ecological features should be indicated. Land use plan of the lease area should be prepared to encompass preoperational, operational and post operational phases and submitted. Impact, if any, of change of land use should be given	Land Use map showing forest area, agricultural land, grazing land, water bodies, human settlements, ecological features etc has been prepared and is given at **Plate 12** of the EIA report.
21	Details of the land for any Over Burden Dumps outside the lease, such as extent of land area, distance from lease, its land use, R&R issues, if any, should be given.	No outside OB Dump has been planned.
22	A Certificate from the Competent Authority in the State Forest Department should be provided, confirming the involvement of forest land, if any, in the Project area. In the event of any contrary claim by the Project Proponent regarding the status of forests, the site may be inspected by the State Forest Department along with the Regional Office of the Ministry to ascertain the status of forests, based on which, the Certificate in this regard as mentioned above be issued. In all such cases, it would be desirable for	As per Sabik records the land schedule of the ML area consists of 115.05 Ha of Forest Land and 1.71 Ha of Non-Forest Land. Lessee has obtained forest clearance (stage II) from MoEF&CC, over 115.05 ha of forest land, vide letter no: 8-16/2016-FC, dated 22.06.2018. Forest Clearance letter has been attached at **Annexure 7** of the EIA report.

	representative of the State Forest Department to assist the Expert Appraisal Committees.	
23	Status of forestry clearance for the broken up area and virgin forestland involved in the Project including deposition of net present value (NPV) and compensatory afforestation (CA) should be indicated. A copy of the forestry clearance should also be furnished	As per Sabik records the land schedule of the ML area consists of 115.05 Ha of Forest Land and 1.71 Ha of Non-Forest Land. Lessee has obtained forest clearance (stage II) from MoEF&CC, over 115.05 ha of forest land, vide letter no: 8-16/2016-FC, dated 22.06.2018. The NPV of Rs 8,39,86,500 as demanded by Forest Department vide letter no 4655/5F(Misc)/2015 dated 16.052015 has been deposited through SBI vide UTR no SBINR520150520115201024 on 20.05.2015. Forest Clearance letter has been attached at **Annexure 7** of EIA report.
24	Implementation status of recognition of forest rights under the Scheduled Tribes and other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006 should be indicated.	Not Applicable. There are no forest dwellers in the Plant area.
25	The vegetation in the RF / PF areas in the study area, with necessary details, should be given.	EB report is a part of **Chapter 3 heading 3.12 Biodiversity.**
26	A study shall be got done to ascertain the impact of the Project on wildlife of the study area and details furnished. Impact of the project on the wildlife in the surrounding and any other protected area and accordingly detailed mitigative measures required, should be worked out with cost implications and submitted.	The study has been done for ascertaining the impact of the mining project on wildlife of the study area with suggested mitigative measures have been incorporated in the EIA report in **chapter 4 Para 4.10 Biological Environment.** There are no National Parks, Sanctuaries, Biosphere Reserves, Wildlife Corridors, Ramsar site Tiger/Elephant Reserves existing within the study area. The study of flora fauna within study area have been carried out and detailed under heading **3.12 Ecology & Biodiversity** in **chapter-3 Baseline study.**
27	Location of National Parks, Sanctuaries, Biosphere Reserves, Wildlife Corridors, Tiger/Elephant Reserves/(existing as well as proposed), if any, within 10 km of the mine lease should be clearly indicated, supported by a location map duly authenticated by Chief Wildlife Warden. Necessary clearance, as may be applicable to such projects due to proximity of the ecologically sensitive areas as mentioned above, should be obtained from the Standing Committee of National Board of Wildlife and copy furnished.	There are no National Parks, Sanctuaries, Biosphere Reserves, Wildlife Corridors, Ramsar site Tiger/Elephant Reserves.
28	A detailed biological study of the study area [core zone and	Details of fauna existing within the study

	buffer zone (10 km radius of the periphery of the mine lease)] shall be carried out. Details of flora and fauna, endangered, endemic and RET Species duly authenticated, separately for core and buffer zone should be furnished based on such primary field survey, clearly indicating the Schedule of the fauna present. In case of any scheduled- I fauna found in the study area, the necessary plan along with budgetary provisions for their conservation should be prepared in consultation with State Forest and Wildlife Department and details furnished. Necessary allocation of funds for implementing the same should be made as part of the project cost.	area are given in **Heading 3.12 Ecology & Biodiversity** in **chapter-3 Baseline study.** Necessary Conservation plan along with budgetary provisions for their conservation has been approved by the Chief Wildlife warden. The approval letter is given at **Annexure-9.** It is duly implemented and measures have been taken to ensure the protection of the species and help it thrive in the area.
29	Proximity to Areas declared as 'Critically Polluted' shall also be indicated and where so required, clearance certifications from the prescribed Authorities, such as the SPCB/CPCBshall be secured and furnished to the effect that the proposed activities could be considered.	The proposed project does not fall within 10 Km radius of any "Critically polluted" area and also it does not come under the "Aravali Range"
30	Similarly, for coastal Projects, A CRZ map duly authenticated by one of the authorized agencies demarcating LTL. HTL, CRZ area, location of the unit w.r.t CRZ, coastal features such as mangroves, if any, should be furnished. (Note: The Projects falling under CRZ would also need to obtain approval of the concerned Coastal Zone Management Authority).	Not Applicable
31	R&R Plan/compensation details for the Project Affected People (PAP) should be furnished. While preparing the R&R Plan, the relevant State/National Rehabilitation & Resettlement Policy should be kept in view. In respect of SCs /STs and other weaker sections of the society in the study area, a need based sample survey, family-wise, should be undertaken to assess their requirements, and action programmes prepared and submitted accordingly, integrating the sectoral programmes of line departments of the State Government. It may be clearly brought out whether the village(s) located in the lease area will be shifted or not. The issues relating to shifting of village(s) including their R&R and socio-economic aspects, should be discussed in the report.	This is an expansion project without addition of any land and there is no habitation within the lease area hence no R&R is applicable. Surface rights for entire lease area has already been obtained by PP as given at **Annexure-3** of the EIA report
32	One season (non-monsoon) [i.e. March-May (Summer Season); October-December (post monsoon season) ; December-February (winter season)] primary baseline data on ambient air quality as per CPCB Notification of 2009, water quality, noise level, soil and flora and fauna shall be collected and the AAQ and other data so compiled presented date-wise in the EIA and EMP Report. Site specific meteorological data should also be collected. The location of the monitoring stations should be such as to represent whole of the study area and justified keeping in view the pre-dominant downwind direction and location of sensitive receptors. There should be at least one monitoring station	The baseline data of one Season (Pre–monsoon) was collected from **October 2015 to December 2015** and has been revalidated in October 2018**.** Please refer **Chapter-3.** Further as per Direction of MoEF&CC an additional one month baseline in the month of Nov 2019 has been collected and is given in the ADS reply..

	within 500 m of the unit in the pre-dominant downwind direction. The mineralogical composition of PM10, particularly for free silica, should be given.	
33	Air quality modeling should be carried out for prediction of impact of the project on the air quality of the area. It should also take into account the impact of movement of vehicles for transportation of mineral. The details of the model used and input parameters used for modeling should be provided. The air quality contours may be shown on a location map clearly indicating the location of the site, location of sensitive receptors, if any, and the habitation. The wind roses showing pre-dominant wind direction may also be indicated on the map.	The combined study on Air quality modelling for mining as well as COB plant with respect to PM2.5, PM10, SO2, and NOx has been done and it has been observed that there is no significant impact is envisaged. This is covered in chapter-4. The AQ report is attached at Annexure 25
34	The water requirement for the Project, its availability and source should be furnished. A detailed water balance should also be provided. Fresh water requirement for the Project should be indicated.	The makeup water requirement for the plant is estimated to be 160 KLD which will be sourced from the treated water from the ETP already installed within the mining lease area. Total water requirement for all operations including mining, sprinkling, beneficiation, plantation, domestic is estimated at 1240 KLD comprising of 240 KLD drinking and domestic use, Water for sprinkling & dust suppression will be 710 KLD, Plantation 100 KLD, Chrome Ore Beneficiation plant make up water will be 160 KLD and others 30 KLD. Water demand will be fulfilled by existing bore well and ETP treated water within the mine lease area. Water drawl permission for withdrawing of 3500 m^3/day (240 m^3/day from borewell and 3260 m^3/day through mine seepage) has been obtained from Central Ground Water Authority dated 07.04.2016 and attached at Annexure 8 of EIA report. Water balance has been given at Annexure 7 of the ADS reply submitted.
35	Necessary clearance from the Competent Authority for drawl of requisite quantity of water for the Project should be secured and copy furnished.	Permission letter from CGWB for drawing water is attached as **Annexure-8.**
36	Description of water conservation measures proposed to be adopted in the Project should be given. Details of rainwater harvesting proposed in the Project, if any, should be provided.	90% water will be recirculated in the beneficiation process. Thus makeup water requirement will be only 160 KLD. The rain water accumulated in the pit and quarry water after treatment in ETP is being used for sprinkling and green

		belt development as a water conservation measure. The stored rainwater in the pit is also getting recharged in the ground as the strata are permeable. Rain water harvesting pits are installed which helps in recharging the groundwater. Water conservation measures are detailed in the EIA report at EMP given in **Chapter-9.**
37	Impact of the project on the water quality, both surface and groundwater should be assessed and necessary safeguard measures, if any required, should be provided.	Beneficiation plant will not adversely impact surface or groundwater. Mining as well as beneficiation shall be done keeping all the safety procedures in mind. Anticipated impact on the water quality both surface and groundwater have been assessed and mitigation measures are suggested & provided in **Chapter-4 Para 4.5 Water Environment.** To avoid contamination of the downstream water body an ETP of 8640 KLD has been installed for treatment of effluent before discharging the water into the Damsal Nala. There is proper management of Run-off from the mine by constructing settling pond, retaining walls built along OB dump, Sub-grade dump and fines dump.
38	Details of any stream, seasonal or otherwise, passing through the lease area and modification / diversion proposed, if any, and the impact of the same on the hydrology should be brought out.	There is no river or water body flowing across the mine site.
39	A time bound Progressive Greenbelt Development Plan shall be prepared in a tabular form (indicating the linear and quantitative coverage, plant species and time frame) and submitted, keeping in mind the same will have to be executed up front on commencement of the project. The plant species selected for green belt should have greater ecological value and should be of good utility value to the local population with emphasis on local and native species and the species which are tolerant to the pollution.	Progressive Green Belt plan is provided in Chapter 9 of the EIA report. Details of Existing plantations done by PP from 1999 to till date are given at **Annexure no. 14.** Existing Plantation details have been covered in brief and proposed plantation during plan period are given in EIA Chapter 4 under heading **4.12 Plantation/Afforestation Programme**
40	Impact on local transport infrastructure due to the Project should be indicated. Projected increase in truck traffic as a result of the Project in the present road network (including those outside the Project area) should be worked out,	Projected increase in truck traffic as a result of the Project in the present road network has been studied and capability of existing road w.r.t. Incremental load has been

	indicating whether it is capable of handling the incremental load. Arrangement for improving the infrastructure, if contemplated (including action to be taken by other agencies such as State Government) should be covered.	worked out. It has been found that the existing road network is sufficient to handle the increased transportation of mineral ore produced after expansion of mine. Impact of transportation after the expansion will be minimal. Detail is given in **Ch-4 heading 4.9 Transportation**
41	Details of the onsite shelter and facilities to be provided to the workers should be included in the EIA report.	A mine office, rest shelter and first aid center have already been constructed at the site of mining. Details are given in **2.11.3. in Chapter 2 Proposed Transportation and Infrastructure**
42	Occupational Health impacts of the Project should be anticipated and the proposed preventive measures spelt out in detail. Details of pre-placement medical examination and periodical medical examination schedules should be incorporated in the EMP. The project specific occupational health mitigation measures with required facilities proposed in the mining area should be detailed.	Existing and proposed measures towards Occupational health and safety to maintain a safe and healthy work environment have been detailed with budget estimation. Rs 8 Lakh per annum has been provided as a recurring expenditure for dealing with occupational health impact. Details are given in EIA report in **Chapter 7 under heading 7.8 Occupational Health**
43	Public health implications of the Project and related activities for the population in the impact zone should be systematically evaluated and the proposed remedial measures should be detailed along with budgetary allocations.	Public health implications of the Project have been studied and the Detail is given in EIA **Chapter-7 para 7.8.8 Public Health and safety** with budget allocations.
44	Measures of socio economic significance and influence to the local community proposed to be provided by the Project Proponent should be indicated. As far as possible, quantitative dimensions may be given with time frames for implementation.	The CER budget has been provided as per the provision of OM dated 01.05.2018. The head wise expenditure is given with the ADS reply of point no 12 and attached as Annexure 11 of ADS. The Details of significant Welfare Activities to be taken up by the Company under Corporate Environmental Responsibility are given in **EIA report Chapter 7 heading 7.7 Corporate Environmental Responsibility**
45	Public hearing points raised and commitment of the Project Proponent on the same along with time bound Action Plan to implement the same should be provided and also incorporated in the final EIA/EMP Report of the Project.	The public hearing minutes and the compliance of the same is given at **Annexure-no. 18** of the EIA report**.**
46	Details of litigation pending against the project, if any, with direction /order passed by any Court of Law against the project should be given.	There is no litigation against the proposed beneficiation plant. However, there are three litigations pending against the mine which are as follows:

		i) Case no. RA No. 22/46/2018/RC-I has been filed before Hon'ble Mines Tribunal, New Delhi. Matter reserved for orders. (ii) Case no.- WP (C) No. 1382/2017 has been filed before Hon'ble High Court of Odisha, Cuttack against demand of land premium/ land cost towards sanction of government land for the purpose of Compensatory afforestation in lieu of forest land diverted for non-forest purpose. Land premium deposited in a separate escrow account as per the direction of the Hon'ble Court. Final hearing awaited. i) WP (C) No.3996/2016 filed before Hon'ble High Court of Odisha, Cuttack, in relation to filing and processing of Application for Forest Clearance under Forest Conservation Act, 1980, in respect of land recorded as forest within the mining leasehold area on or after 25.10.1980 as per SABIK record. Status quo order dated 03.03.2016 and subsequent extension in relation to operation of mines is continuing. However, vide Affidavit dated 20.11.2018, IMFA filed the copy of Stage – II Forest Clearance dated 22.06.2018. Matter is pending for final disposal.
47	The cost of the Project (capital cost and recurring cost) as well as the cost towards implementation of EMP should be clearly spelt out.	The project cost for the beneficiation plant is estimated at Rs 40 crores which will be part of the entire project involving opencast & underground mine estimated at Rs.394.45 Crore. The details of the project cost is given at Chapter 2 & EMP cost is given in Chapter 9 of EIA report. Capital Amount of Rs 73.5 Lakhs and Recurring expenditure of Rs 87 Lakhs per annum have been provided under the various heads of Environment management plan.
48	A brief background of the Project, its financial position, Group Companies and legal issues etc should be provided with past and current important litigations if any	M/s Indian Metals & Ferro Alloys Limited is India's largest, fully integrated producer of ferro alloys with 187 MVA installed furnace capacity backed up by 262.5 MW captive power generation capacity (including 4.5 MW solar) and extensive chrome ore mining tracts. a) Project Cost: Rs 394.45 Crores (Rs. 354.45 crores for underground mining and Rs 40

		crores for COBP). b)M/s Indian Metals & Ferro Alloys Limited c)Nil d) (i) Case no. RA No. 22/46/2018/RC-I has been filed before Hon'ble Mines Tribunal, New Delhi. Matter reserved for orders. (ii) Case no.- WP (C) No. 1382/2017 has been filed before Hon'ble High Court of Odisha, Cuttack against demand of land premium/ land cost towards sanction of government land for the purpose of Compensatory afforestation in lieu of forest land diverted for non-forest purpose. Land premium deposited in a separate escrow account as per the direction of the Hon'ble Court. Final hearing awaited. ii) WP (C) No.3996/2016 filed before Hon'ble High Court of Odisha, Cuttack, in relation to filing and processing of Application for Forest Clearance under Forest Conservation Act, 1980, in respect of land recorded as forest within the mining leasehold area on or after 25.10.1980 as per SABIK record. Status quo order dated 03.03.2016 and subsequent extension in relation to operation of mines is continuing. However, vide Affidavit dated 20.11.2018, IMFA filed the copy of Stage – II Forest Clearance dated 22.06.2018. Matter is pending for final disposal.

49	Benefits of the Project, if the project is implemented should be outlined. The benefits of the projects shall clearly indicate environmental, social, economic, employment potential, etc.	The proposed beneficiation plant will be very useful for the conservation of mineral which will beneficiate the sub grade ore to make it saleable. Other benefits from the mining & beneficiation project are as under: Social: IMFA is committed towards welfare activities of surrounding areas through peripheral development and CER activities. Impetus to the agriculture sector, physical infrastructures like roads, railways, electricity generation- Improvement in social infrastructures like education, health sector, water supply and training etc. Economic: The company will provide direct employment opportunity. It will meet the rising demand of chromite Ore in the country thus increasing revenue for the state as well as country. Environmental: Regular Monitoring is and shall be done during the process. Employment potential: The maximum strength of direct employment will be 921 including managerial, Technical, skilled, semi-skilled and unskilled including 712 existing employees. Besides there will be indirect employment on account of transportation, canteen, repair shop, security etc.
50	Besides the above, the below mentioned general points are also to be followed:- a) Executive Summary of the EIA/EMP Report b) All documents to be properly referenced with index and continuous page numbering. c) Where data are presented in the report especially in Tables, the period in which the data were collected and the sources should be indicated. d) Project Proponent shall enclose all the analysis/testing reports of water, air, soil, noise etc. using the MoEF&CC/NABL accredited laboratories. All the original analysis/testing reports should be available during appraisal of the project	 Complied with Complied with Complied with Complied with

	. e) Where the documents provided are in a language other than English, an English translation should be provided. f) The Questionnaire for environmental appraisal of the project as devised earlier by the Ministry shall also be filled and submitted. g) While preparing the EIA report, the instructions for the proponents and instructions for the consultants issued by MoEF&CC vide O.M. No. J-11013/41/2006-IA.II(I) dated 4th August, 2009, which are available on the website of this Ministry, should also be followed. h) Changes, if any made in the basic scope and project parameters (as submitted in Form-I and the PFR for securing the TOR) should be brought to the attention of MoEF&CC with reasons for such changes and permission should be sought, as the TOR may also have to be altered. Post Public Hearing changes in structure and content of the draft EIA/EMP (other than modifications arising out of the P.H. process) will entail conducting the PH again with the revised documentation. i) As per the circular no. J-11011/618/2010-IA.II(I) dated 30.5.2012, certified Report of the status of compliance of the conditions stipulated in the environment clearance for the existing operations of the project by the Regional Office of Ministry of Environment, Forest and Climate Change, as may be applicable.	Complied with Complied with Complied with Complied with Certified compliance report of the mine has been obtained by RO, MoEF&CC, Bhubaneshwar vide letter no. 101-409/08/EPE dated 06.12.2019.

Enclosure II
Copy of Lease deed

Original

MINING LEASE FOR

CHROMITE

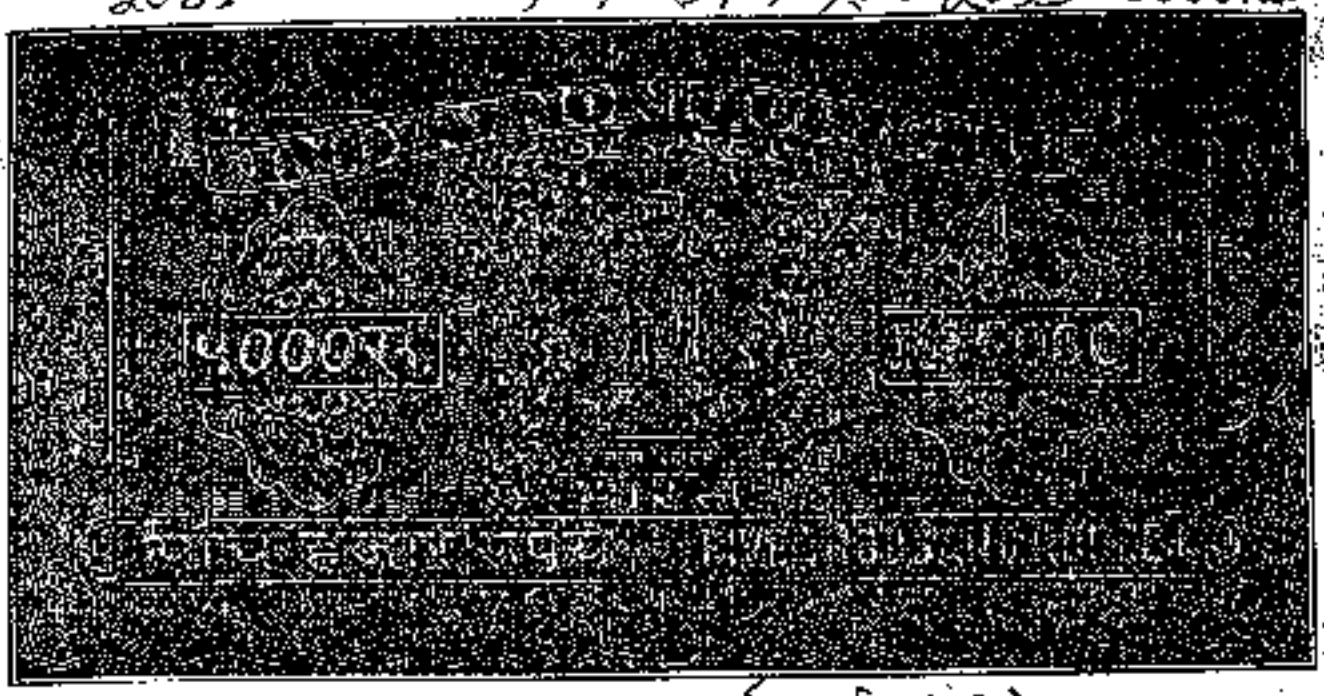
In favour of :

M/s INDIAN METALS & FERRO ALLOYS LTD.
Bomikbal, Rasulgarh, Bhubaneswar 751 010 (Orissa)

Dated the 4th Sept 1999

Over 288.52 Acres or 116.76 Hectares
in village, Kaliapani in Jajpur district.

2085 Original Sale Deed 13,75,072/- 2059 5000Rs.



-1- 17.50 Fee paid
1,@ 6,54,790.00
Area 5.00
Area 6.50
(2) 50.00
6,54,151.50

Admissible under rule 25 duly stamped under the Indian Stamp (Orissa Amendment Act, 1986, Schedule I-A No. 35 (C) and Schedule-II (2) of the Orissa Additional Stamp Duty Act, 1986 exempted from the ~~payment of~~ requisite Stamp Duty.

REGISTERING OFFICER
JAJPUR

FORM - K

MINING LEASE

(See Rule 31)

THIS INDENTURE made this

4th day of

September 1999 between

the Governor of Orissa

Com...

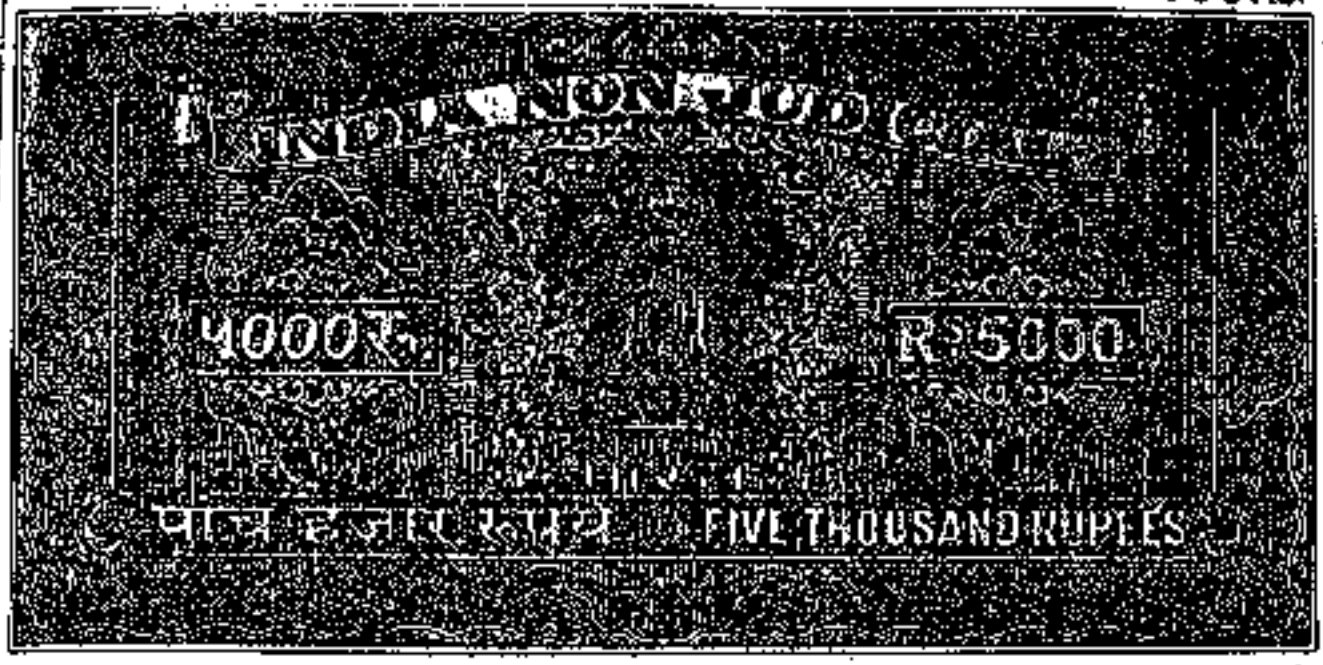
FOR INDIAN METALS & FERRO ALLOYS LTD.

4.9.99

CONSTITUED ATTORNEY

COLLECTOR, JAJPUR

5000Rs.



(hereinafter referred to as the 'State Government' which expression shall where the context so admits be deemed to include the successors and assigns) of the one part;

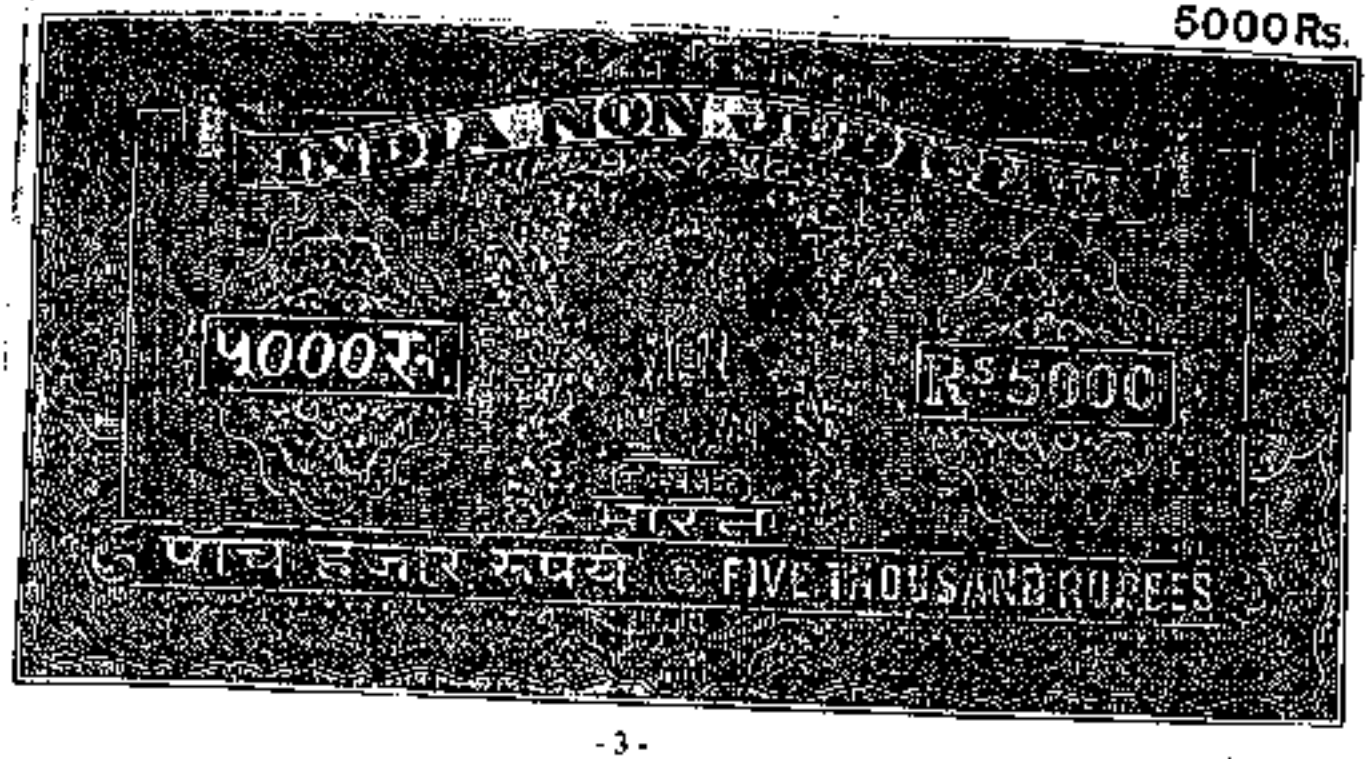
and

Cont....

FOR INDIAN RE [illegible]

CONSTITUED ATTORNEY

5000 Rs.



M/s. Indian Metals & Ferro

When the lessee is a registered Company

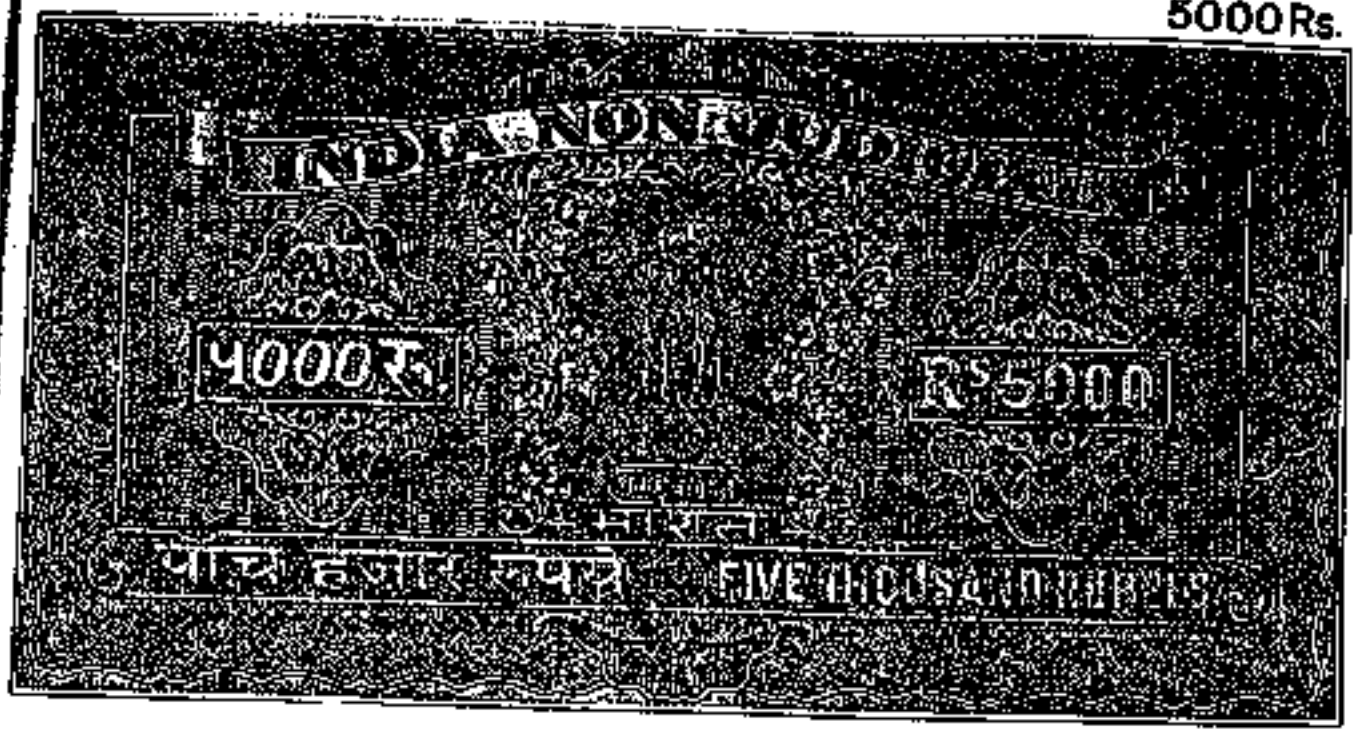
Alloys Ltd. (Name of Company) a company registered under Companies Act, 1956 (Act under which incorporated) having Company Registration No.428/8 of 1961-62 and having its registered office at Bomikhal, Rasulgarh,

Cont....

FOR INDIAN METALS & FERRO ALLOYS LTD.

CONSTITUED ATTORNEY

5000Rs.



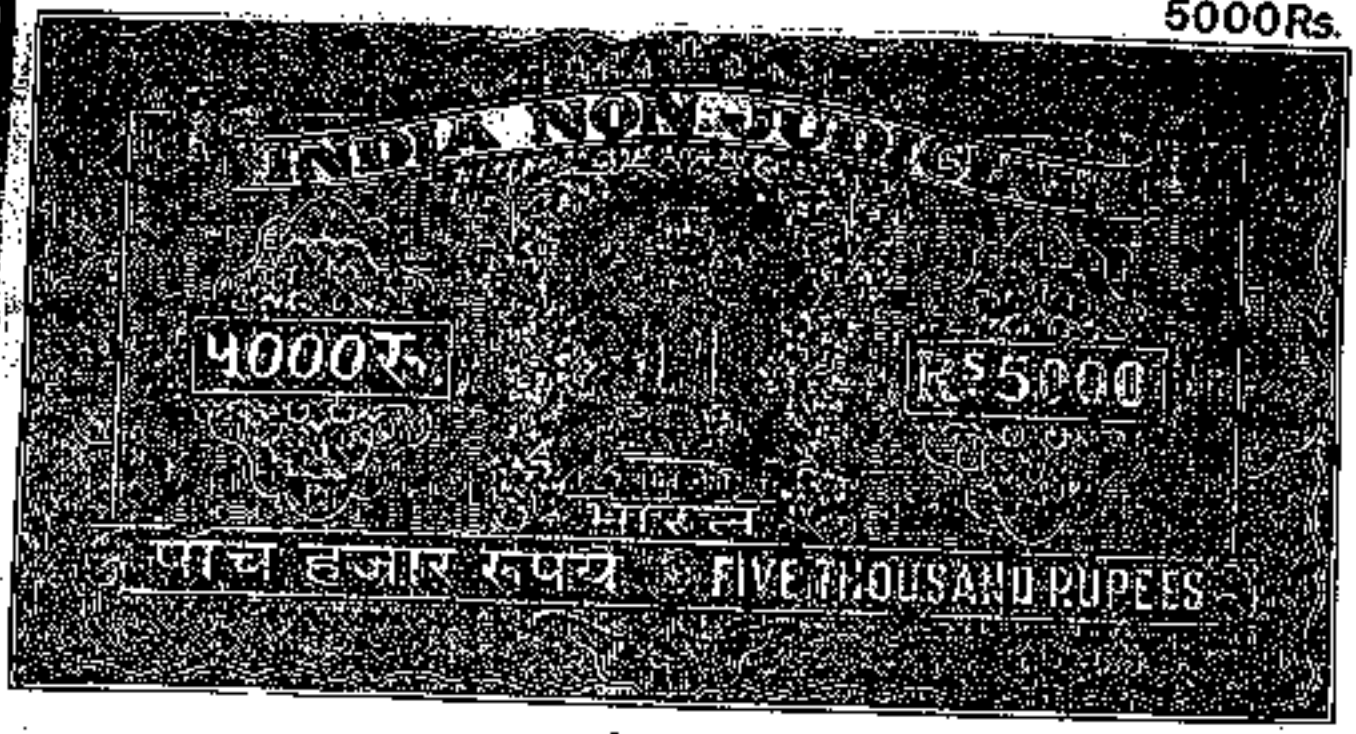
Bhubaneswar - 751 010, Dist: Khurda (hereinafter referred to as "the lessee" which expression shall where the context so admits be deemed to include its successors and permitted assigns), of the other part, represented by Sri P.K.Mohanty, S/o. Late Jadumani Mohanty, aged about 58 years,

Cont....

FOR INDIAN METALS & FERRO ALLOYS LTD.

CONSTITUTED ATTORNEY

5000Rs.



occupation - Vice President(Mines) and power of Attorney Holder of M/s. Indian Metals & Ferro Alloys Ltd.

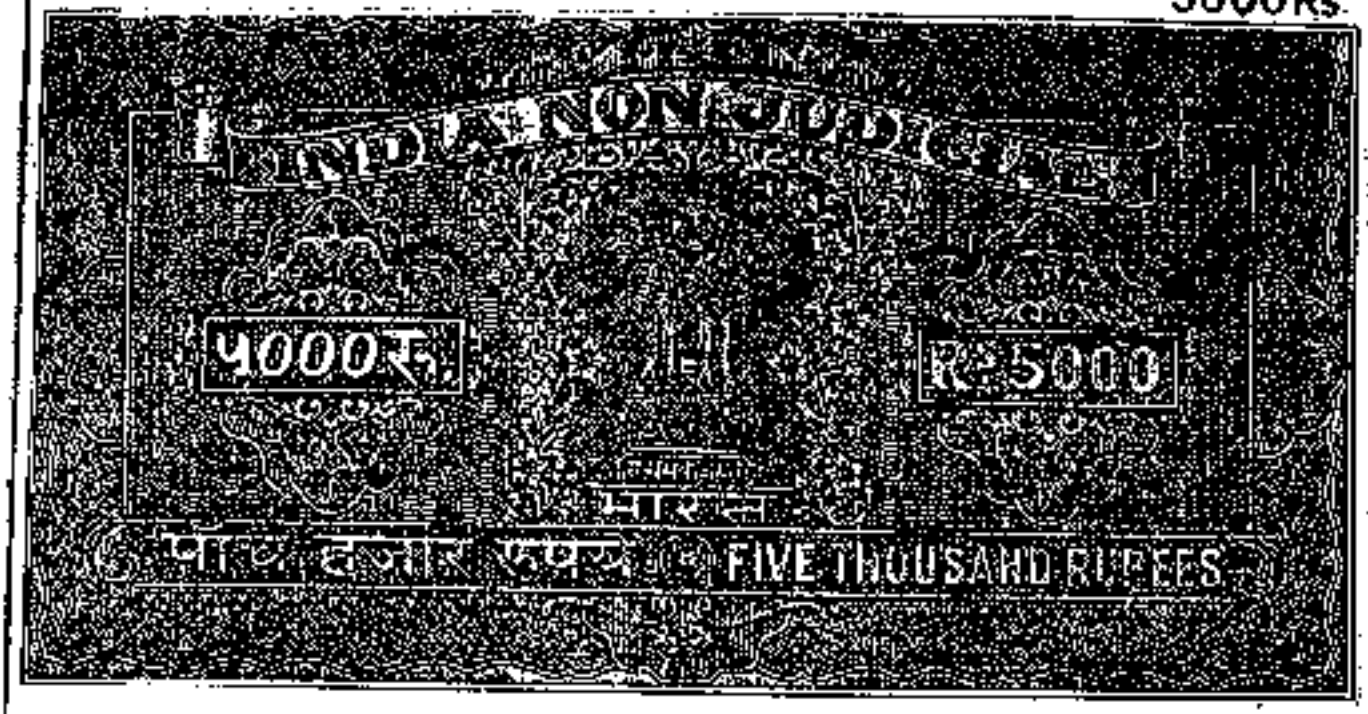
WHEREAS THE lessee has applied to the State Government in accordance with the Mineral Concession

Cont....

FOR INDIAN METALS & FERRO ALLOYS LTD.

CONSTITUED ATTORNEY

5000Rs.



Rules, 1960 (hereinafter referred to as the said Rules) for a mining lease for chromite in respect of the lands described in Part I of the Schedule hereunder written and has deposited with the State Government the sum of Rs.2,000/- (Rupees two thousand only) as security and the sum of Rs.1,000/- (Rupees one Thousand only) for meeting the preliminary

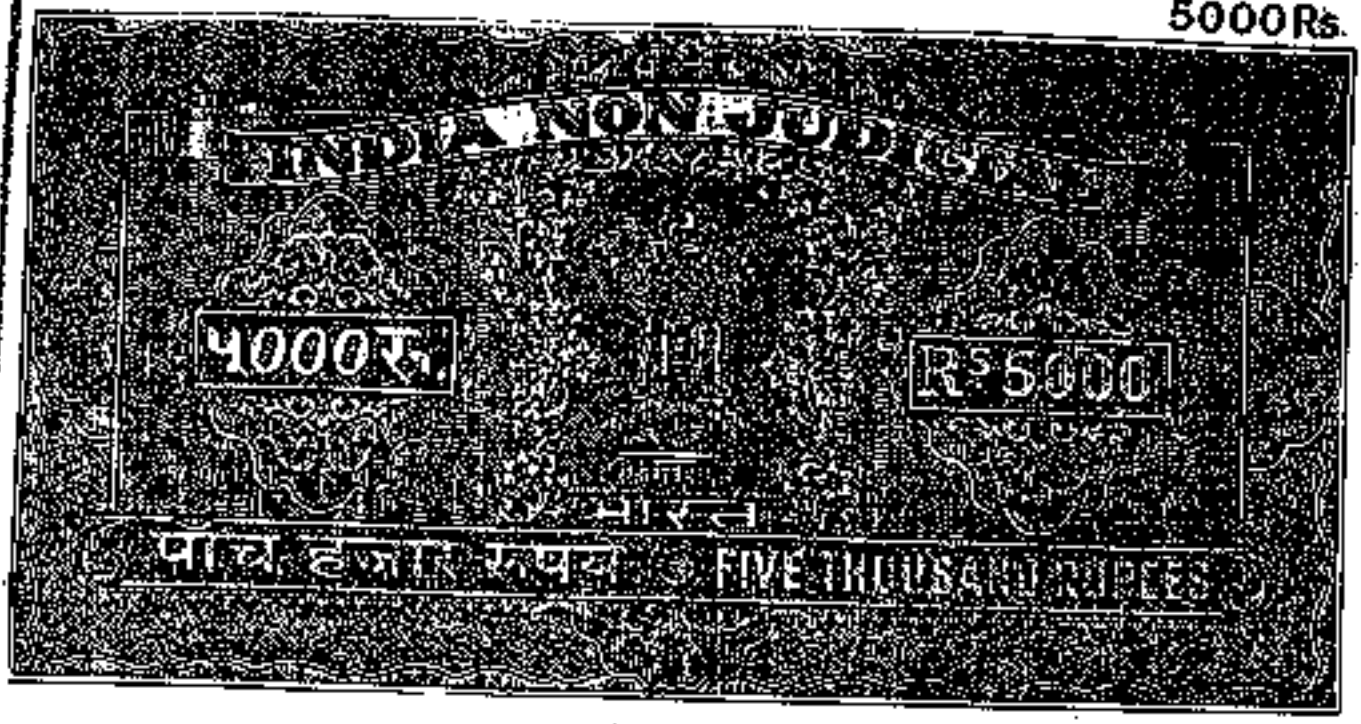
Cont....

For INDIAN METALS & FERRO ALLOYS LTD.

CONSTITUED ATTORNEY

COLLECTOR, JAJPUR

5000Rs.



expenses for a mining lease (and

WHEREAS the Central Government has

approved the grant of lease).

WITNESSETH that in

consideration of the rents and royalties,

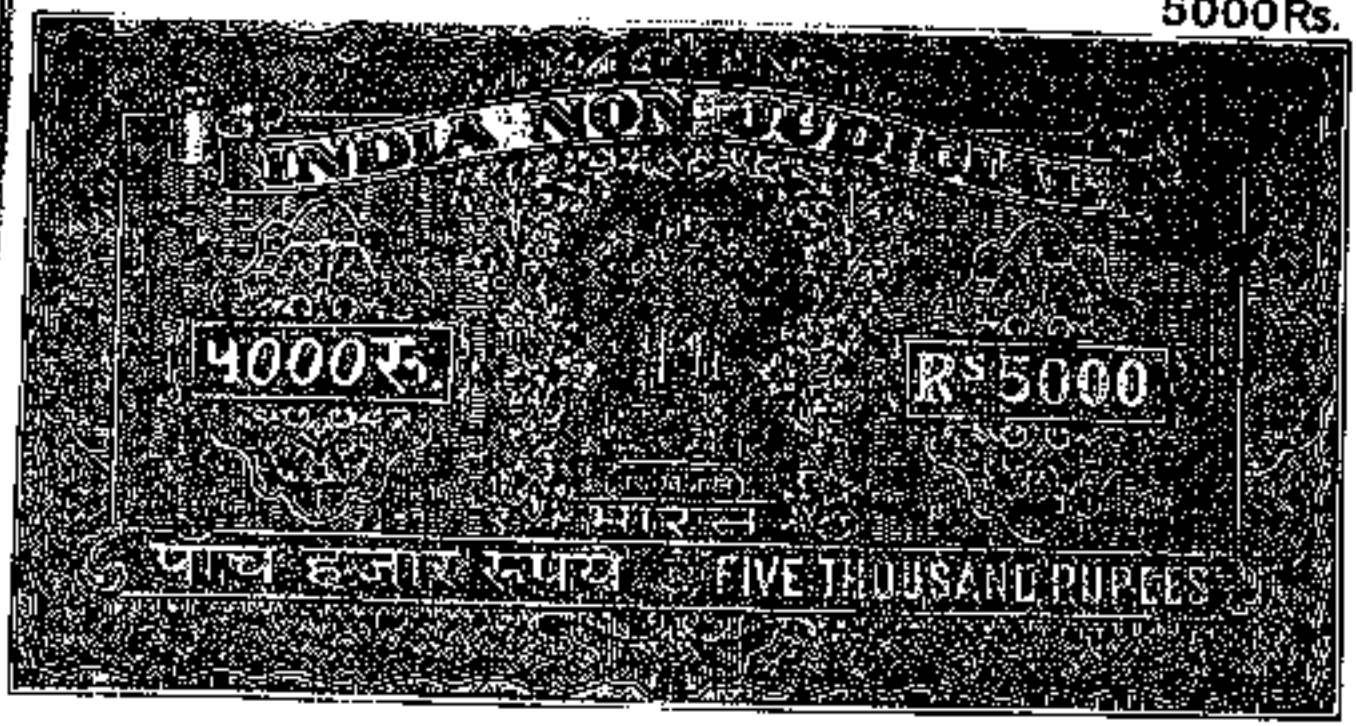
covenants and agreements by and in these

Cont....

FOR INDIAN RARE EARTHS LTD.

CONSTITUED ATTORNEY.

5000Rs.



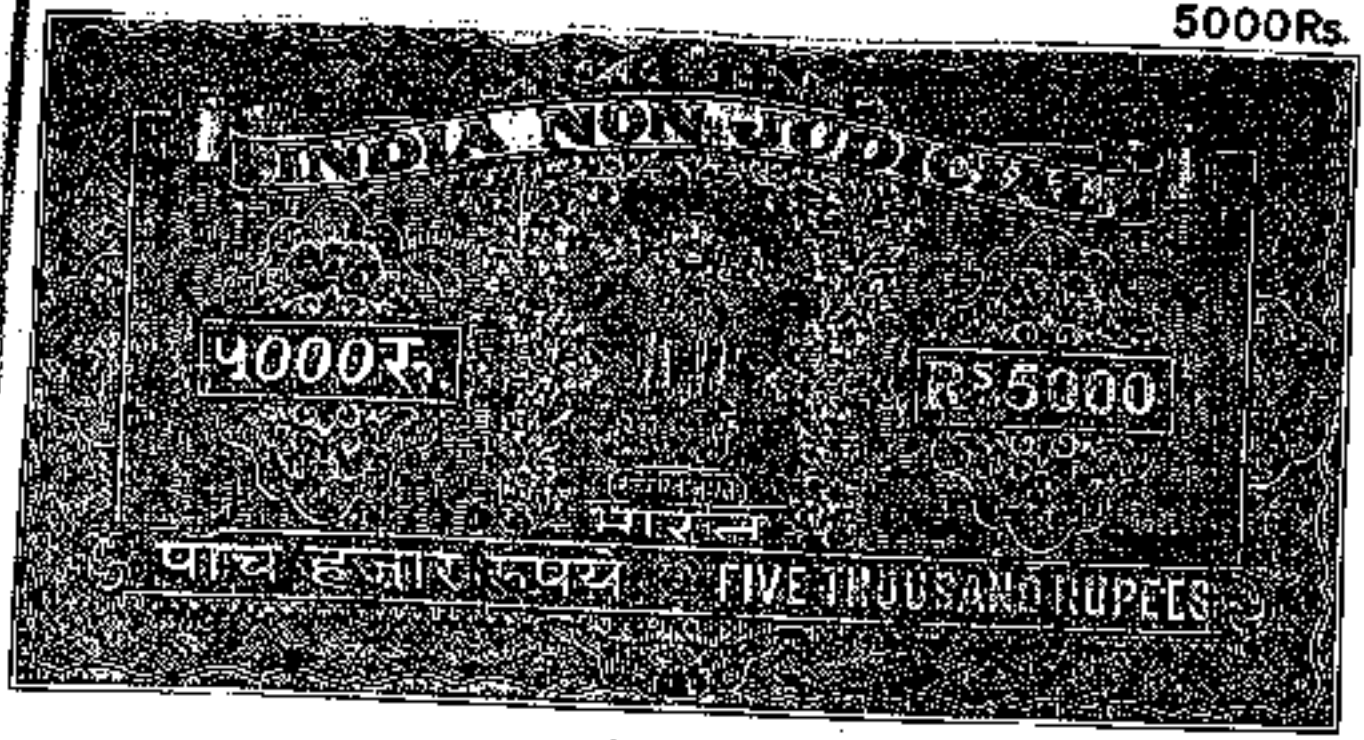
presents and the Schedule hereunder written reserved and contained and on the part of the lessee to be paid observed and performed, the State Government (with the approval of the Central Government) hereby grants and demises unto lessee.

Cont....

For INDIAN METALS & FERRO ALLOYS LTD.

CONSTITUTED ATTORNEY

5000Rs.



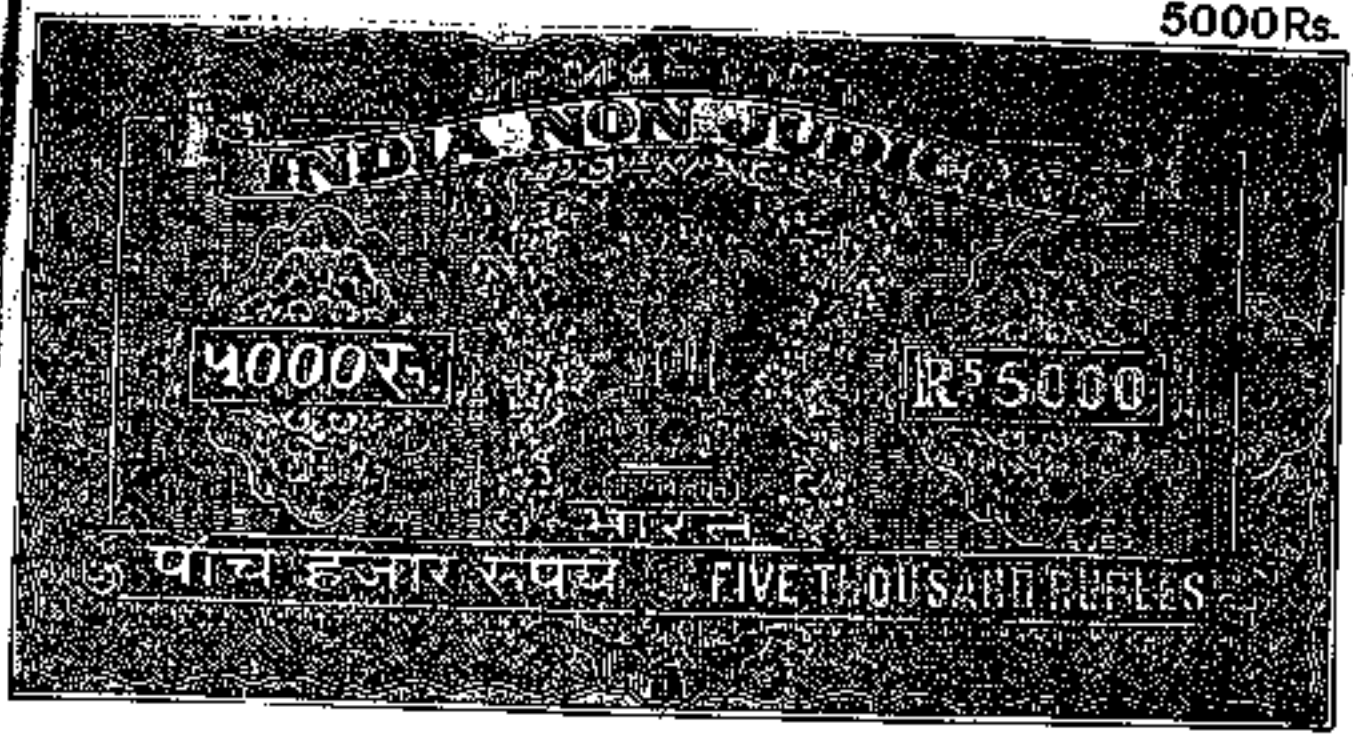
All those the mines beds/veins seams of chromite (here state the mineral or minerals) (hereinafter and in the Schedule referred to as the said minerals) situated lying and being in or under the lands which are referred to in Part I of the

Cont...

For INDIAN METALS & FERRO ALLOYS LTD.

CONSTITUTED ATTORNEY

5000Rs.



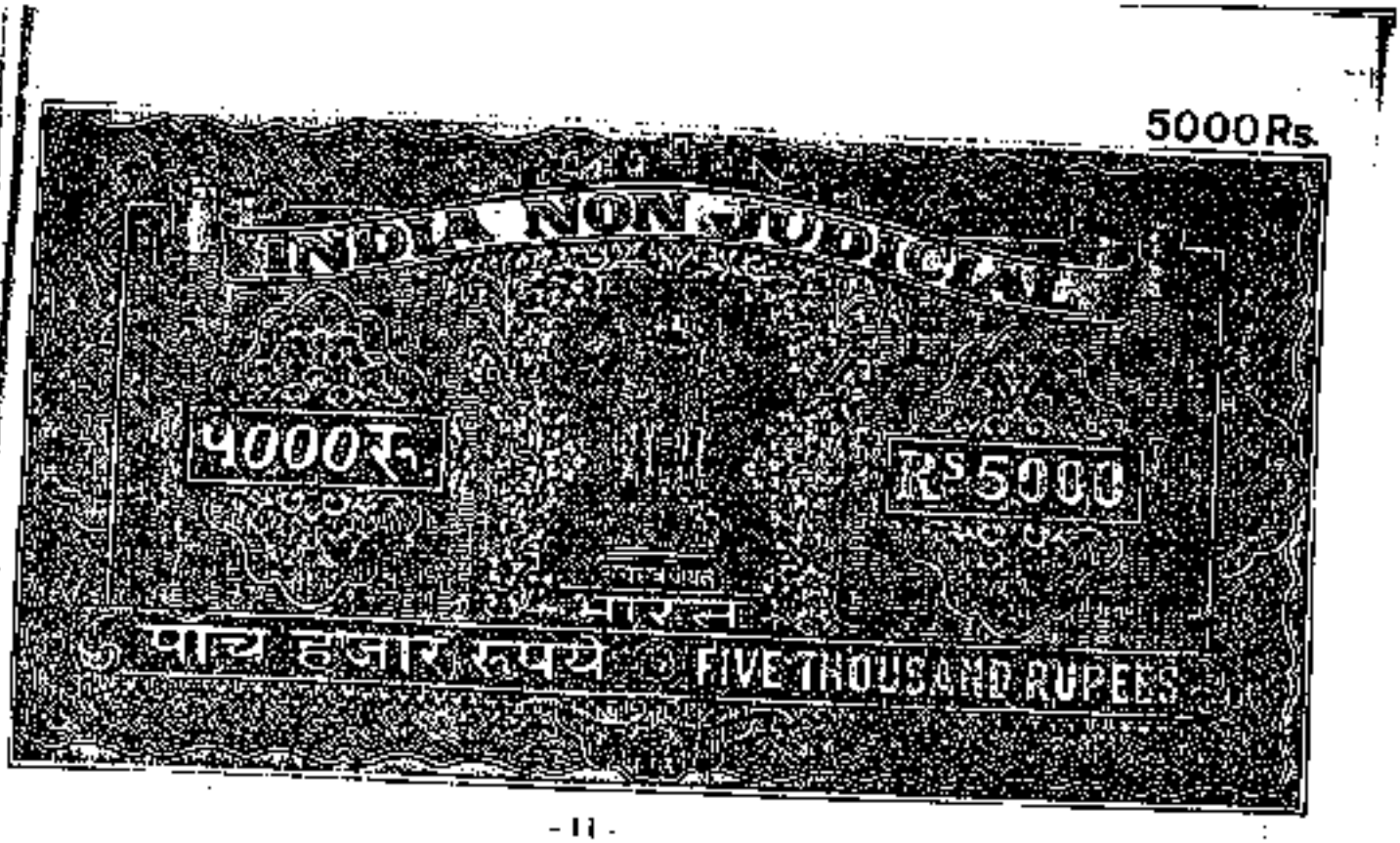
said Schedule, together with the liberties, powers and privileges to be exercised or enjoyed in connection herewith which are mentioned in Part II of the said Schedule subject to the restrictions and conditions as to the exercise and enjoyment of such liberties, powers and privileges which are

Cont....

For INDIAN METALS & FERRO ALLOYS Ltd.

CONSTITUTED ATTORNEY

COLLECTOR, JAIPUR



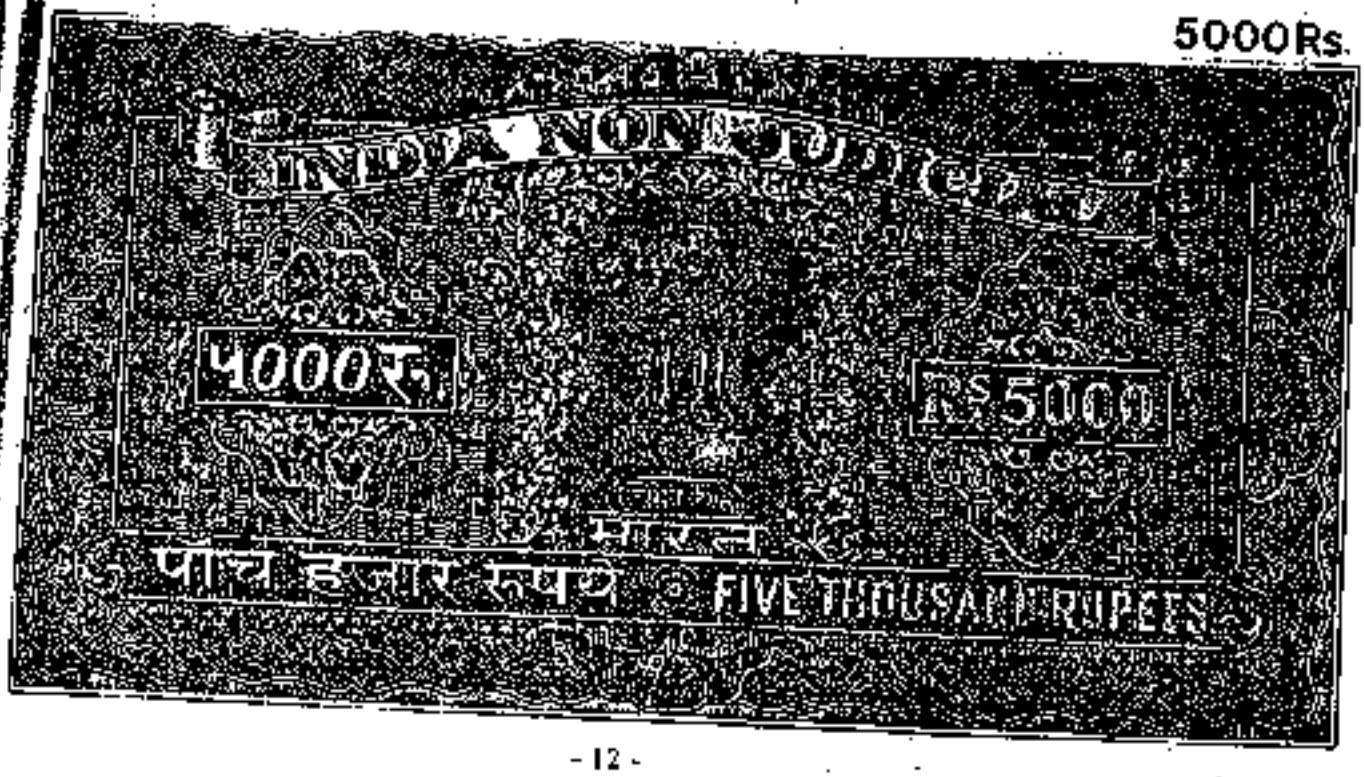
mentioned in Part III of the said Schedule EXCEPT and reserving out of this demise unto the State Government the liberties, powers and privileges mentioned in Part IV of the said Schedule TO HOLD the premises hereby granted and demised unto the lessee from the 4th day of

Cont...

FOR INDIAN METALS & FERRO ALLOYS Ltd.,

CONSTITUTED ATTORNEY.

5000Rs.



Sept 1999 for the term of 30 (thirty) years thence next ensuing YIELDING AND PAYING therefore unto the State Government the several rents and royalties mentioned in Part V of the said Schedule at the respective times therein specified subject to the provisions

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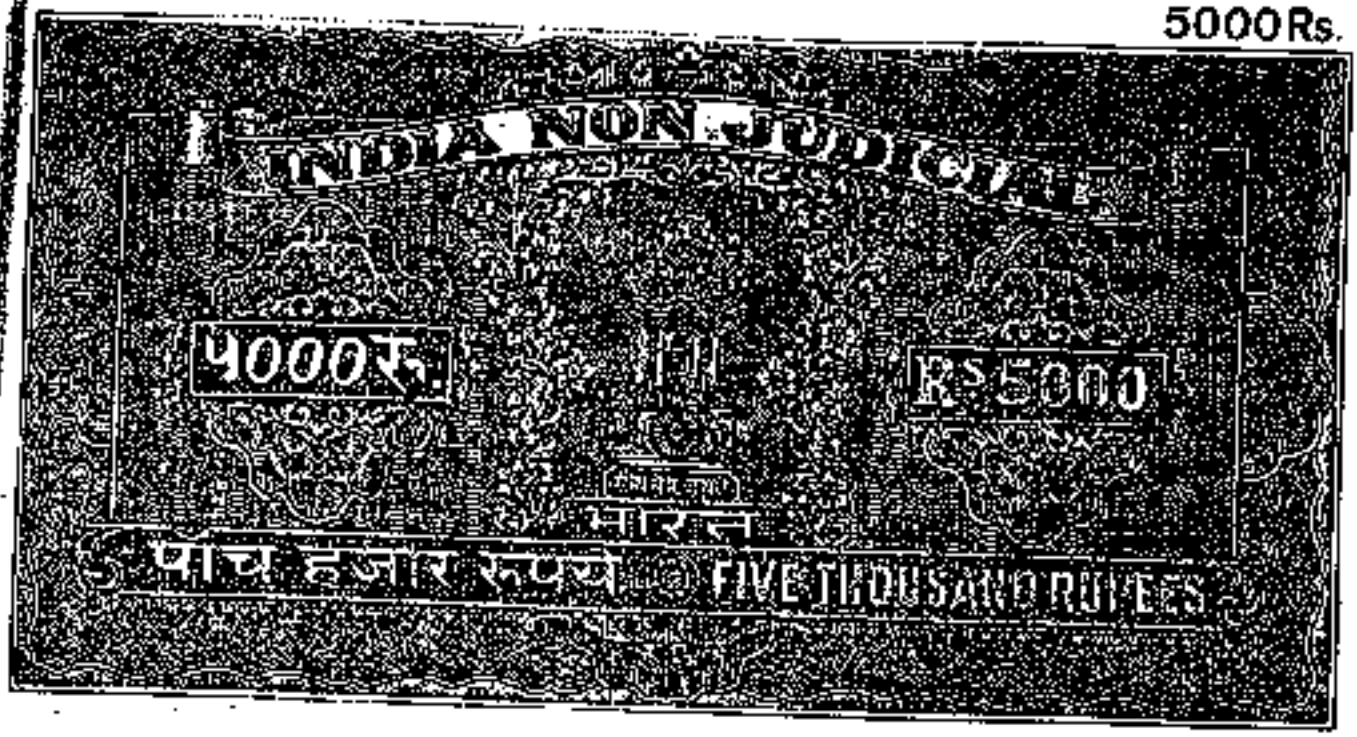
For INDIAN METALS & FERRO ALLOYS LTD.

CONSTITUED ATTORNEY

5000 Rs.



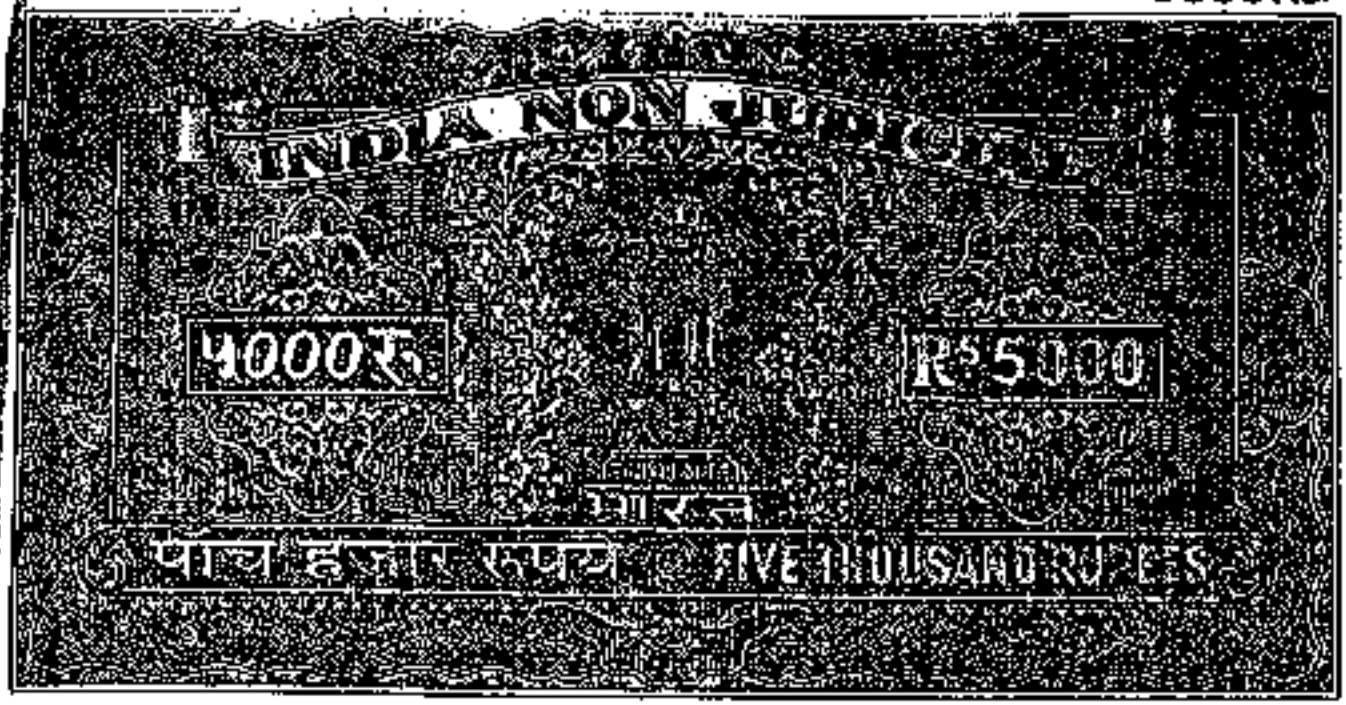
contained in Part VI of the said Schedule and the lessee hereby covenant with the State Government as in Part VII of the said Schedule is expressed and the State Government hereby convenants with the lessee as in Part VIII of the said Schedule as expressed AND it is hereby mutually

Cont....

For INDIAN METALS & FERRO ALLOYS LTD.

CONSTITUED ATTORNEY

5000Rs.



agreed between the parties hereto as in Part IX of the said Schedule is expressed.

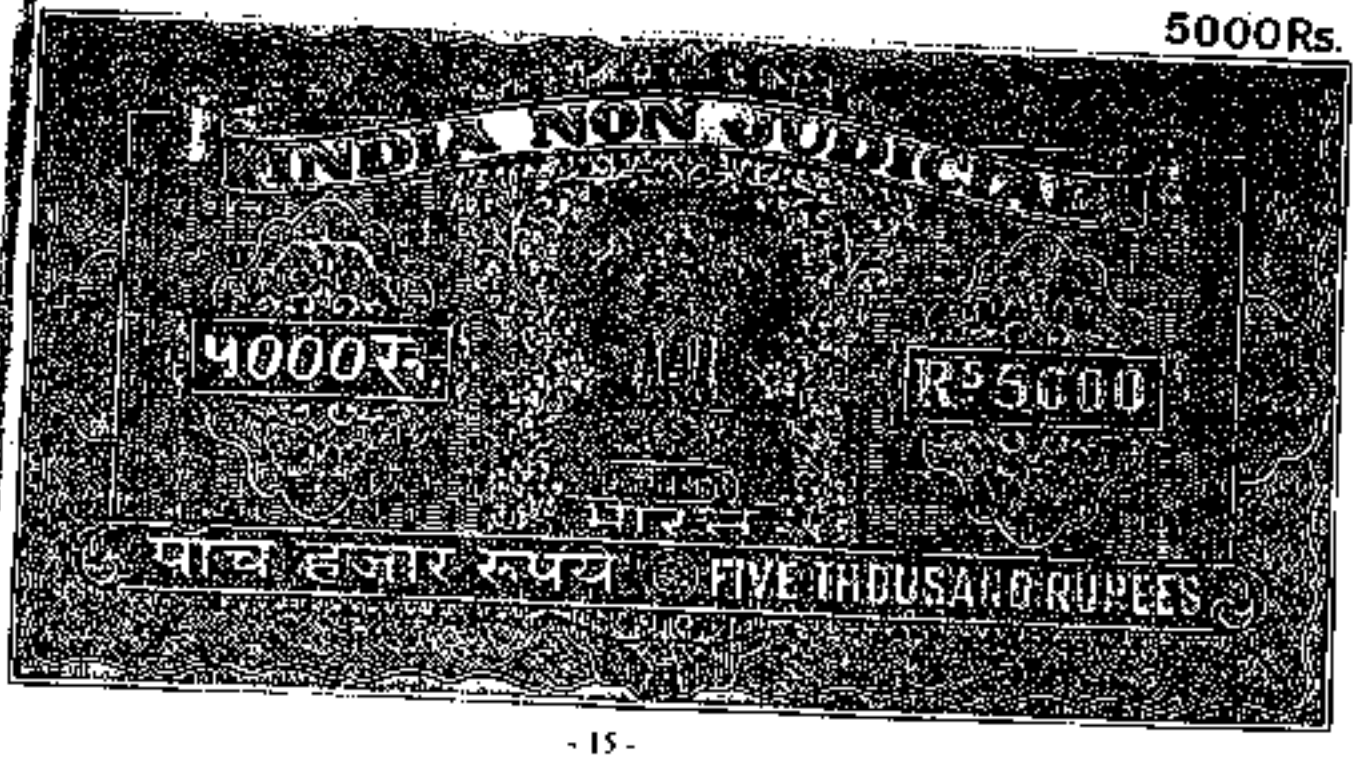
IN WITNESS WHEREOF these presents have been executed in manner hereunder appearing the day and

Cont....

FOR INDIAN MET LIFE & FEA O...BOYS LTD.

CONSTITUTED ATTORNEY

5000Rs.



year first above written.

The Schedule above referred to -

PART 1

THE AREA OF THIS LEASE

Location and area of the Lease

All that tract of lands situated at village - Kaliapani (Description of area or areas) 288.52

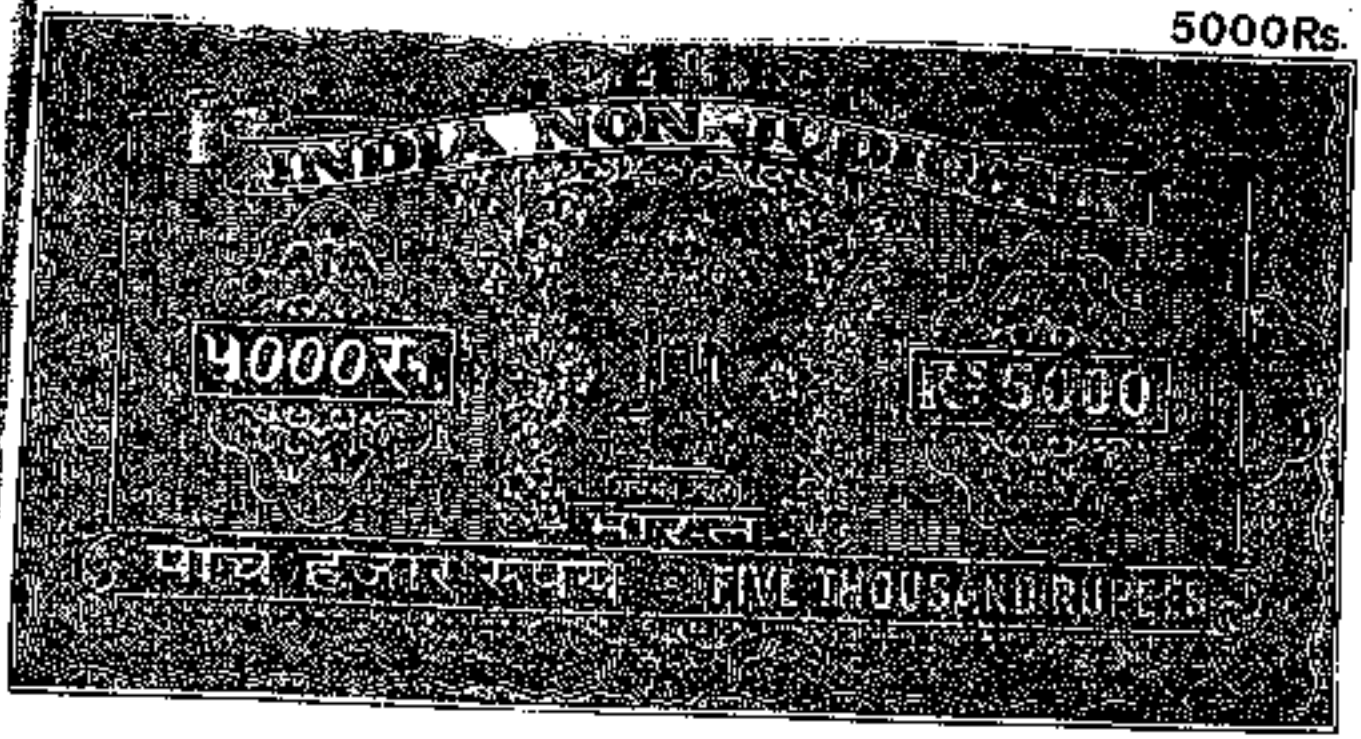
Cont....

For INDIAN METALS & FERRO ALLOYS LTD.

CONSTITUTED ATTORNEY

COLLECTOR, ANGUL

5000Rs.



Acres or 116.760 Hectares in (Pargana) in Sukinda the Registration District of Jajpur Sub-District ~~Jajpur~~ and Thana Sukinda bearing Cadestral survey Nos 73 G/16 containing an area of 116.760 Hects or thereabouts delineated on the plan hereto

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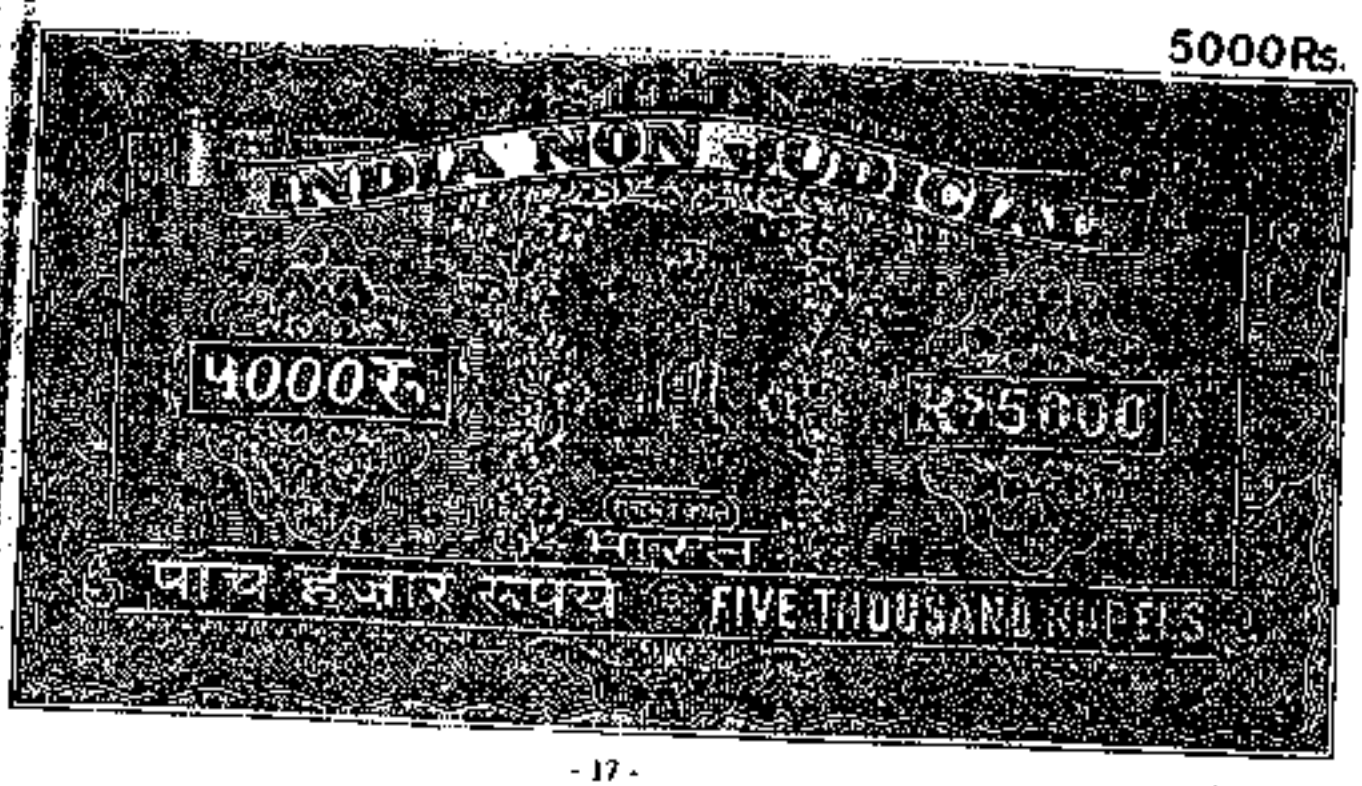
FOR INDIAN [illegible]

CONSTITUTED ATTORNEY



annexed and thereon coloured blue and bounded as follows:-

BOUNDARY DESCRIPTION

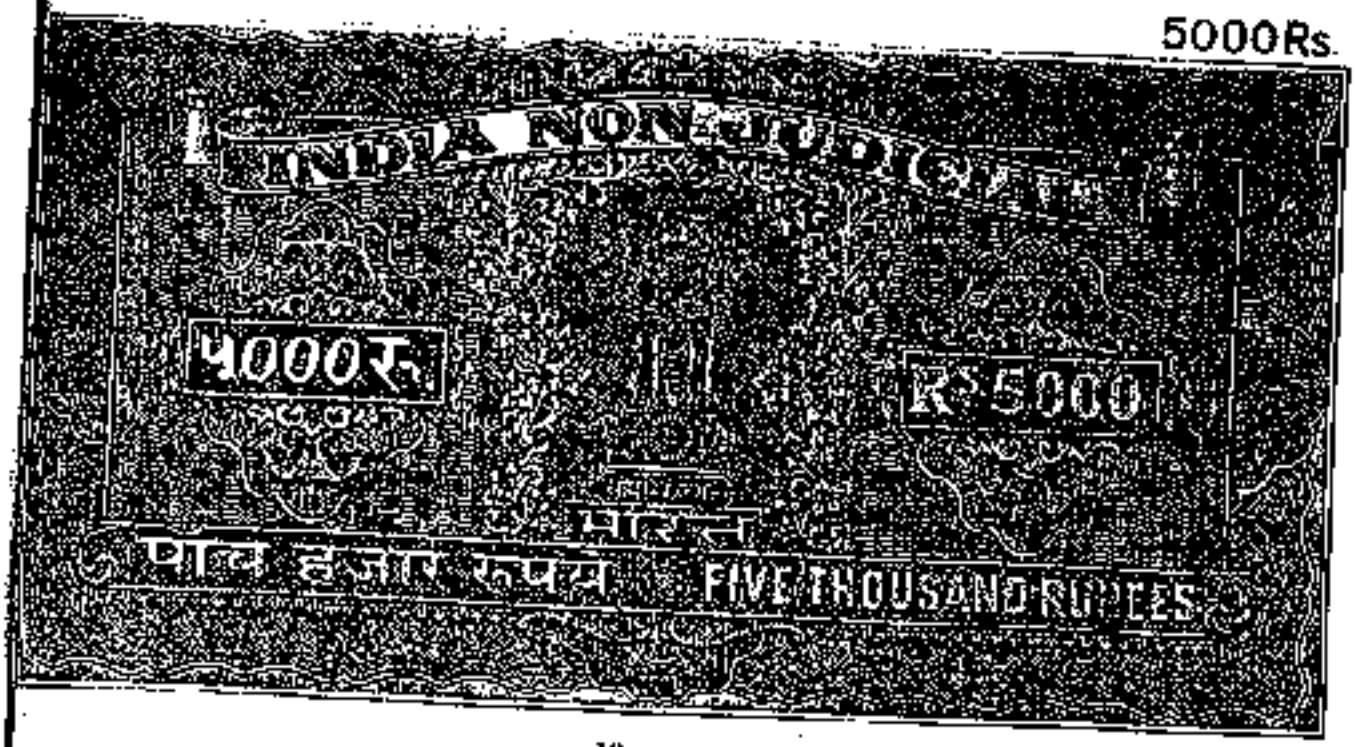
STARTING POINT : The starting point 'A' of the area is situated at a distance of 750 feet or 228.60 mtrs from Pillar 'N' of

Cont....

For INDIAN METALS & FERRO ALLOYS LTD.

CONSTITUED ATTORNEY

5000Rs.



TISCO's 406 Hects with a magnetic bearing of 59°.20' 00".

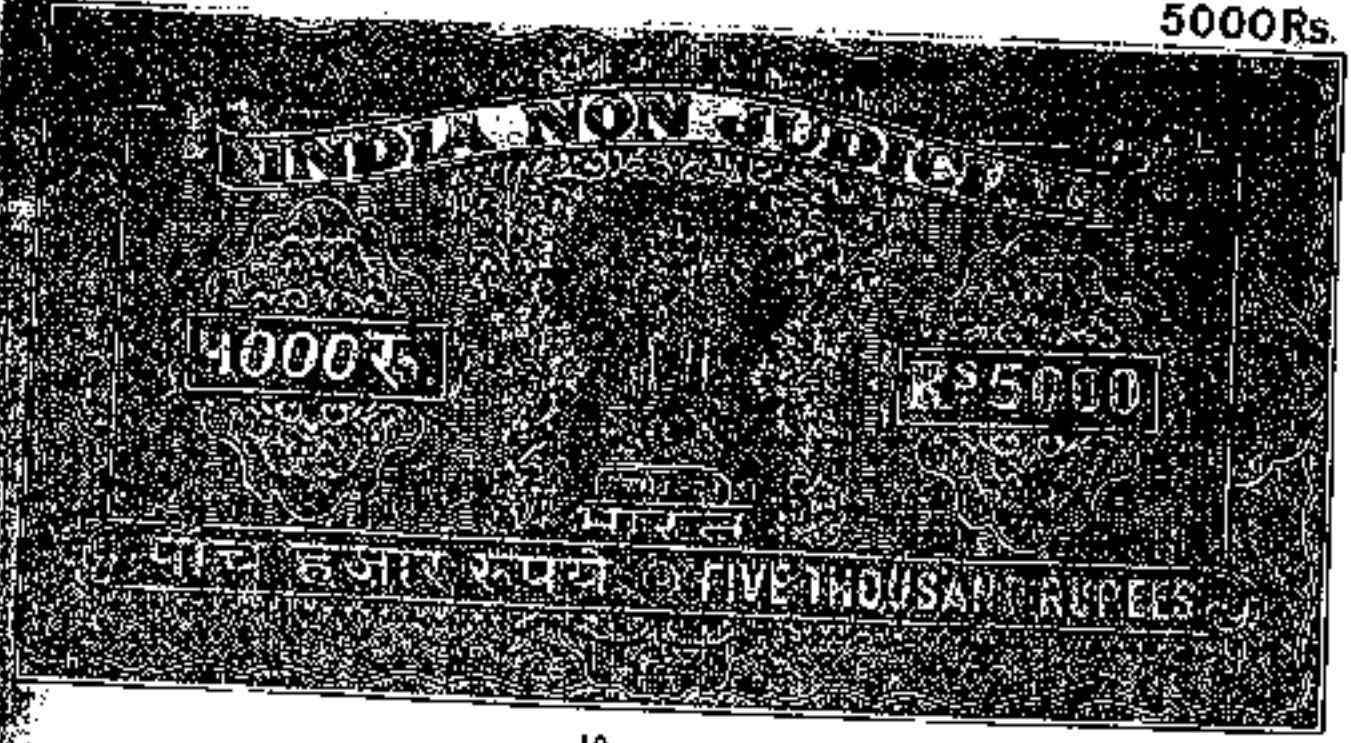
WESTERN BOUNDARY : The Line starts from Station A and runs upto Station D through intermediate stations A1, B,B1,B2,C,C1,C2 and C3 making interier angles of °,180°, 91°,180°,180°,269°,180°, 180° & 180° respectively and runs for a distance of -

Cont....

For INDIAN [illegible] ALLOYS LTD.

CONSTITUTED ATTORNEY

5000Rs.



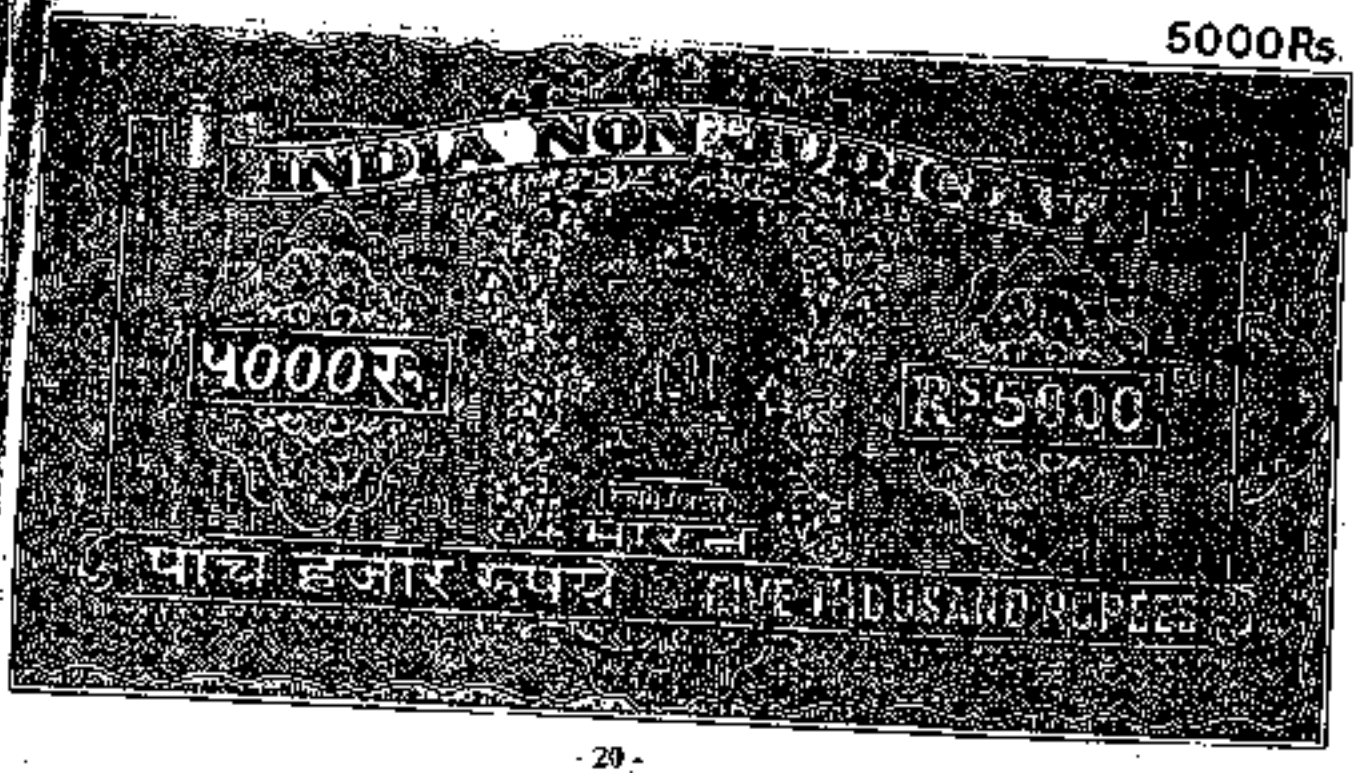
Station	Meter		Feet
A - A1 =	304.80	or	1000
A1 - B =	139.149	or	456.528
B - B1 =	304.80	or	1000
B1 - B2 =	304.80	or	1000
B2 - C =	192.024	or	630
C - C1 =	289.56	or	950
C1 - C2 =	304.80	or	1000
C2 - C3 =	152.40	or	500
C3 - D =	179.83	or	590

Cont....

For INDIAN METALS & FERRO ALLOYS LTD.

CONSTITUED ATTORNEY

5000Rs.



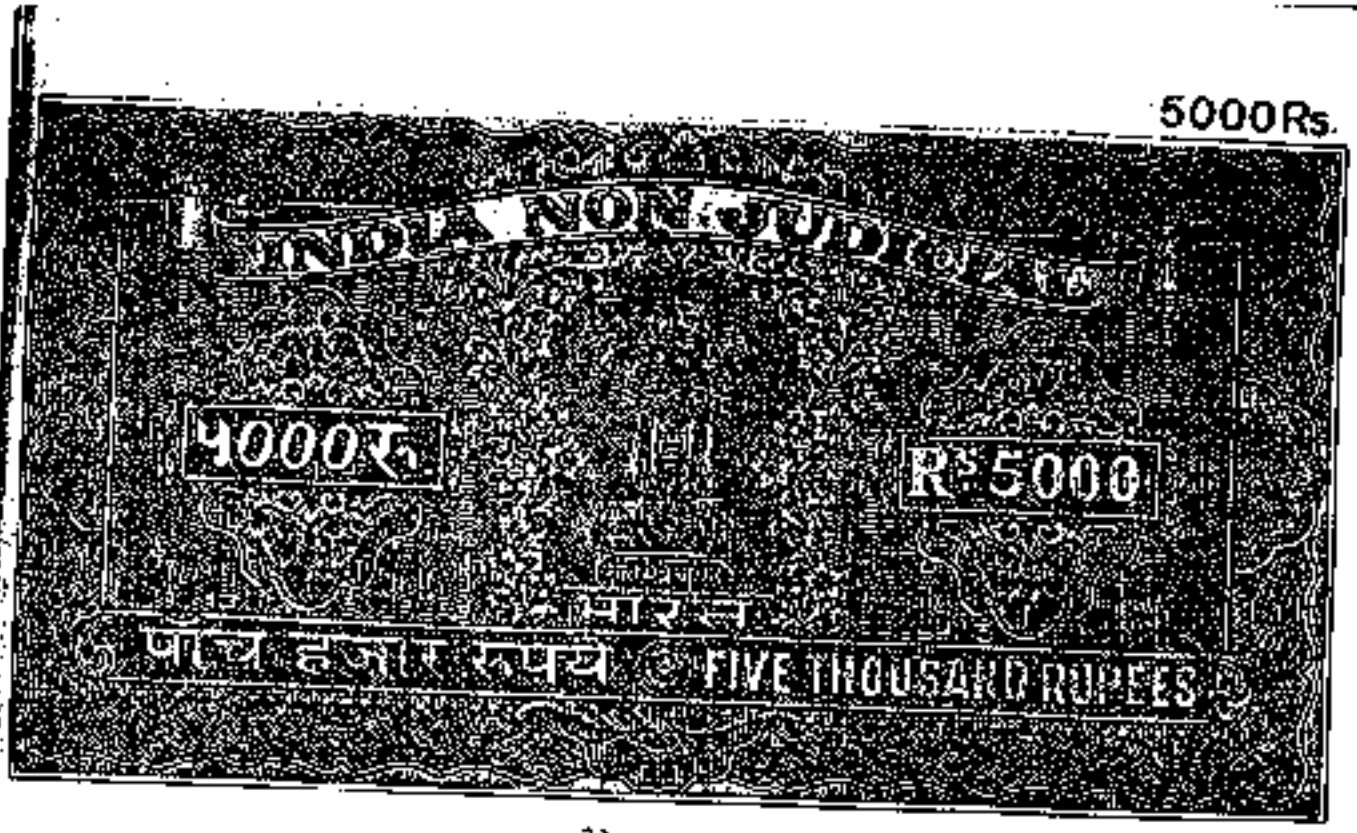
The Line AB runs with a forward bearing of 149° 20' 00". The line AB, BC & CD are common with M/s. Ispat Alloys Ltd.

SOUTHERN BOUNDARY : The Line starts from Station D and runs upto Station G through station E & F making interior

Cont....

for INDIAN MET LS & FER O ALLOYS LTD.

CONSTITUTED ATTORNEY



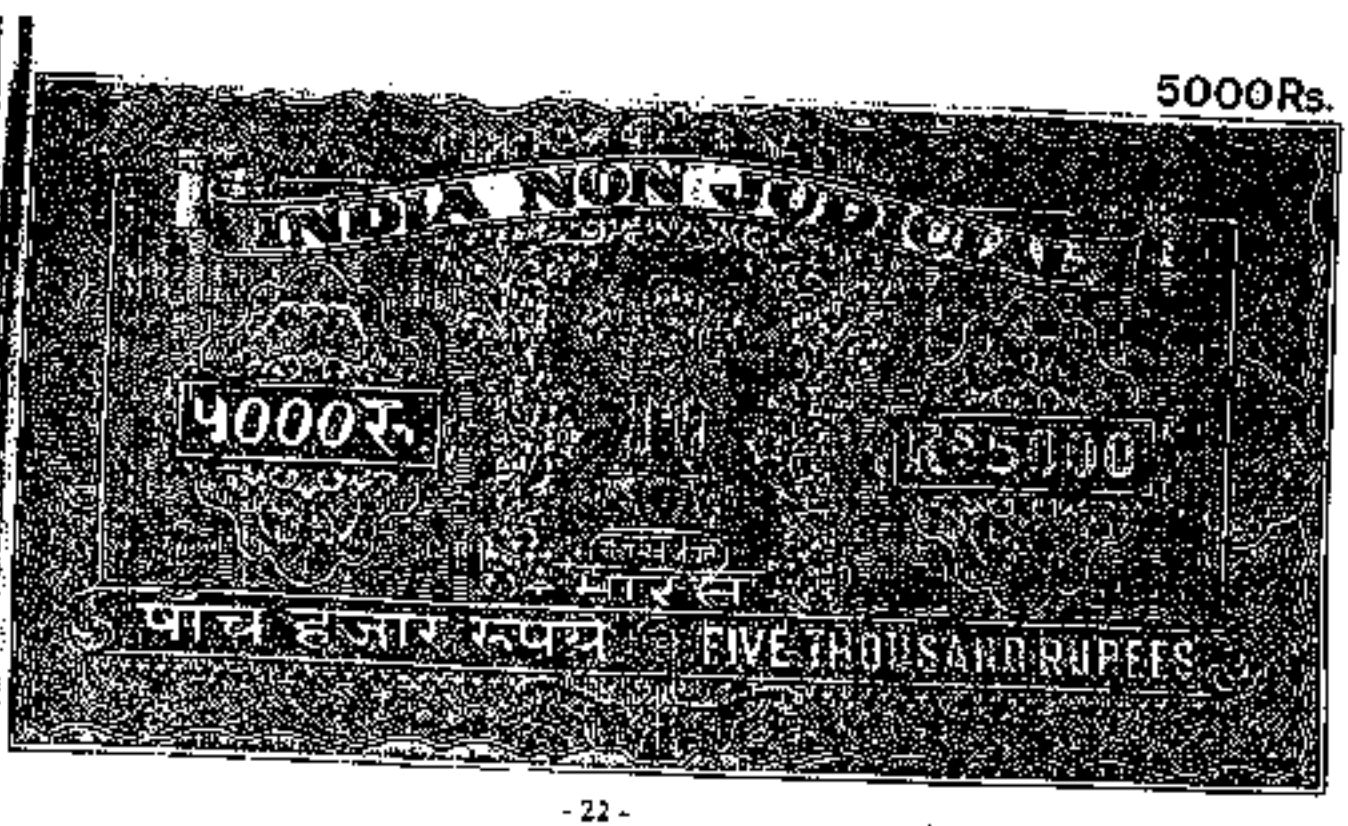
angle of 80° 30' 00", 200° 30' 00" & 145° 00' 00" respectively at stations D,E & F and runs for a distance of :-

Station	Meter		Feet
D - E =	284.99	or	935
E - F =	269.75	or	885
F - G =	56.39	or	185

Cont...

FOR INDIAN METALS & FERRO ALLOYS LTD.

CONSTITUTED ATTORNEY



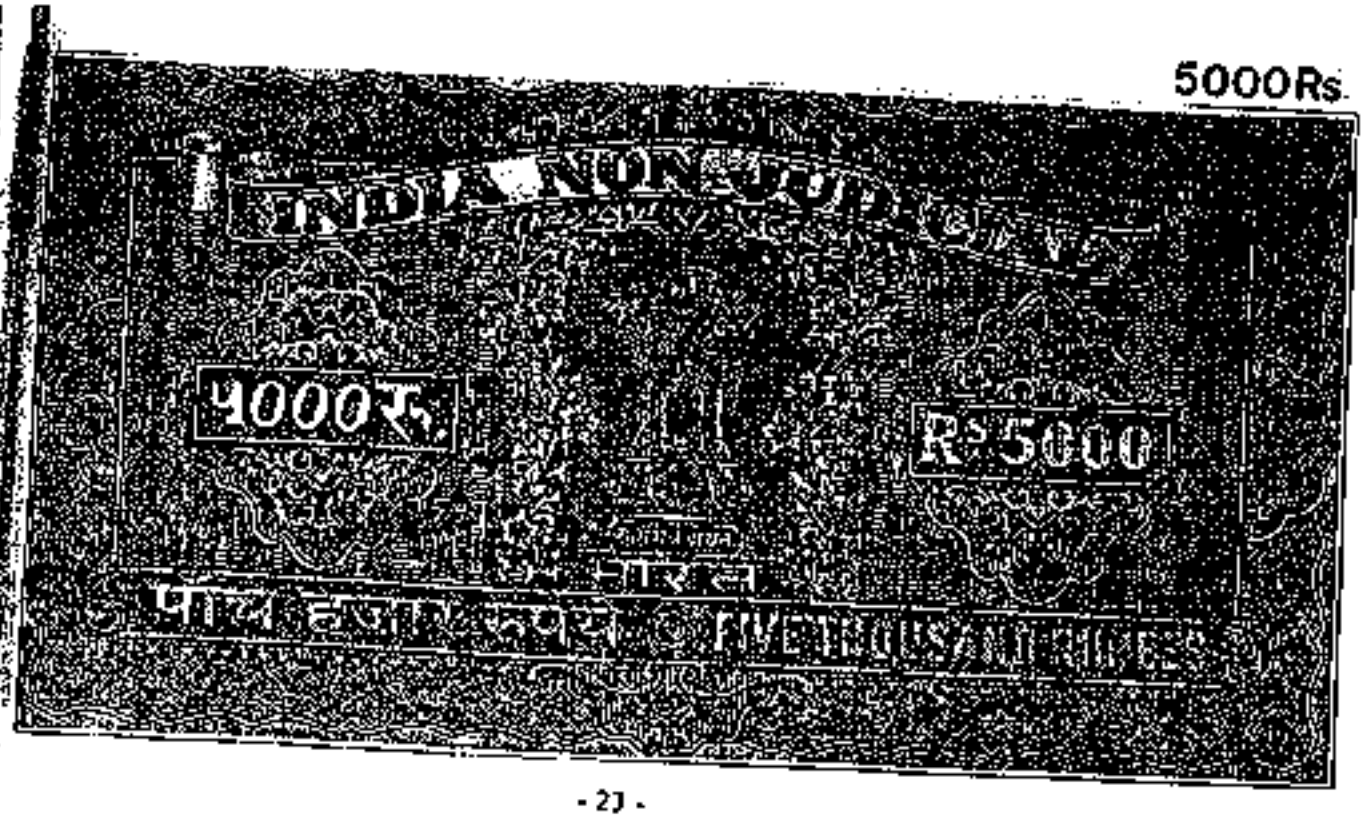
The Line DE, EF & FG are common with M/s. Indian Charge Chrome Ltd. (ICCL).

EASTERN BOUNDARY : The Line starts from Station G and runs upto Station H through stations G1,G2,G3 & G4 making

Cont..

For INDIAN METALS & FERRO ALLOYS Ltd.

CONSTITUED ATTORNEY



an interior angle of 114° at station G and 180° at all other stations and runs for a distance of -

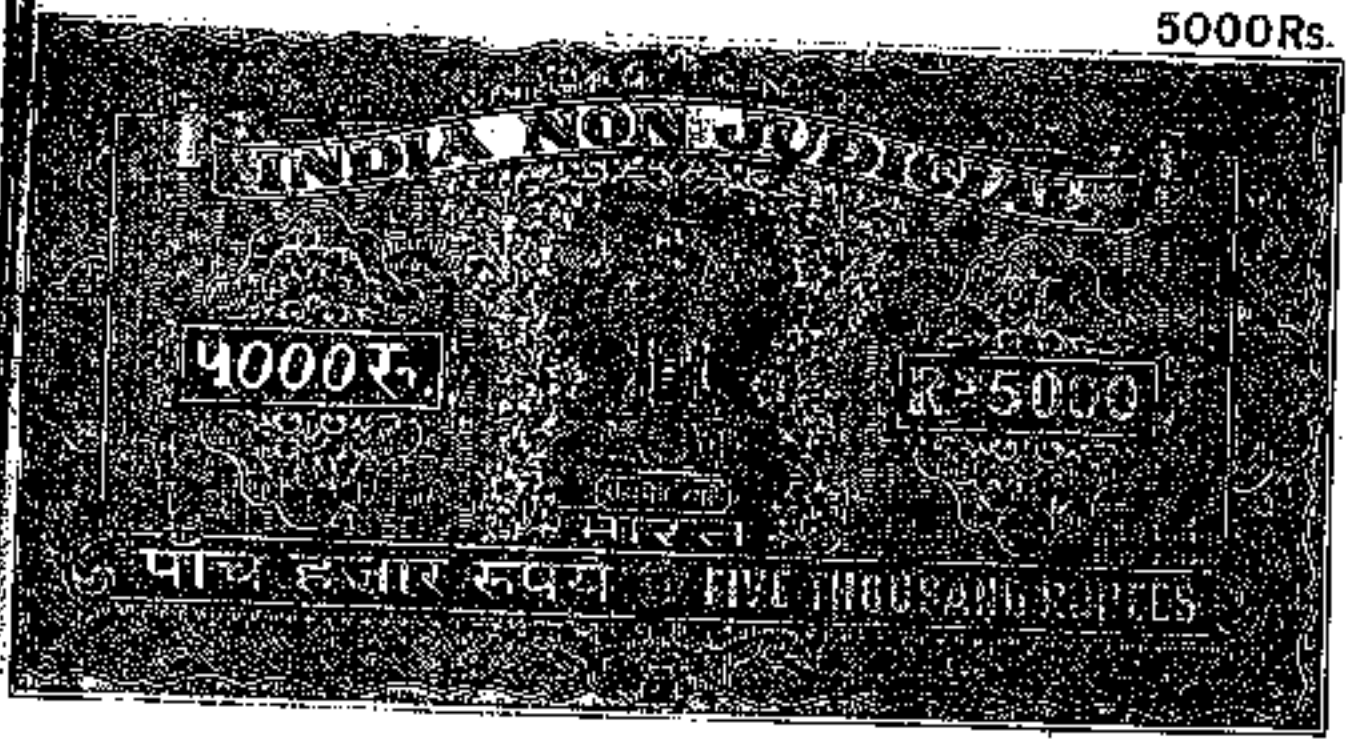
Station	Meter		Feet
G - G1=	304.80	or	1000
G1 - G2=	304.80	or	1000
G2 - G3=	304.80	or	1000
G3 - G4=	304.80	or	1000
G4 - H=	149.35	or	490

Cont....

For INDIAN METALS & FERRO ALLOYS LTD.

CONSTITUTED ATTORNEY

DIRECTOR/AUTHORISED SIGNATORY



NORTHERN BOUNDARY : The line starts from Station H and runs up to Station A through stations H1, H2, H3 & H4 making an interior angle of 90° at Station H and 180° at all other stations runs for a distance of -

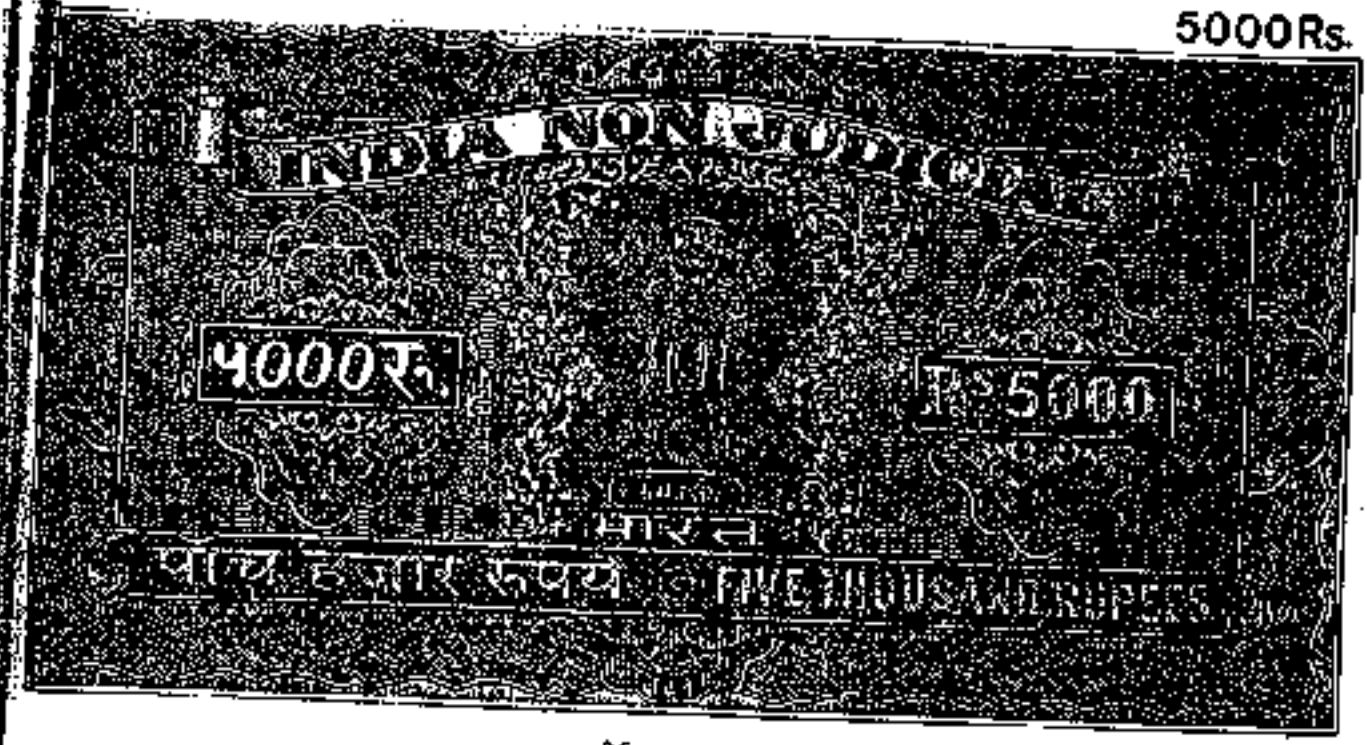
Station	Meter	Feet
H - H1=	304.80 or	1000
H1 - H2=	304.80 or	1000
H2 - H3=	304.80 or	1000
H3 - H4=	304.80 or	1000
H4 - A =	175.26 or	575

Cont....

For INDIAN METALS & FERRO ALLOYS LTD.

CONSTITUED ATTORNEY

5000Rs.



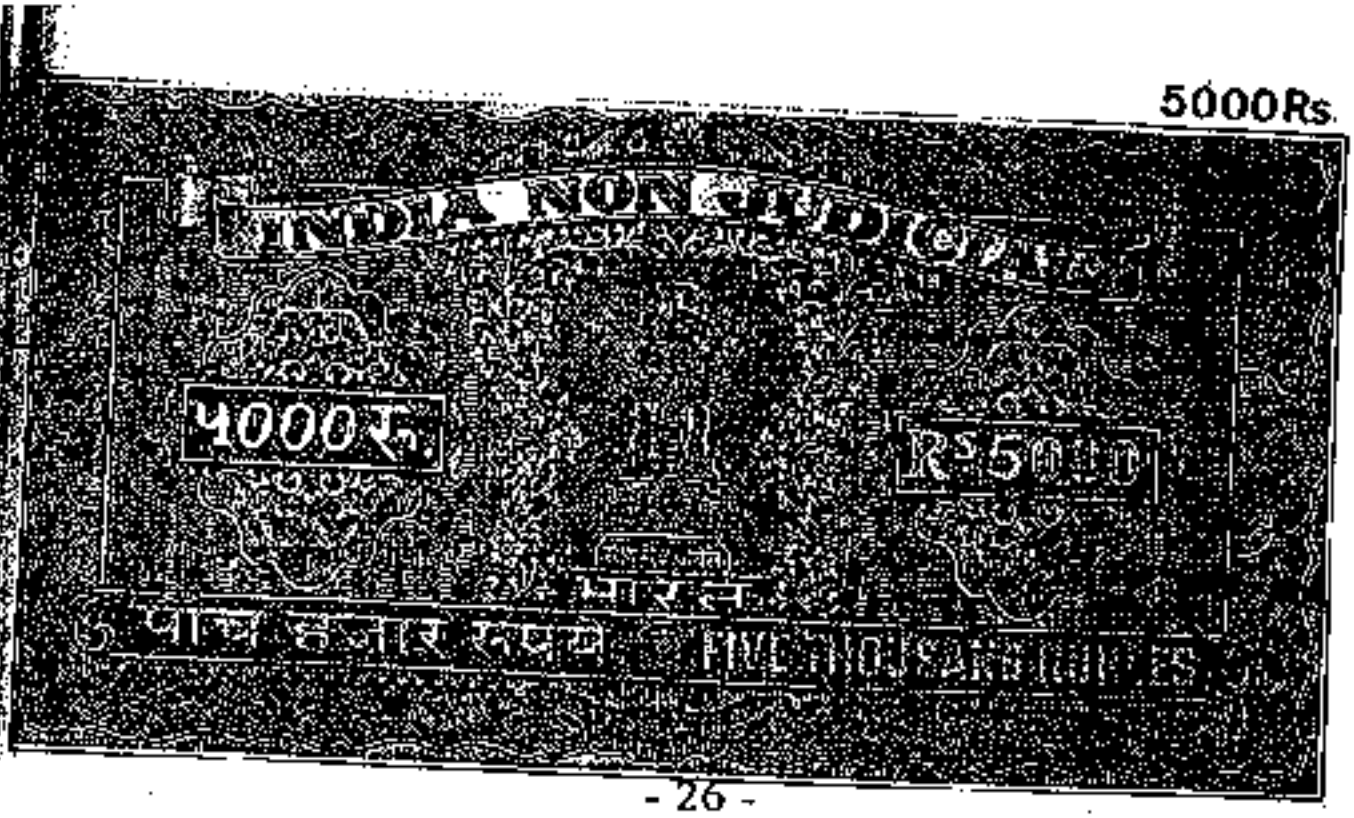
At last the traverse line forms an interior angle of 90° at Station A and thus the traverse is closed running in anti-clockwise direction covering an area of 116.760 Hects.

Cont....

INDIAN METALS & FERRO ALLOYS Ltd;

CONSTITUED ATTORNEY

5000Rs.



LAND SCHEDULE

Plot No.	Khata No	Name of Tenant	Kisam	Area in Acs.	Remarks
488(P)	57	Rokhita	Ghata Jojanjogya	0.55	
502	55	Abadjogya Anabadi	Patharbani	1.11	
627(P)	55	-do-	Patharbani	63.15	
628(P)	7	Kartik Chandra Mohanta & Others	Dali	0.22	
629	49	Sikhar Pate & Others	Sarada	0.66	
630(P)	58	Nimon & Paribahan Bibhag	Road	0.72	
641(P)	55	Abadjogya Anabadi	Patharbani	0.25	
691(P)	56	Sarbasadharan	Road	0.27	
888(P)	55	Abadjogya Anabadi	Patharbani	13.10	
889(P)	55	-do-	-do-	60.58	
892(P)	56	Sarbasadharan	Road	0.36	
894(P)	55	Abadjogya Anabadi	Patharbani	108.80	
895(P)	55	-do-	-do-	5.80	
627/1011(P)	56	Sarbasadharan	Road	0.90	
627/1011(P)	55	Abadjogya Anabadi	Patharbani	31.90	
883 (P)	56	Sarbasadharan	Road	0.15	

288.520 Acres
Or
116.760 Hectares

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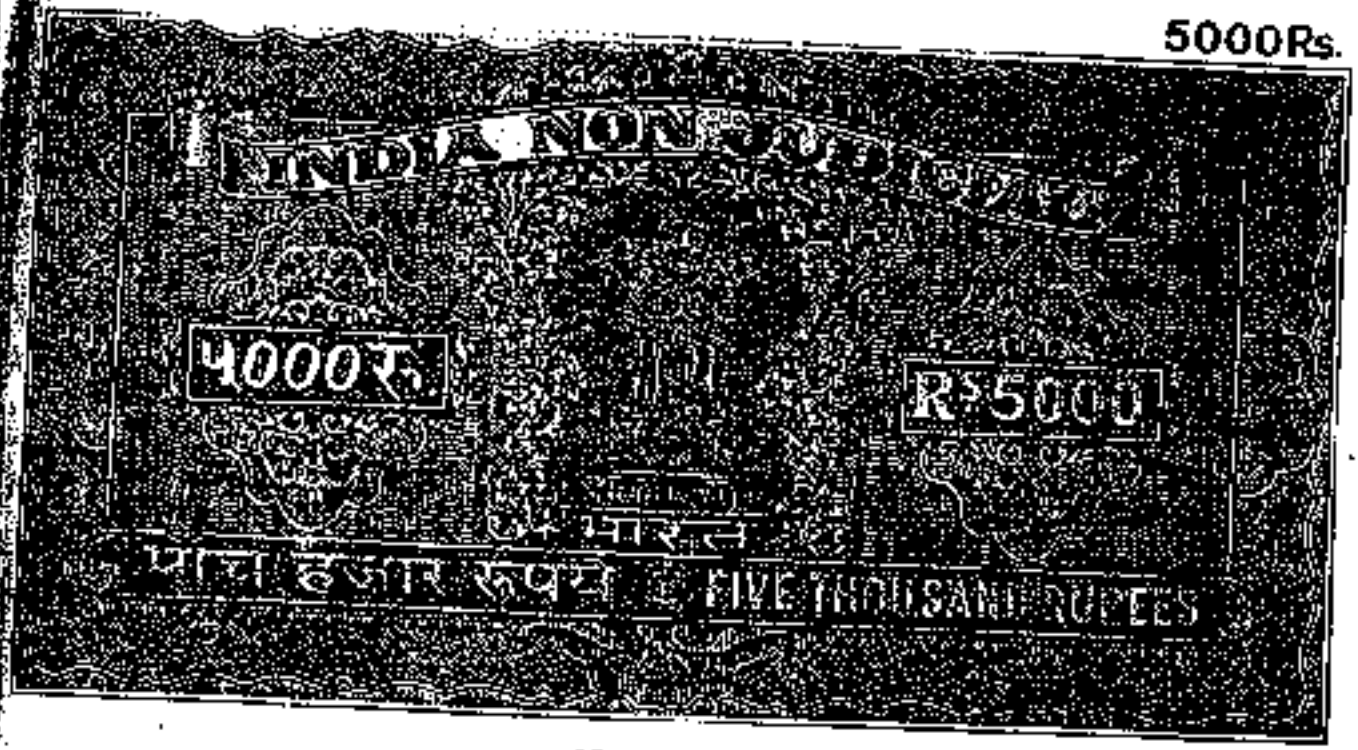

Hereinafter referred to as "the said lands"

PART II

LIBERTIES, POWERS AND PRIVILEGES TO BE EXERCISED AND ENJOYED BY THE LESSEE/LESSEES SUBJECT TO THE RESTRICTIONS AND CONDITIONS IN PART III.

To enter upon land and search for min, work, etc.

1. Liberty and power at all times during the term hereby demised to enter

Cont....

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upon the said lands and to search for mine, bore, dig, drill for, win, work, dress, process, convert, carry away and dispose of the said mineral/minerals.

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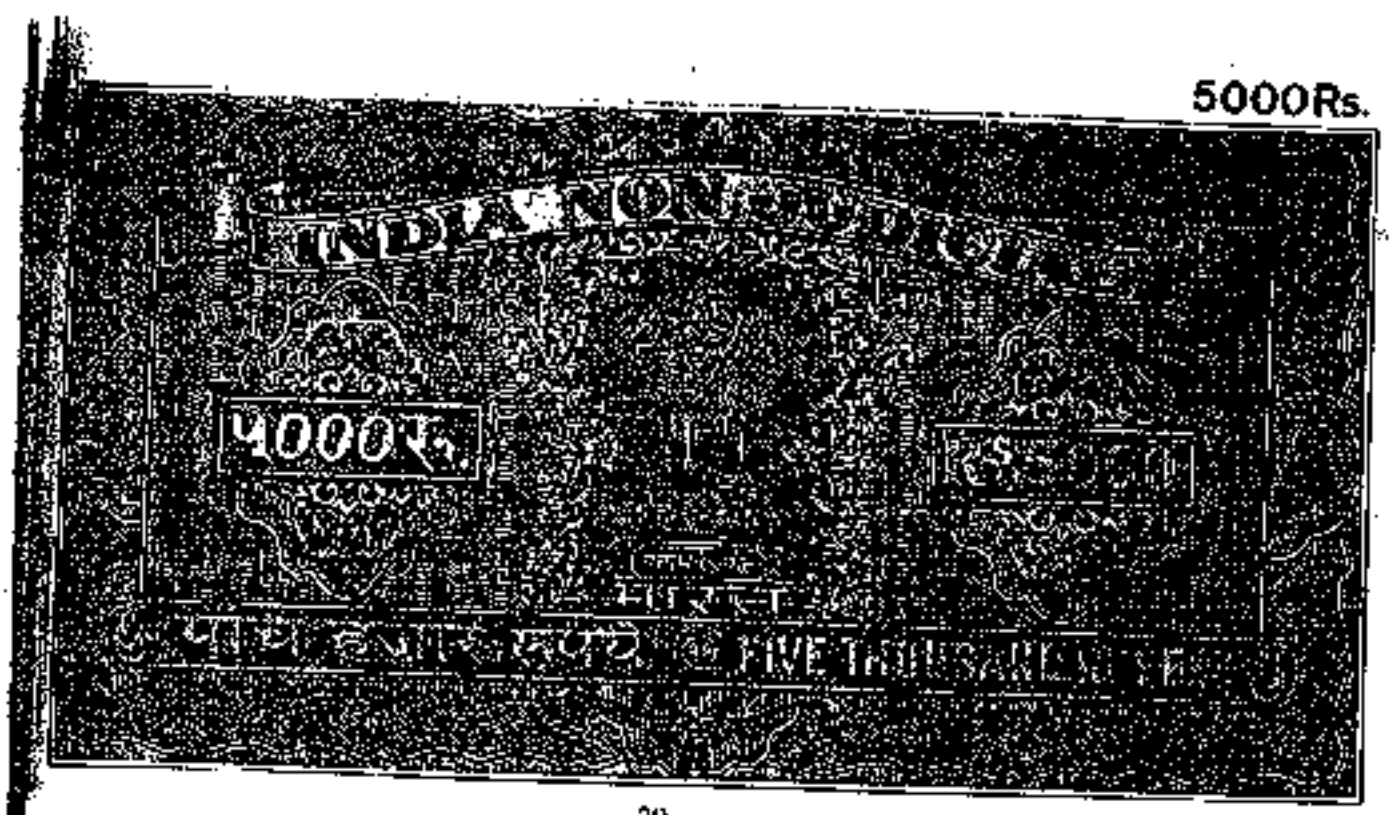

To sink, drive and make pits, shafts and inclines etc.

2. Liberty and power for or in connection with any of the purposes mentioned in this part to sink drive make maintain and use in lands and pits shafts inclines drifts levels waterways airways and other works (and to use maintain deepen

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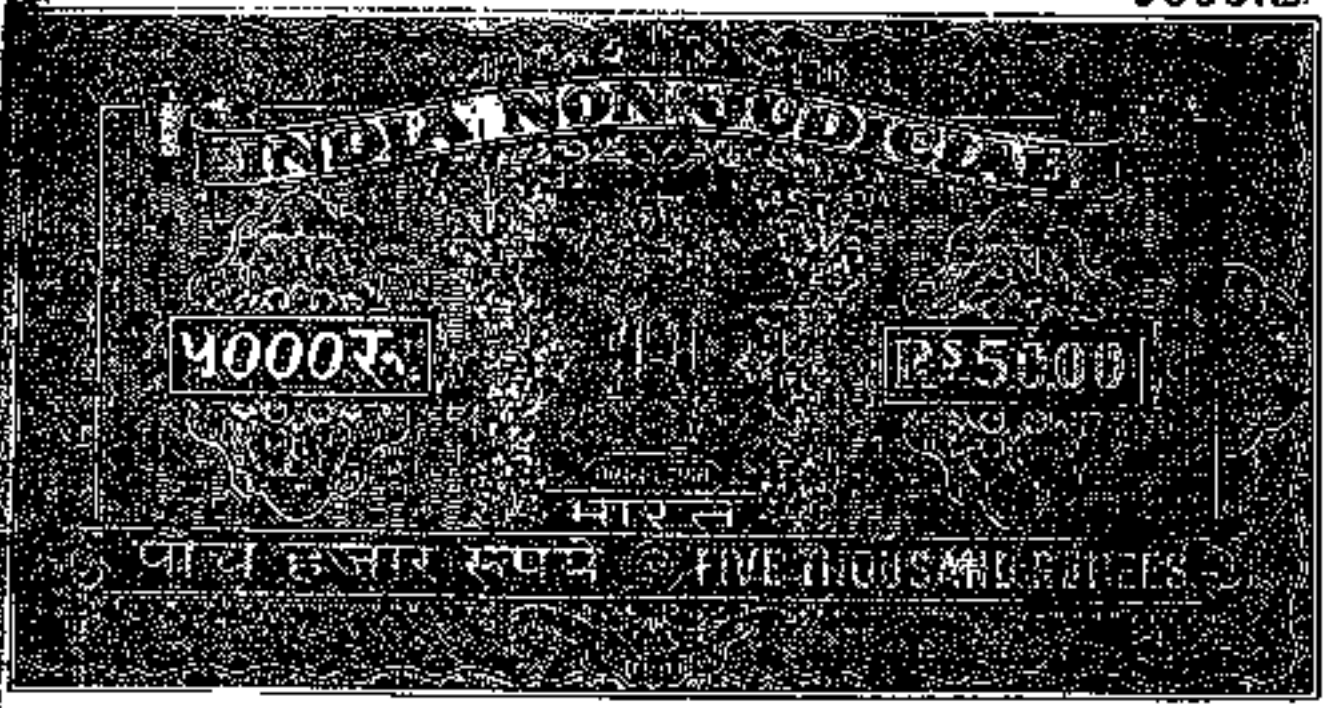

or extent any existing works of the like nature in the said lands).

To bring and use machinery, equipment etc.

3. Liberty and power for or in connection with any of the purposes mentioned in this part to erect, construct, maintain and use on or

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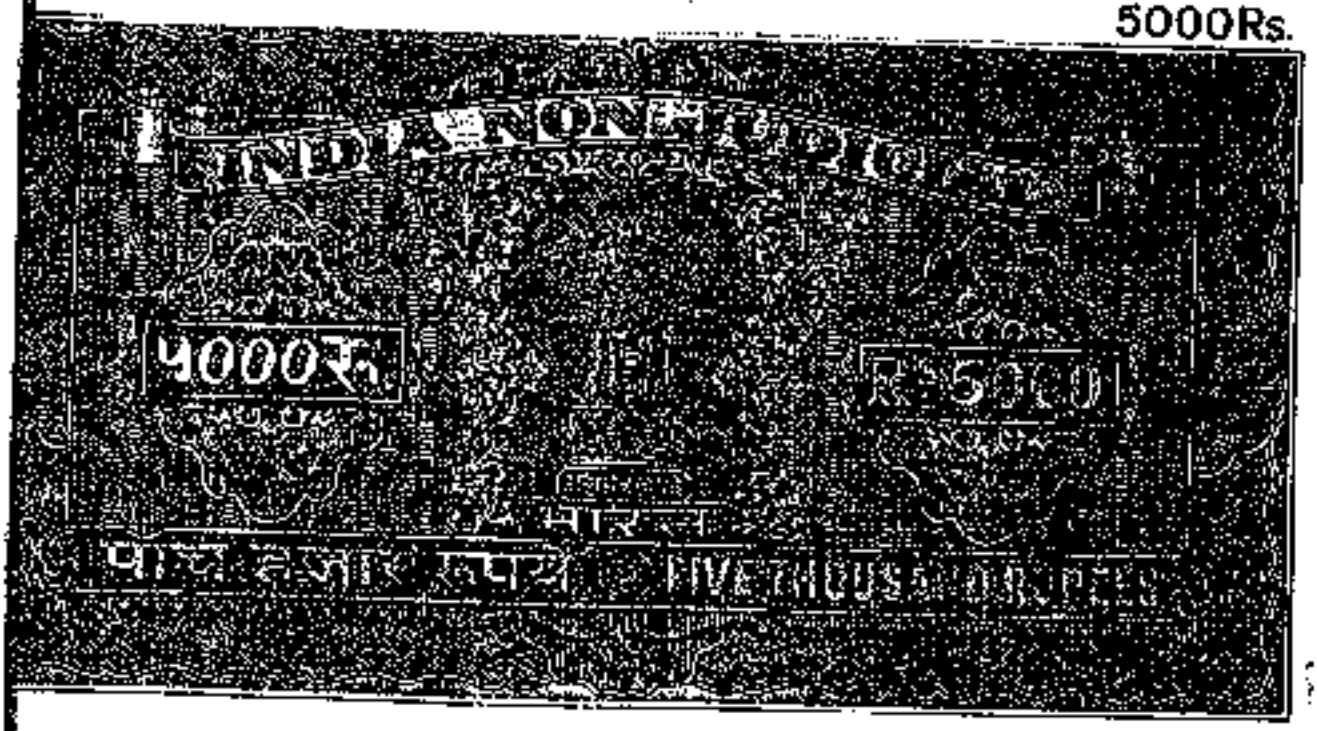

under the said lands any engines, machinery, plant, dressing floors, furnaces, coke ovens, brick-kilns, workshops, store-houses, bungalows, godowns, sheds and other buildings and other works and conveniences of

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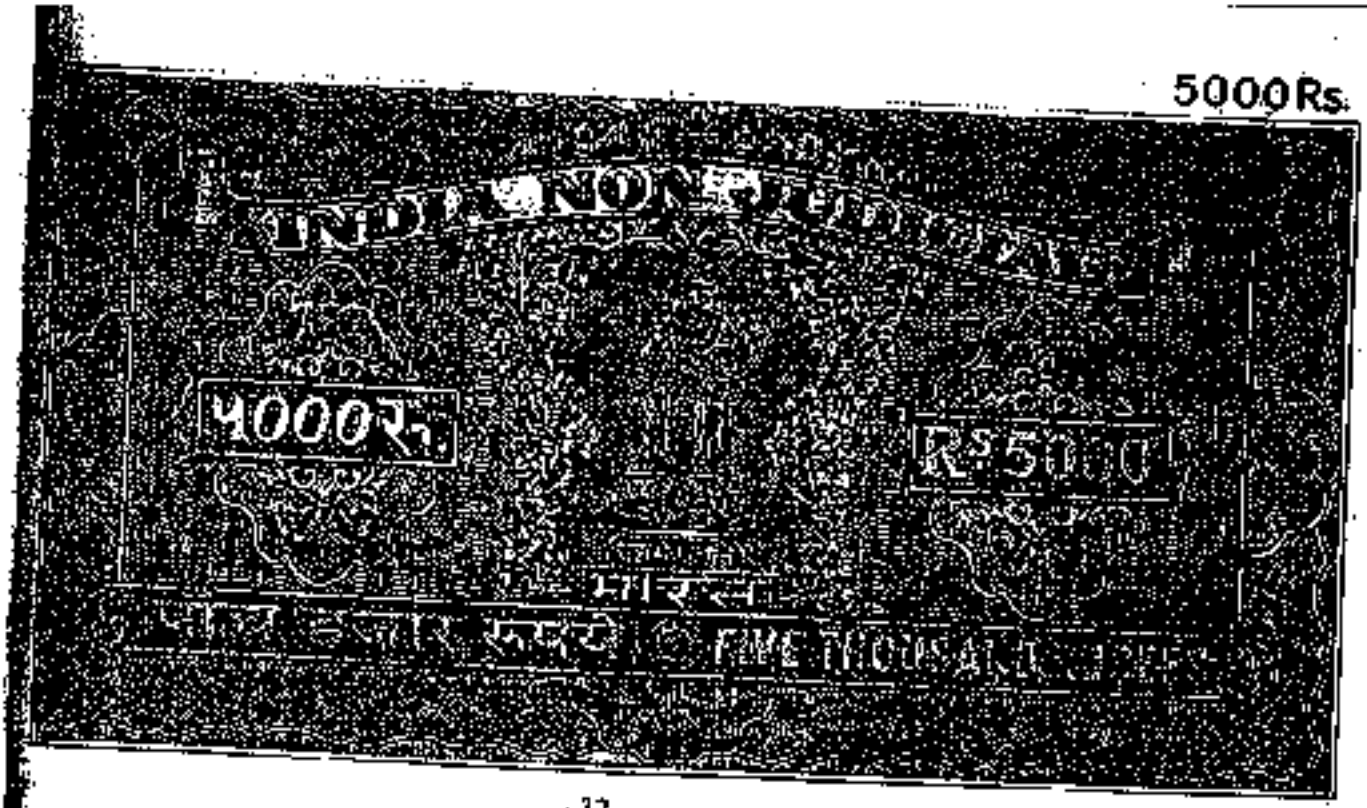

the like nature on or under the said lands.

To make roads and ways etc and use existing roads and ways.

4. Liberty and power for or in connection with any of the purposes mentioned in this part to make any tramways, railways, roads, aircraft

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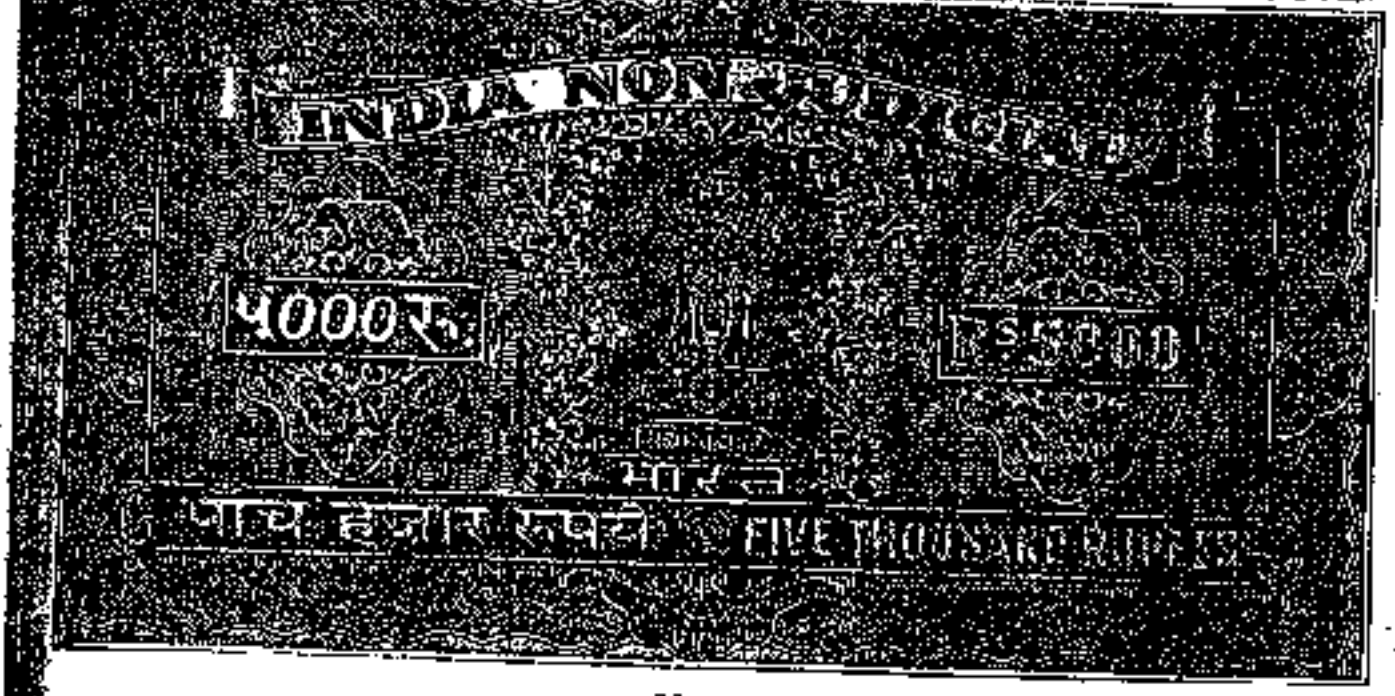

landing grounds and other ways in or over the said lands and to use maintain and go, and repass with or without horses, cattle, wagons, aircrafts, locomotives, or other vehicles over the same (or any existing tramways roads and other

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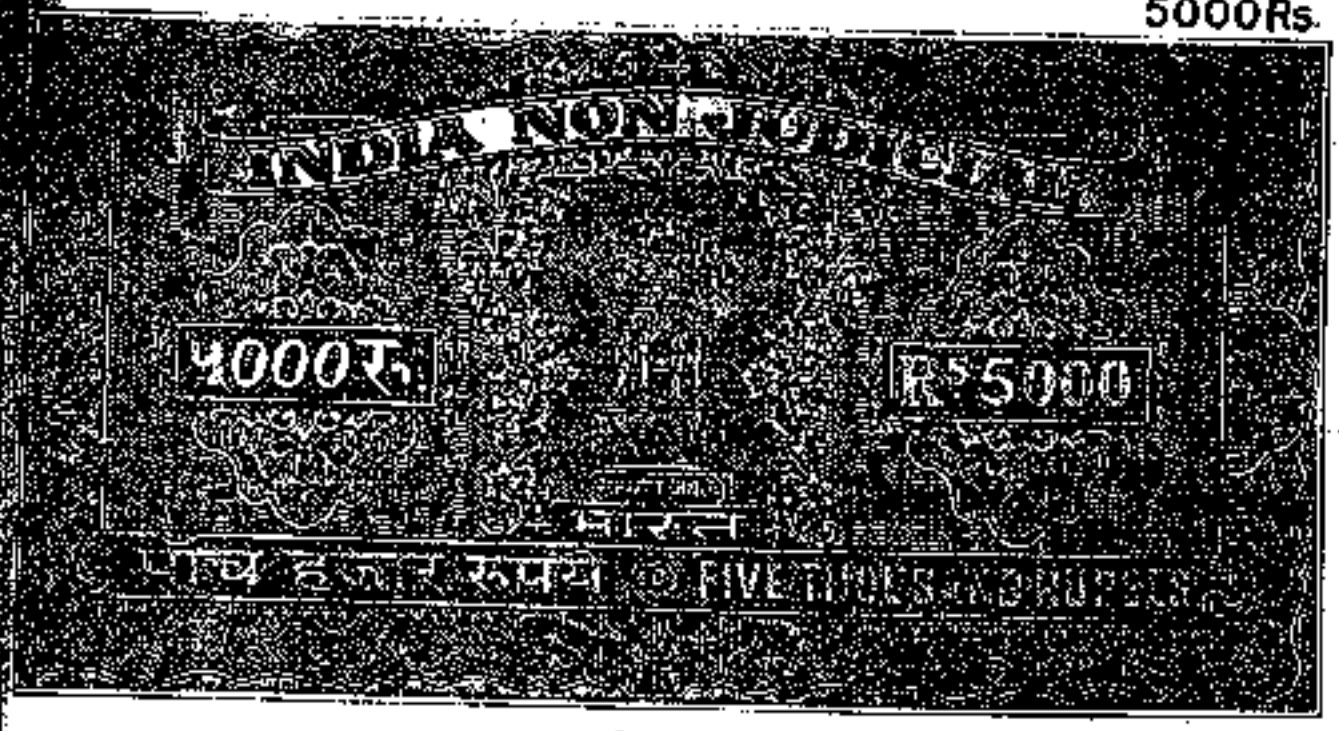

ways in or over the said lands) on such conditions as may be agreed to.

To get building and road materials, etc.

5 Liberty and power for or in connection with any of the purposes mentioned in this part to quarry and get stone gravel and other building

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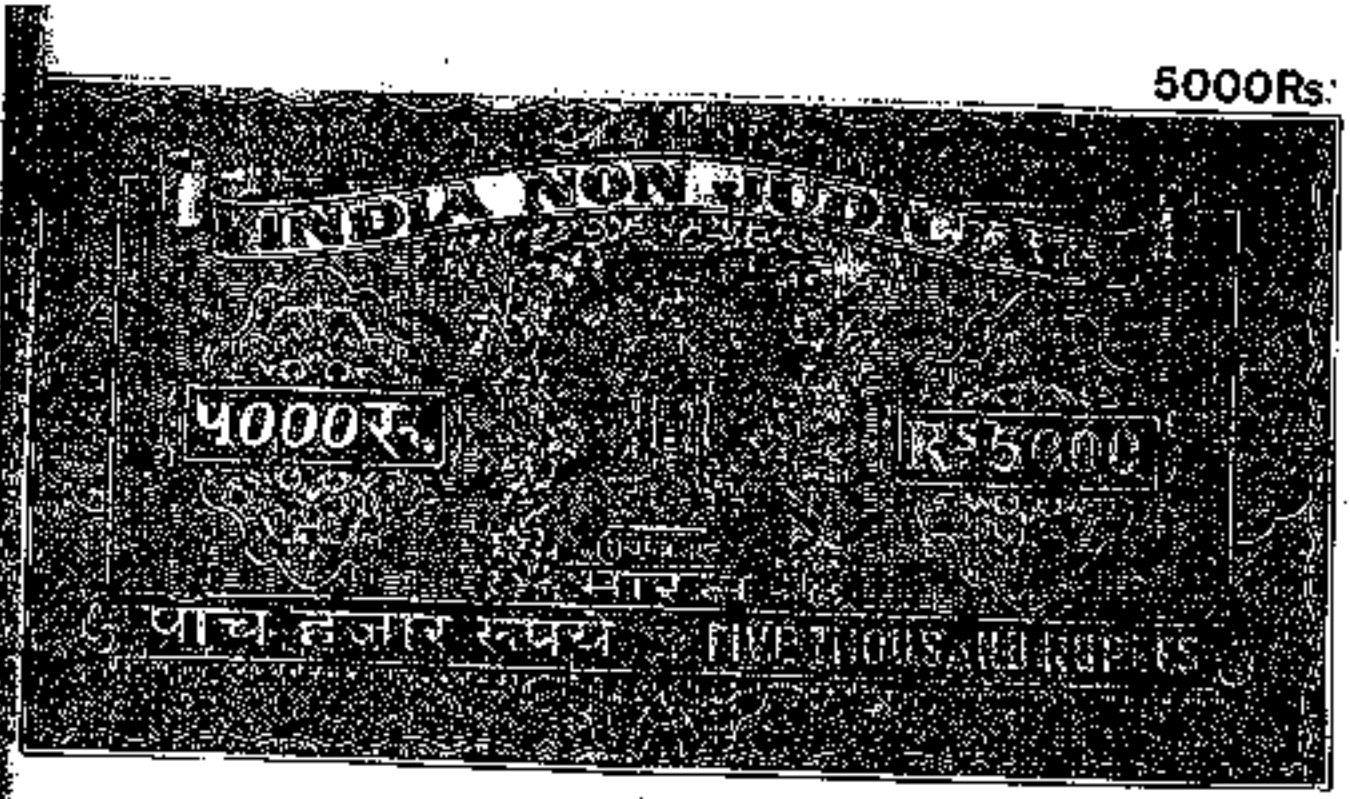

and road materials and clay and to use and employ the same and to manufacture such clay into bricks or tiles and to use such bricks or tiles but to sell any such materials bricks or tiles.

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FOR BIDHAN METALS & FERRO ALLOYS LTD.

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COUNSEL FOR JAIPUR

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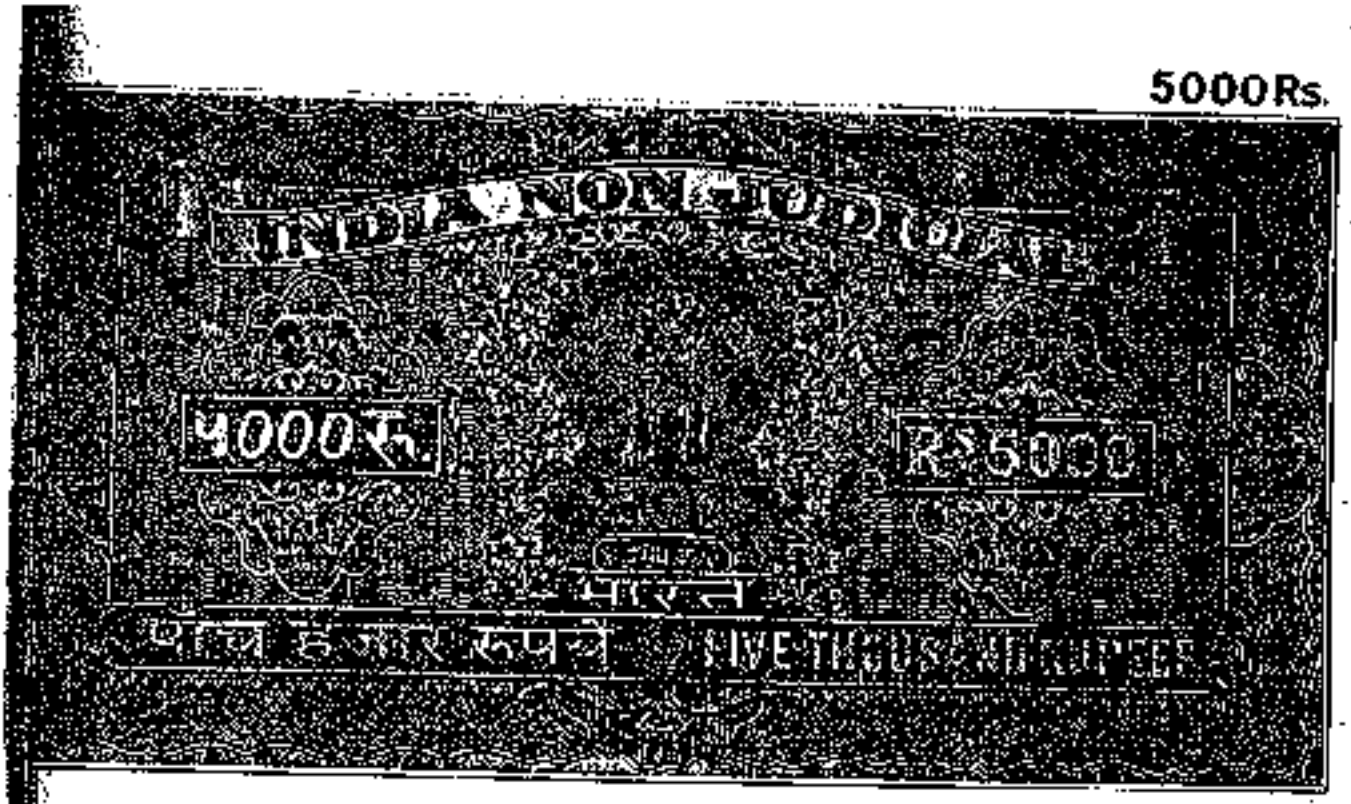

To use water from streams etc.

6. Liberty and power for or in connection with any of the purpose mentioned in this part but subject to the right of any existing or future lessees and with the written permission of Deputy Commissioner/ Collector to appropriate and use

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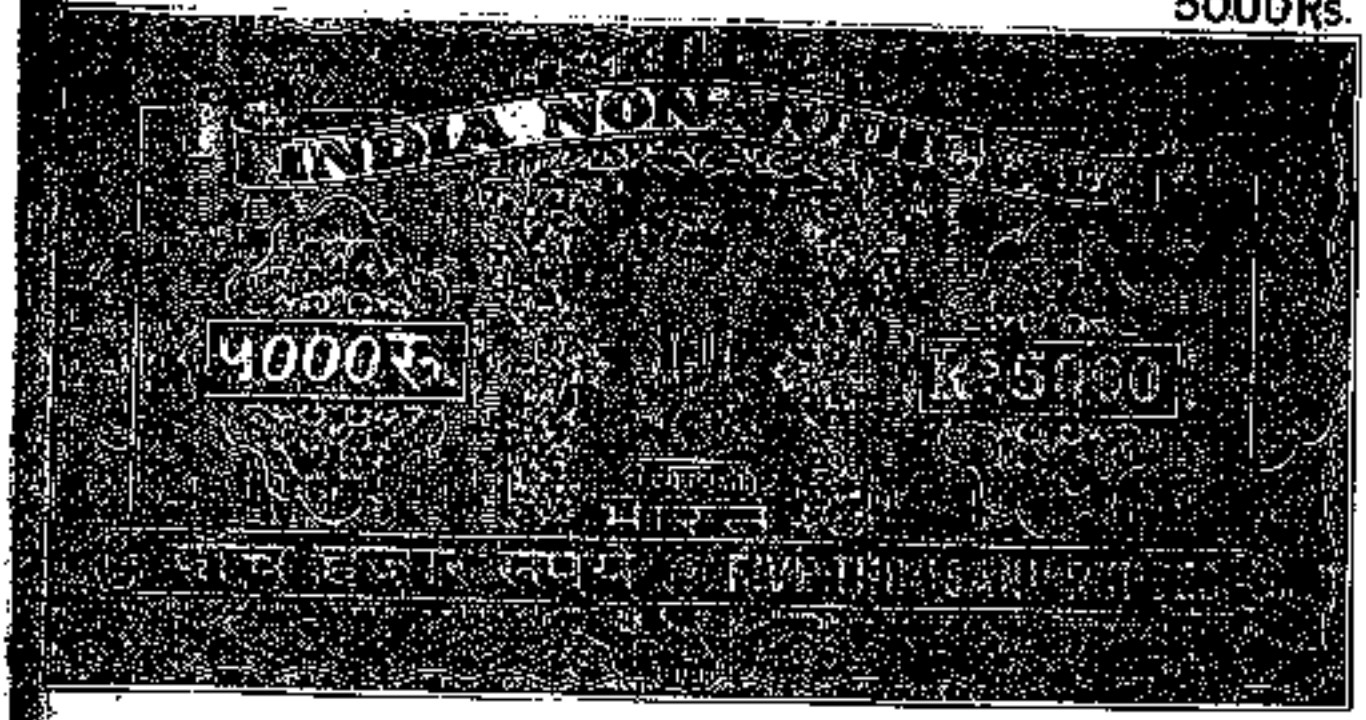

water from any streams water-courses, springs or other sources in or upon the said lands and to divert stop up or dam any such stream or water-course and collect or impound any such water and to make construct and maintain any

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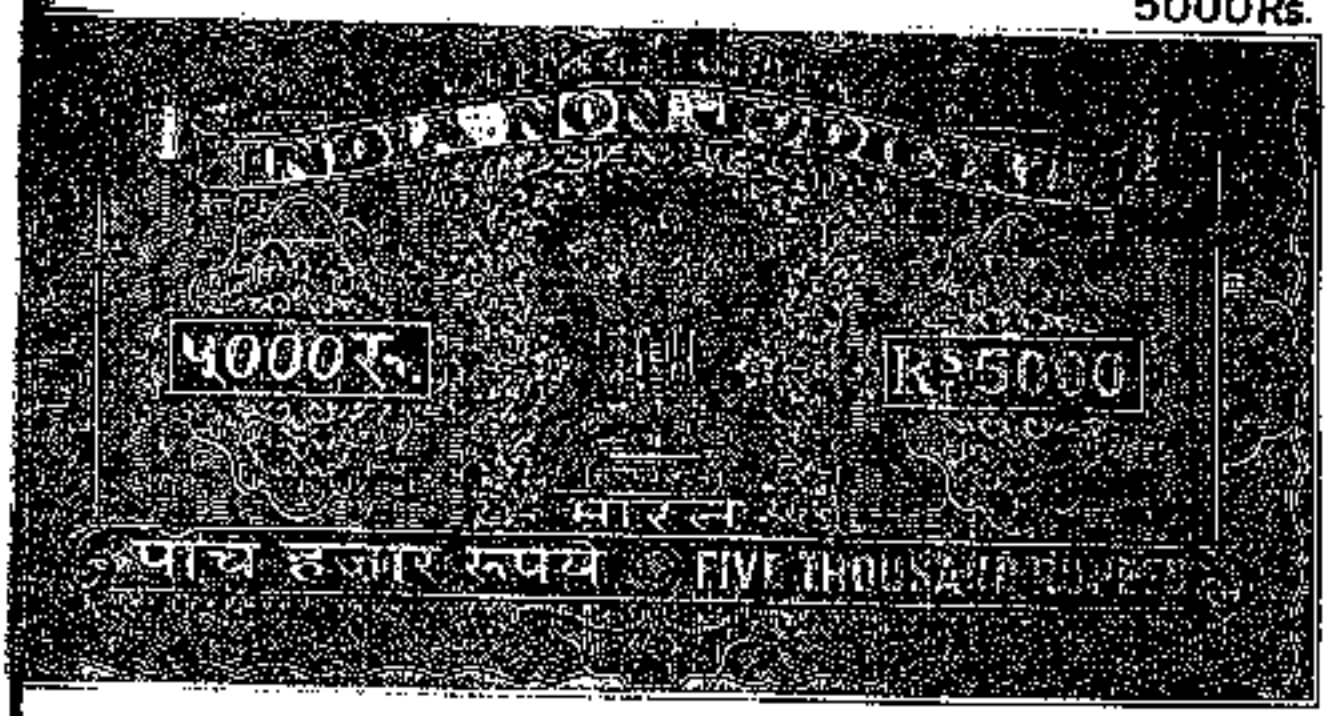

water-course culverts, drains or reservoirs but not as so to deprive and cultivated lands, villages, buildings or watering places for livestock of a reasonable supply of water as before accustomed nor in any way to foul or pollute any stream

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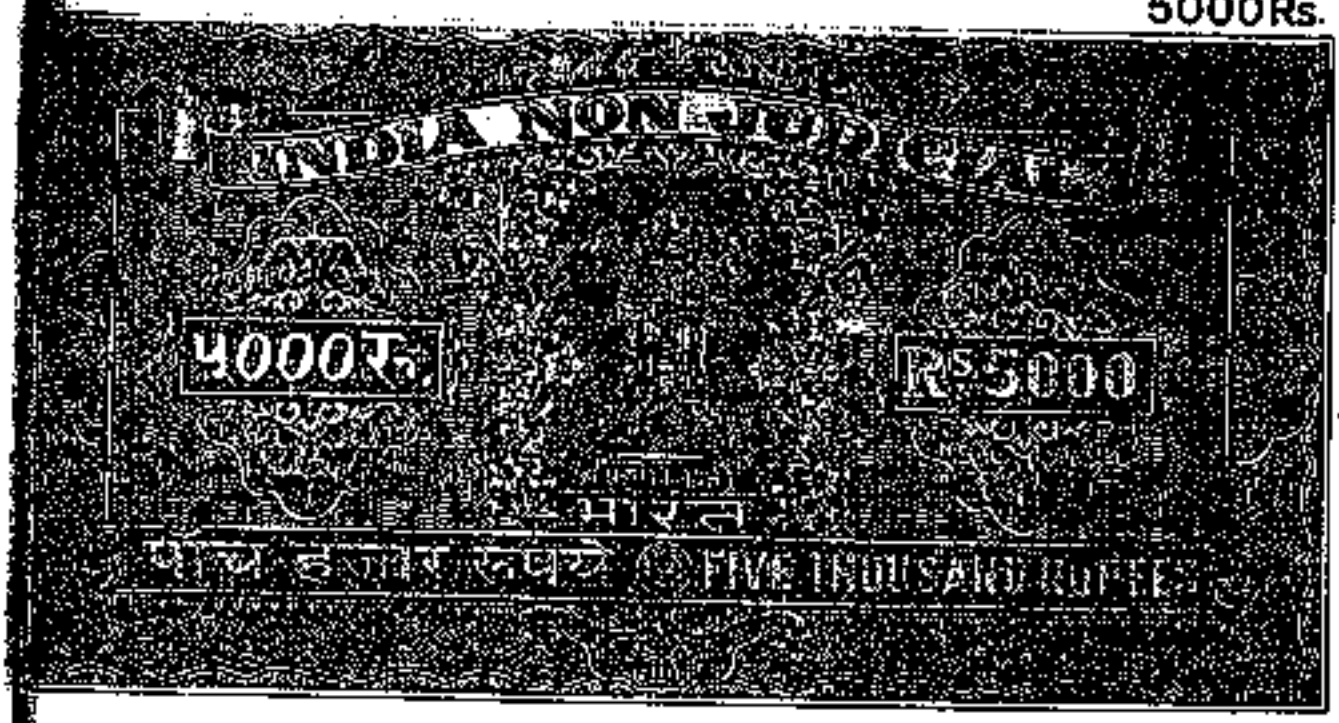

or springs. Provided that the lessee/lessees shall not interfere with the navigation in any navigable stream nor shall divert such stream without the previous written permission of the State Government.

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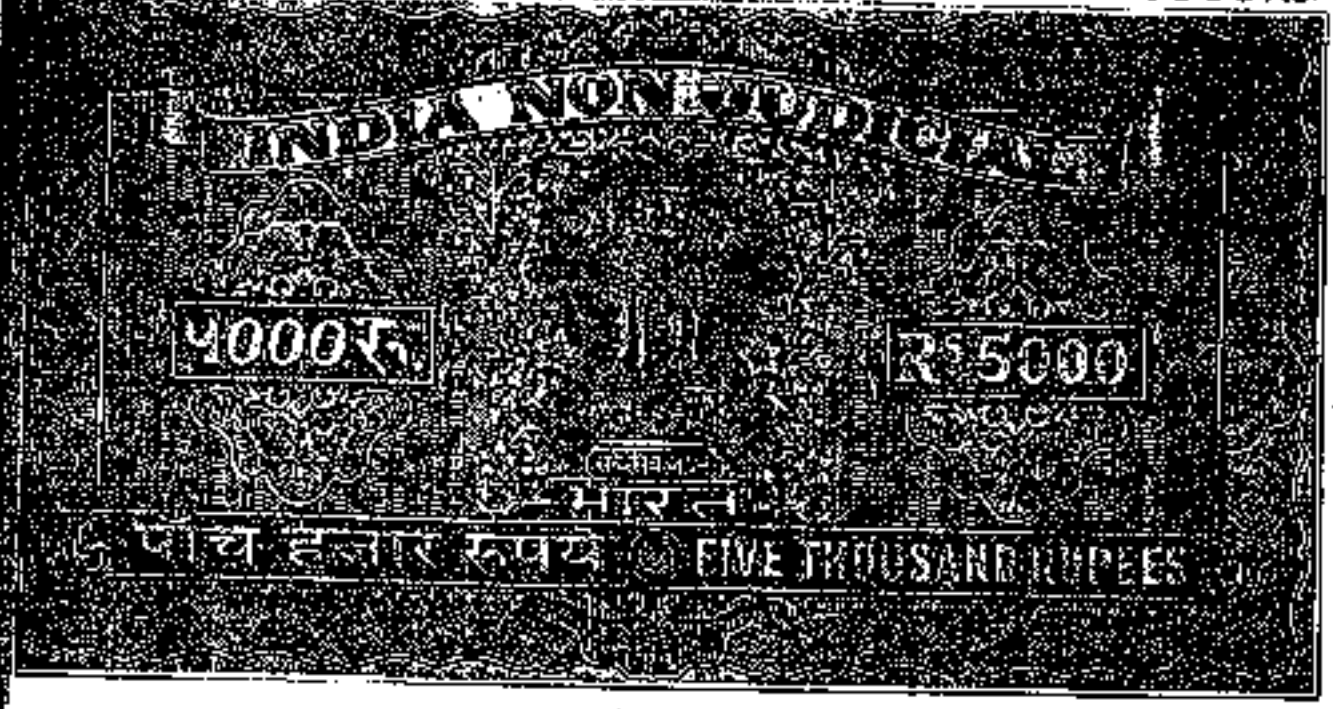

To use land for stacking, heaping, depositing purposes

7 Liberty and power to enter upon and use a sufficient part of the surface of the said lands for the purpose of stacking, heaping, storing or depositing therein any produce of the mines or works carried on and any tools, equipment, earth and materials

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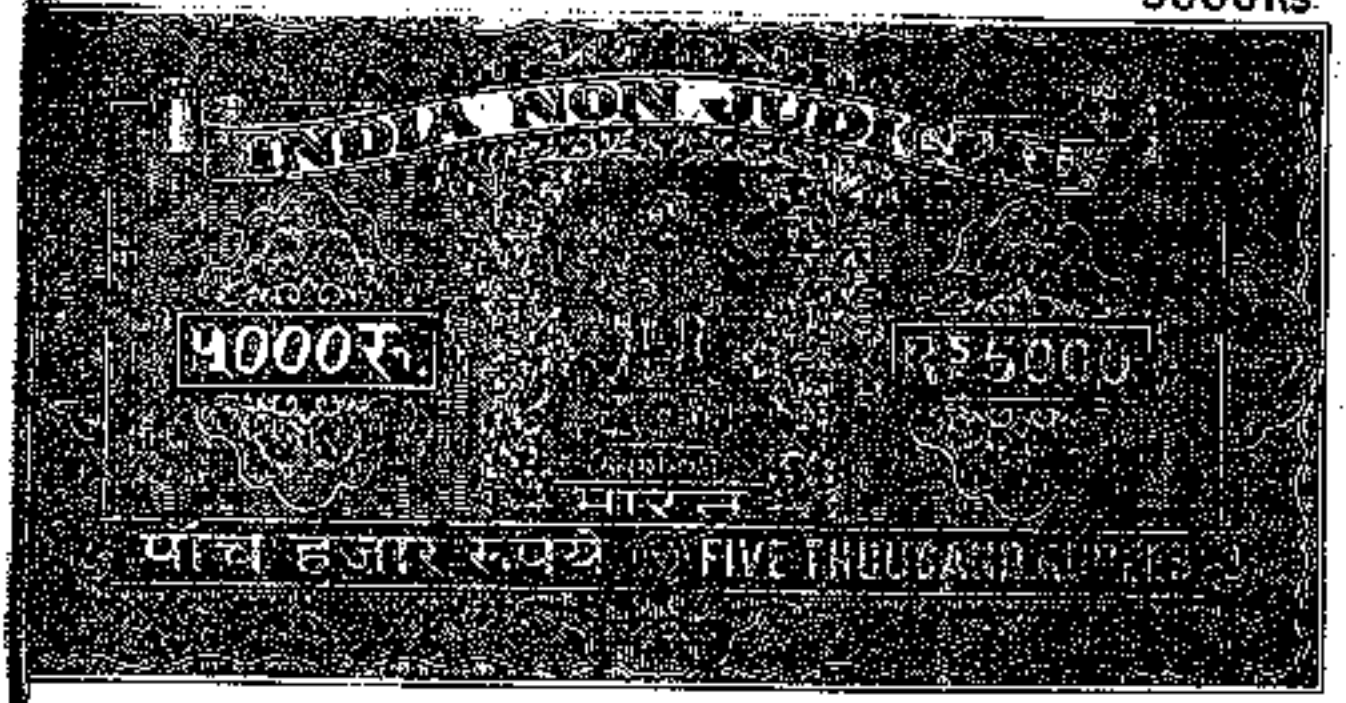

and substances dug or raised under the liberties and powers mentioned in this part.

Beneficiation and conveying away of production.

8.(A) Liberty and power to enter upon and use a sufficient part of the said lands to beneficiate apyore produced from

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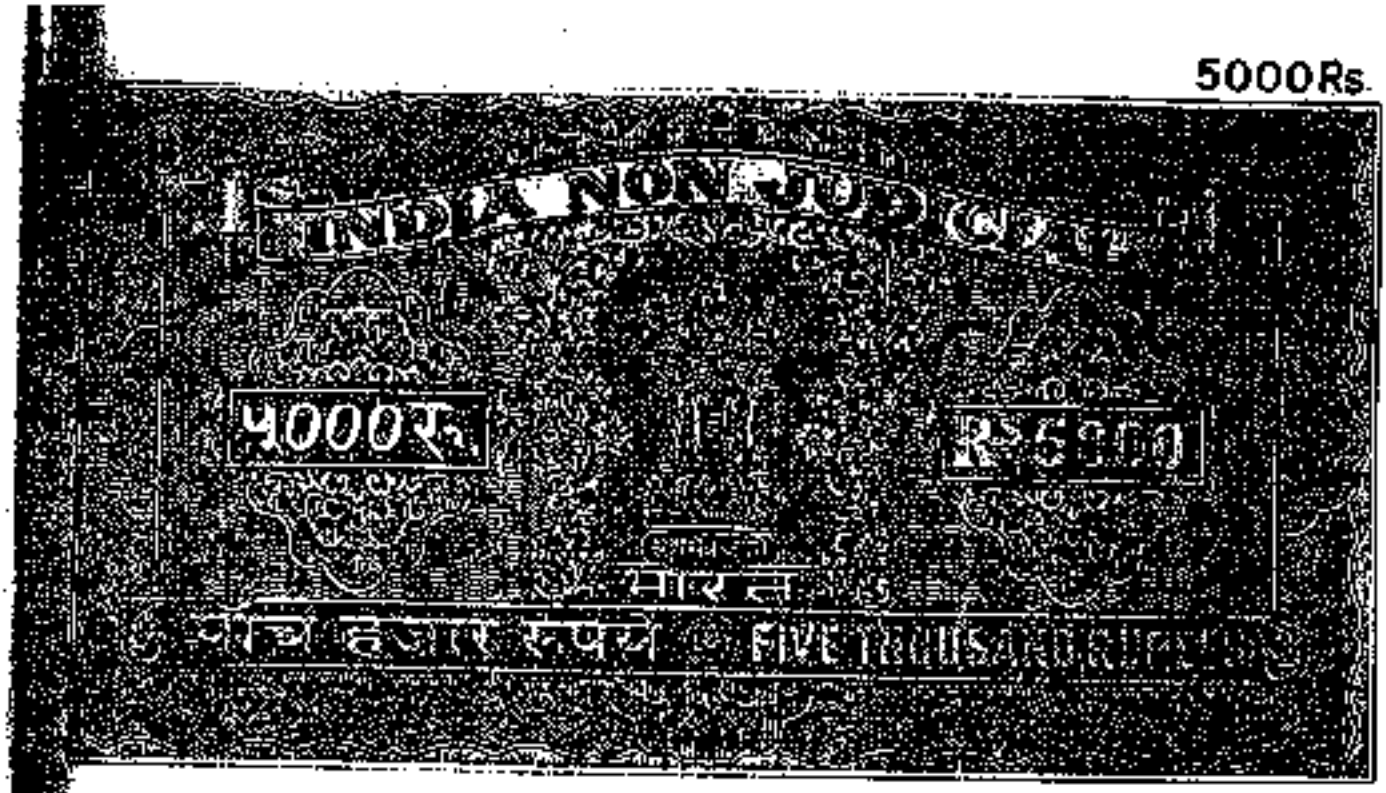

the said lands and to carry away such beneficiated ore.

To clear brushwood and to fell and utilise trees, etc.

9. Liberty and power for or in connection with any of the purposes mentioned in this part and subject to the existing rights of others and save as provided in clause 3 of the Part III

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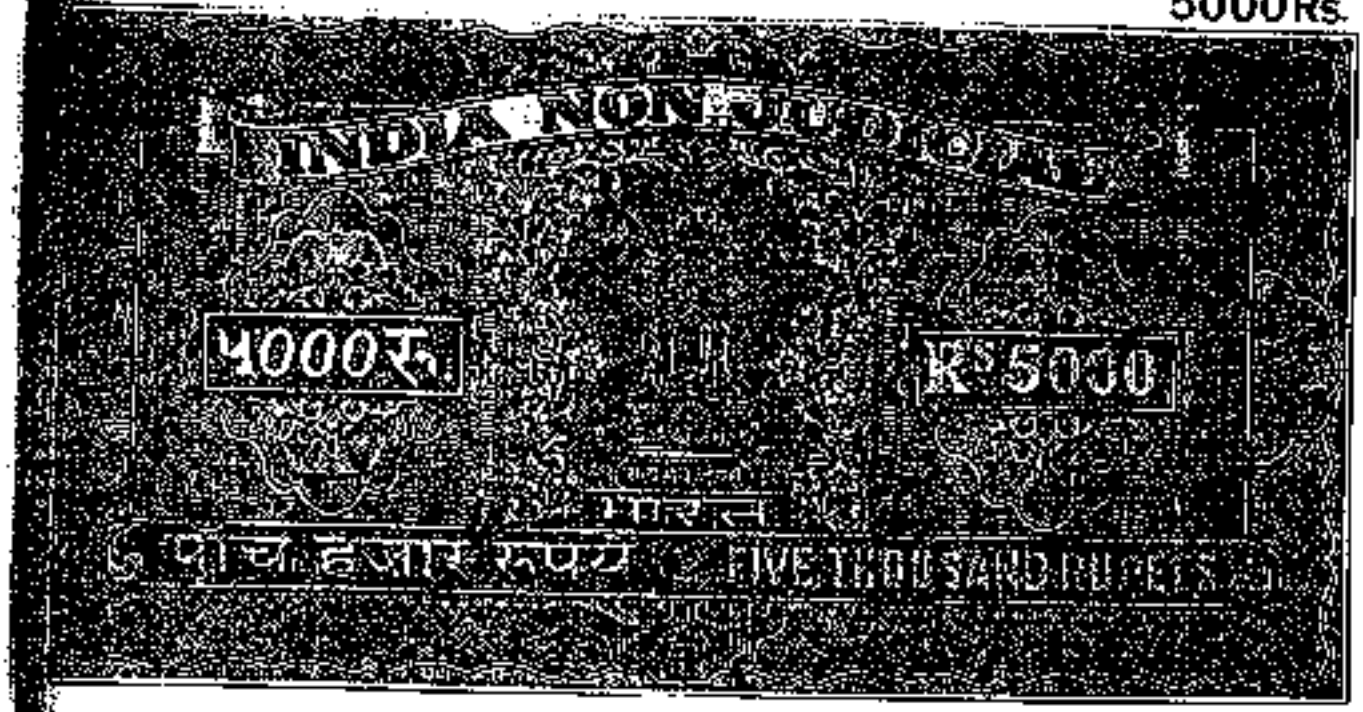

of this Schedule to clear undergrowth and brushwood and to fell and utilise any trees or timber standing or found on the said lands provided that the State Government may ask the lessee/lessees to pay for any trees or timber felled and utilised, by him/them at the rates specified by

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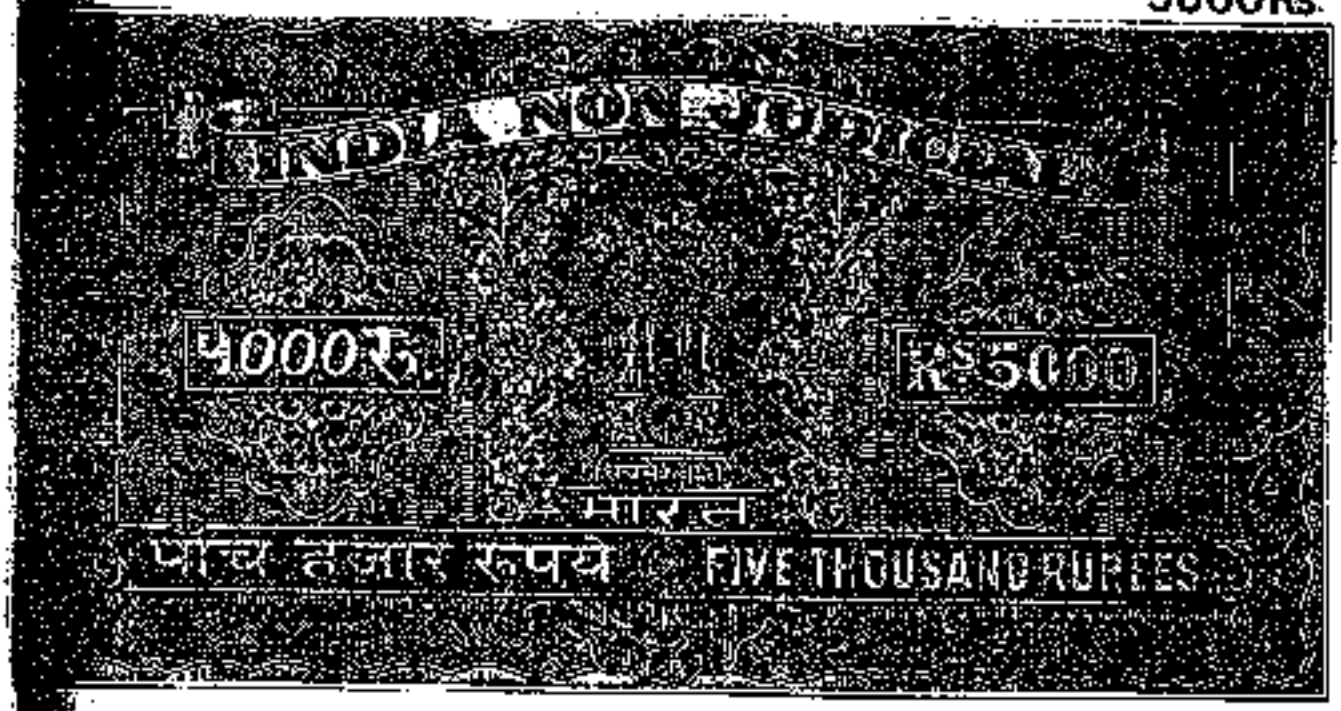

the Deputy Commissioner/Collector

of the State Government.

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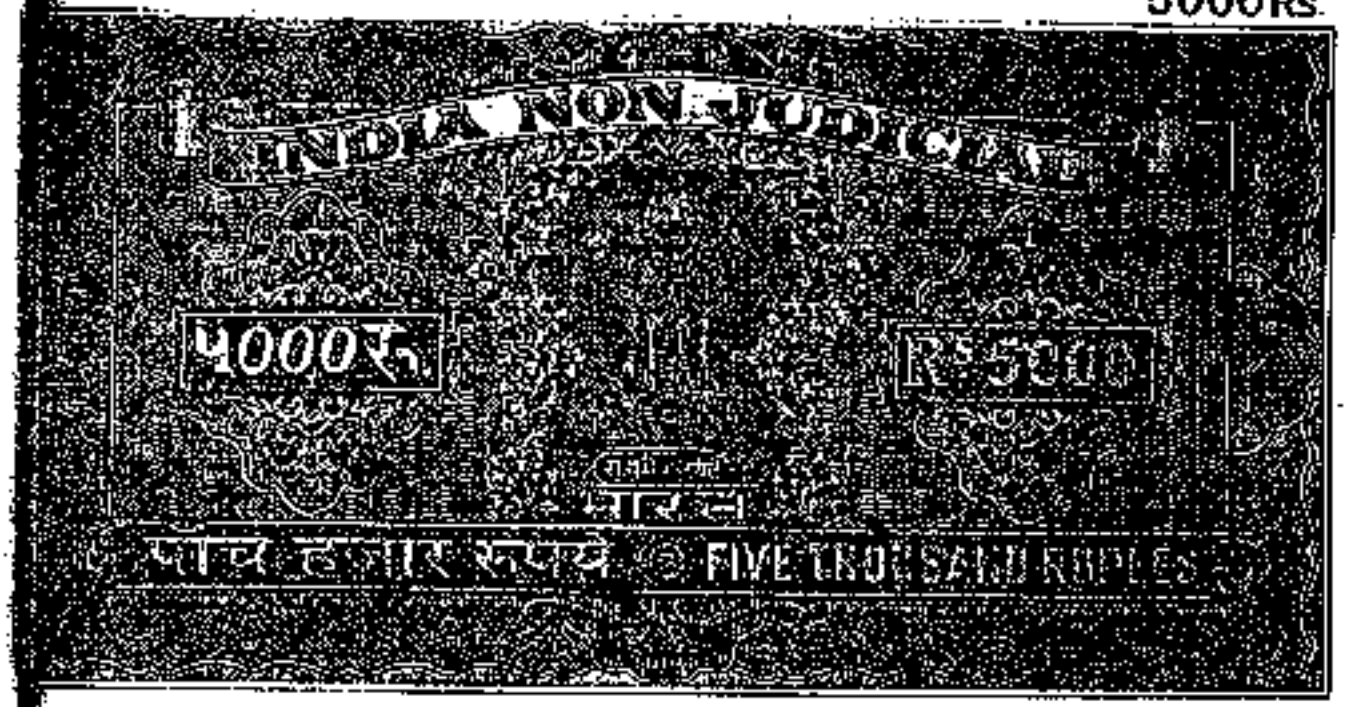

PART III

RESTRICTIONS AND CONDITIONS AS TO THE EXERCISE OF THE LIBERTIES, POWERS AND PRIVILEGES IN PART-II.

No building etc. upon certain places.

1. No building or thing shall be erected, set up or placed and no surface operations shall be carried on in or upon any public pleasure ground, burning or burial ground or place held sacred by any class of persons

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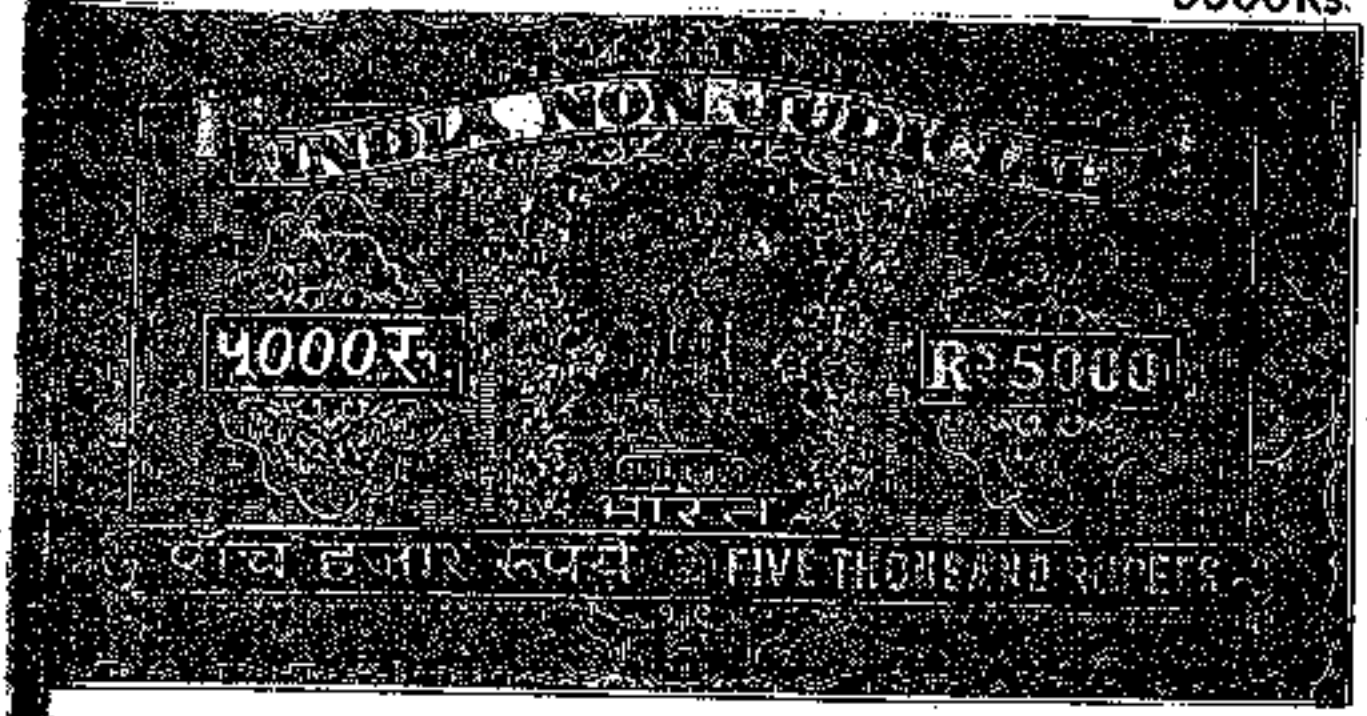

or any house or village site, public road or other place which the State Government may determine as public ground nor in such a manner as to injure or prejudicially effect any buildings works property or rights of other persons and no land shall be used for surface operations which is already occupied by persons other than the State Government for works or purposes not included in this lease. The lessee/lessees shall

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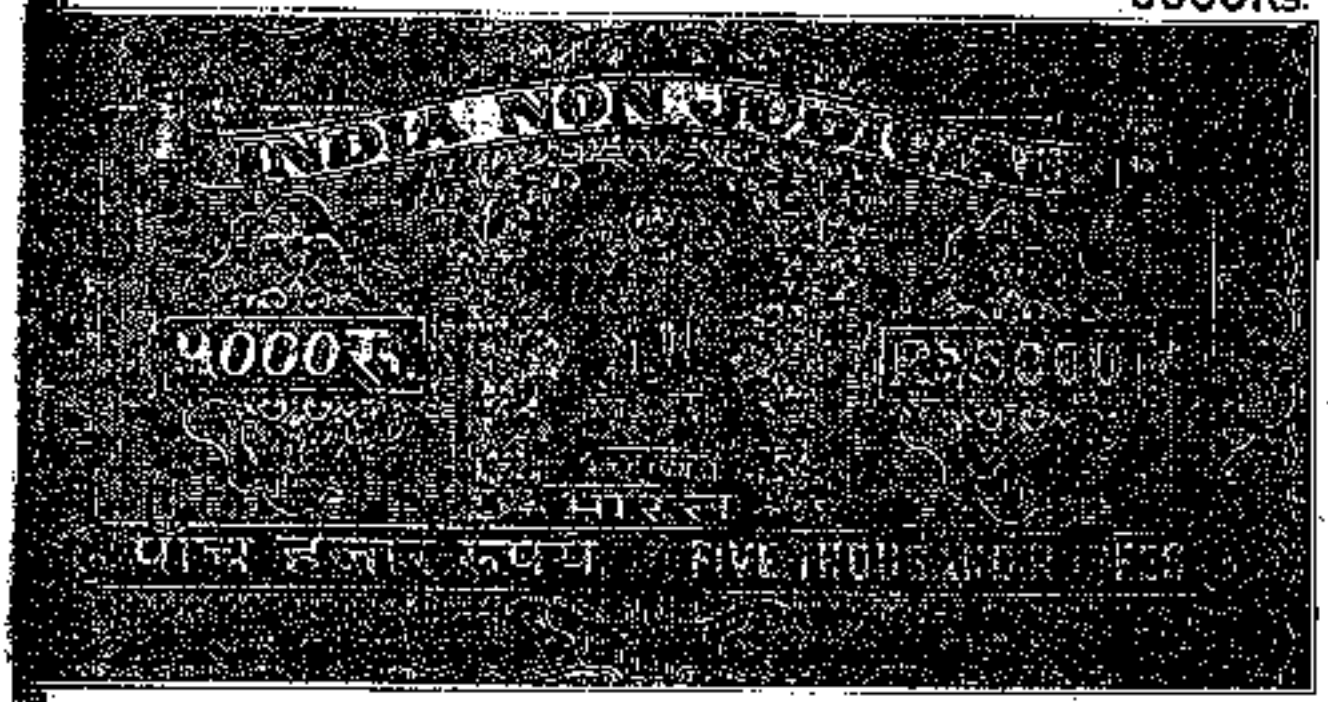

not also interfere with any right of way, well or tank.

Permission for surface operations in a land not already in use.

2. Before using for surface operations any land which has not already been used for such operations, the lessee/lessees shall give to Deputy Commissioner/Collector of the

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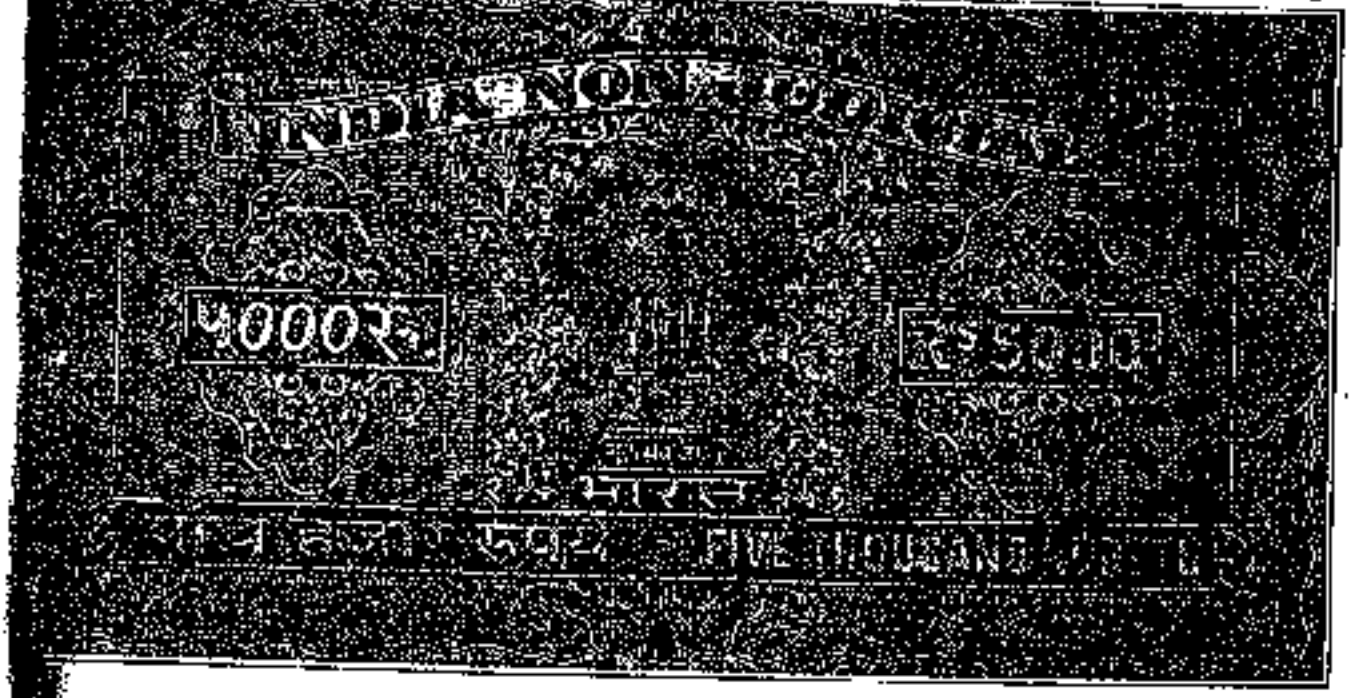

District two calendar months previous notice in writing specifying the name or other description of the situation and the extent of the land proposed to be so used and the purpose for which the same is required and the said land shall not

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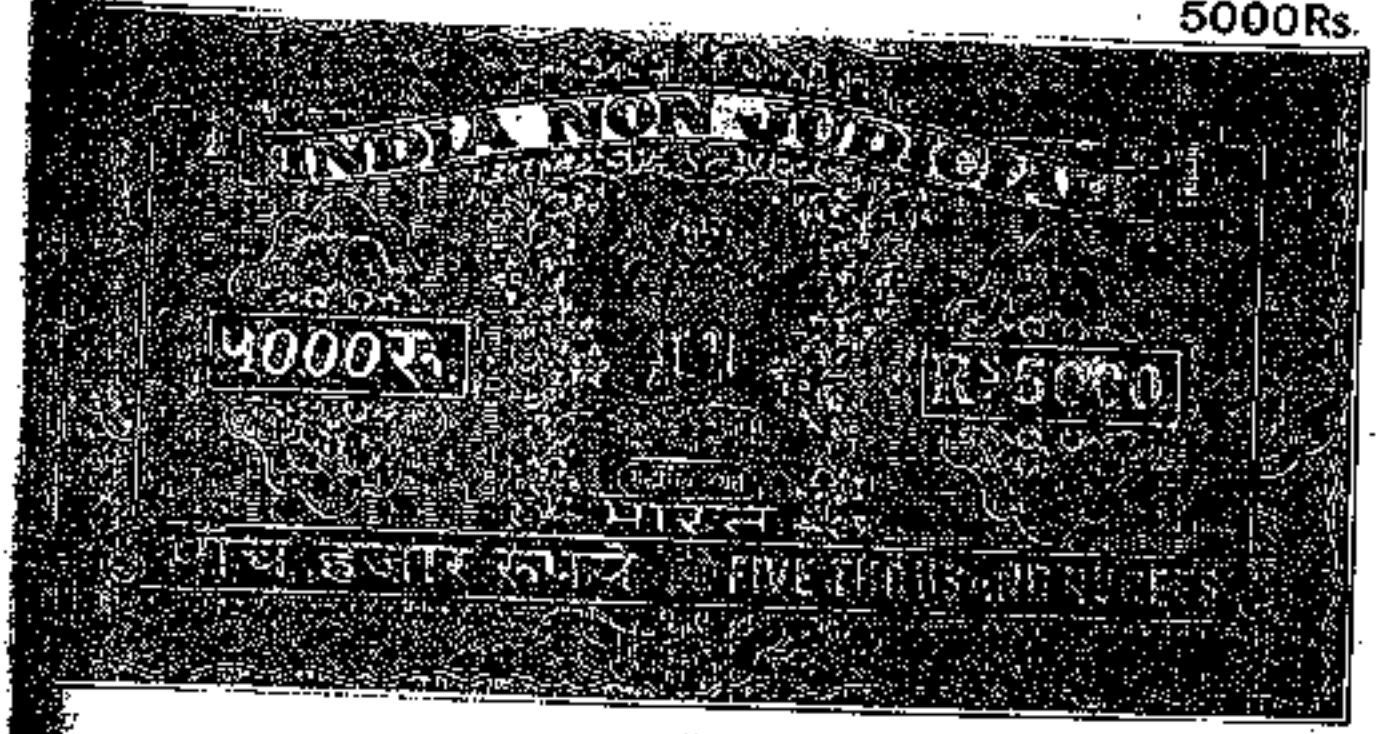

be so used if objection is issued by the Deputy Commissioner/Collector within two months after the receipt by him of such notice unless the objections so stated shall on reference to the State Government be annulled or waived.

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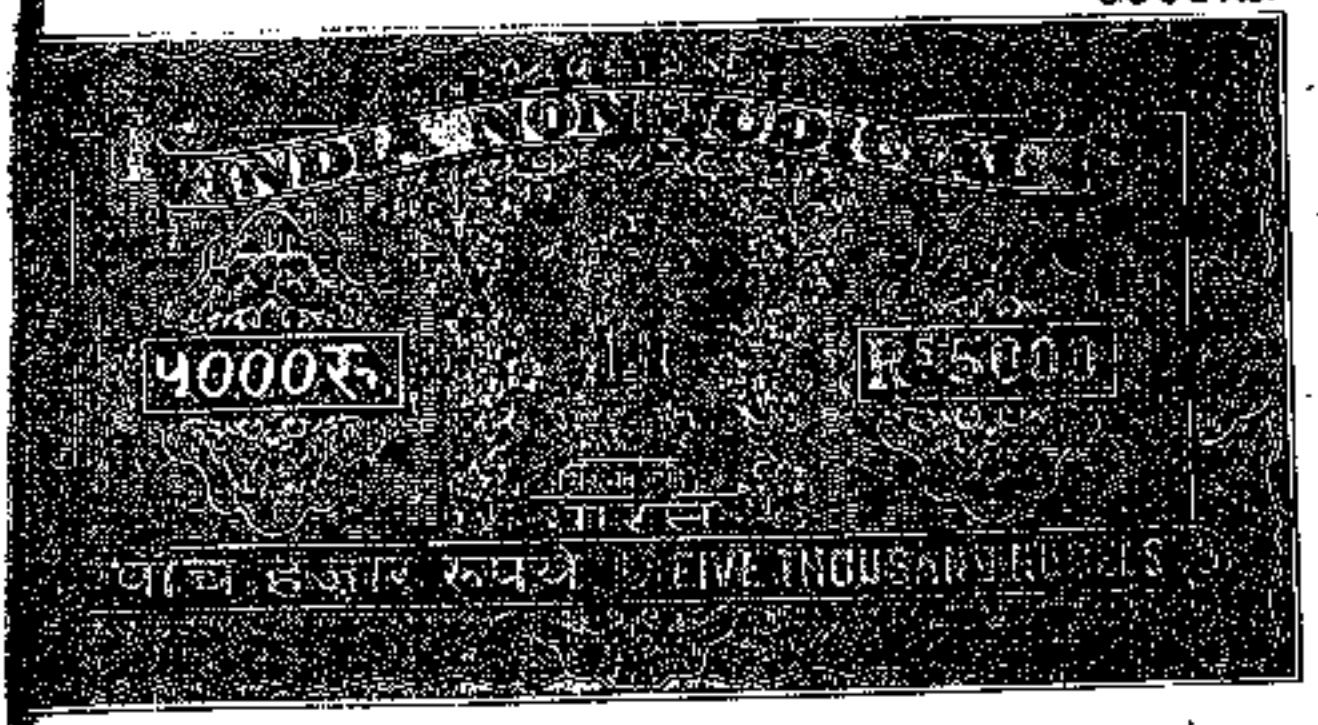

To cut trees in un-reserved lands.

3. The lessee/lessees shall not without the express sanction of the Deputy Commissioner/Collector cut down or injure any timber or trees on the said lands but may without such sanction clear away any brushwood or

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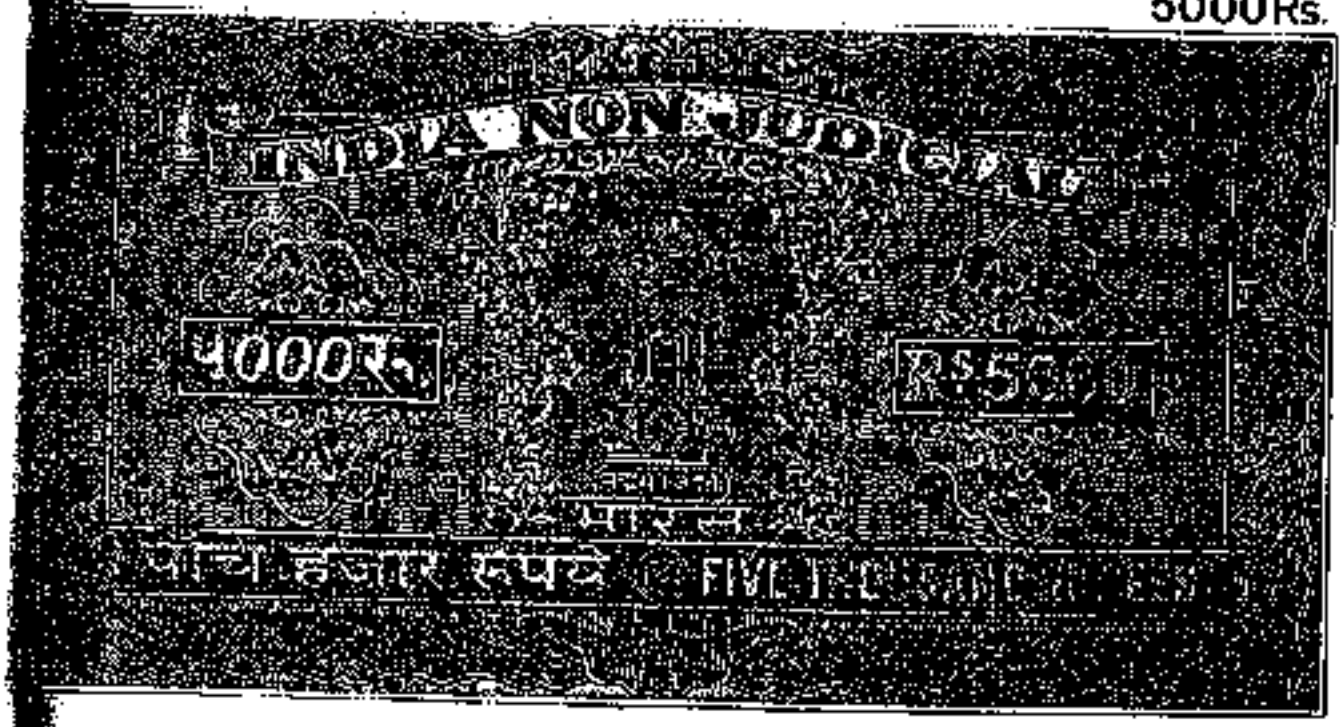

undergrowth which interferes with any operations authorised by these presents. The Deputy Commissioner/Collector or the State Government may require the lessee/lessees to pay for any trees or timber felled and utilised by

Cont....

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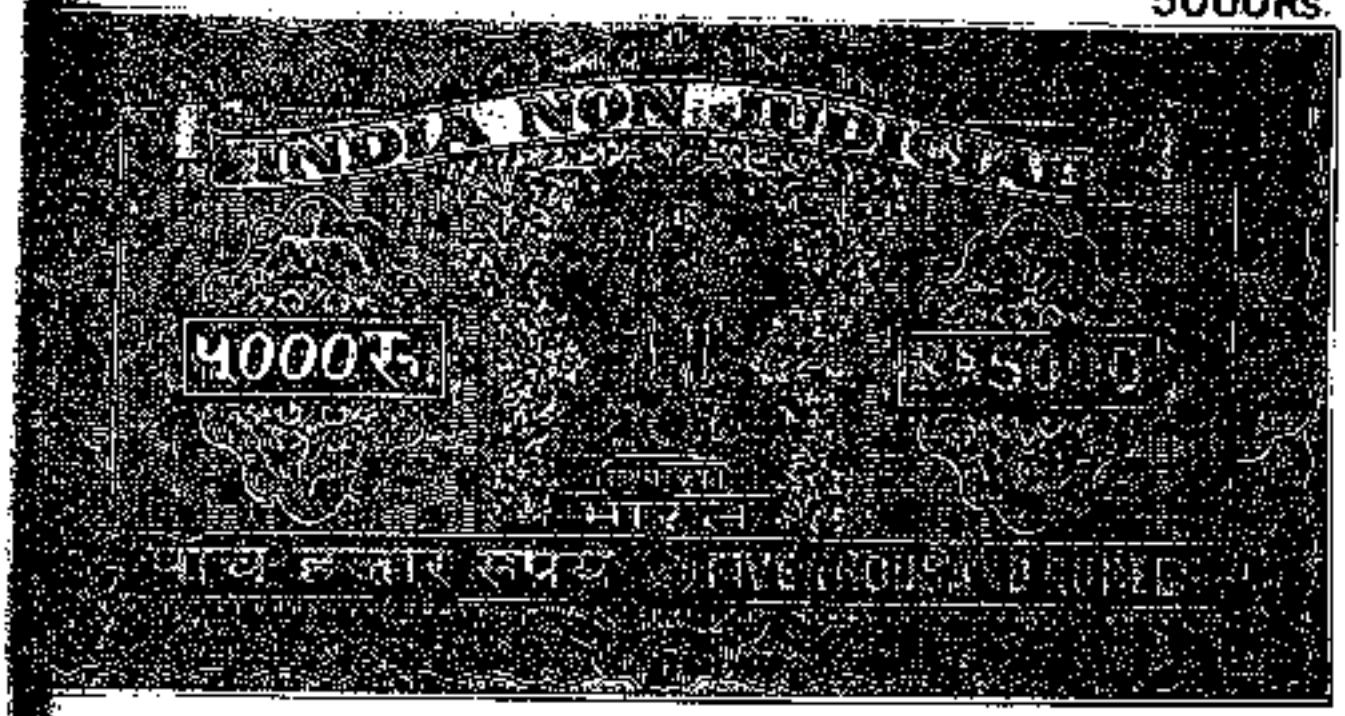
DIRECTOR JAIPUR



him/them at the rates specified by the Deputy Commissioner/Collector of the District.

To enter upon reserved forests.

4. Notwithstanding anything in this Schedule contained the lessee/ lessees shall not enter upon any

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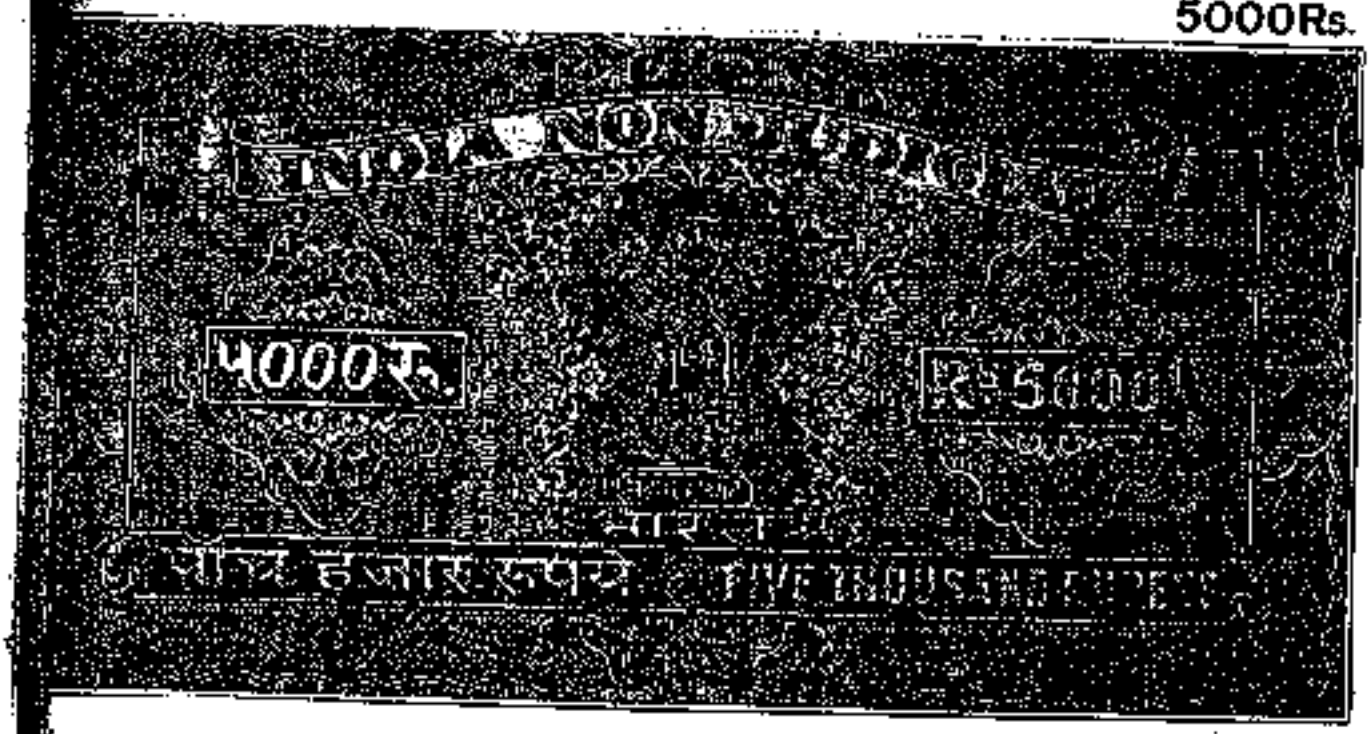

reserved forest included in the said lands without previous sanction in writing of the District Forest Officer nor fell, cut and use any timber or trees without obtaining the sanction in writing of that Officer nor otherwise than in accordance with

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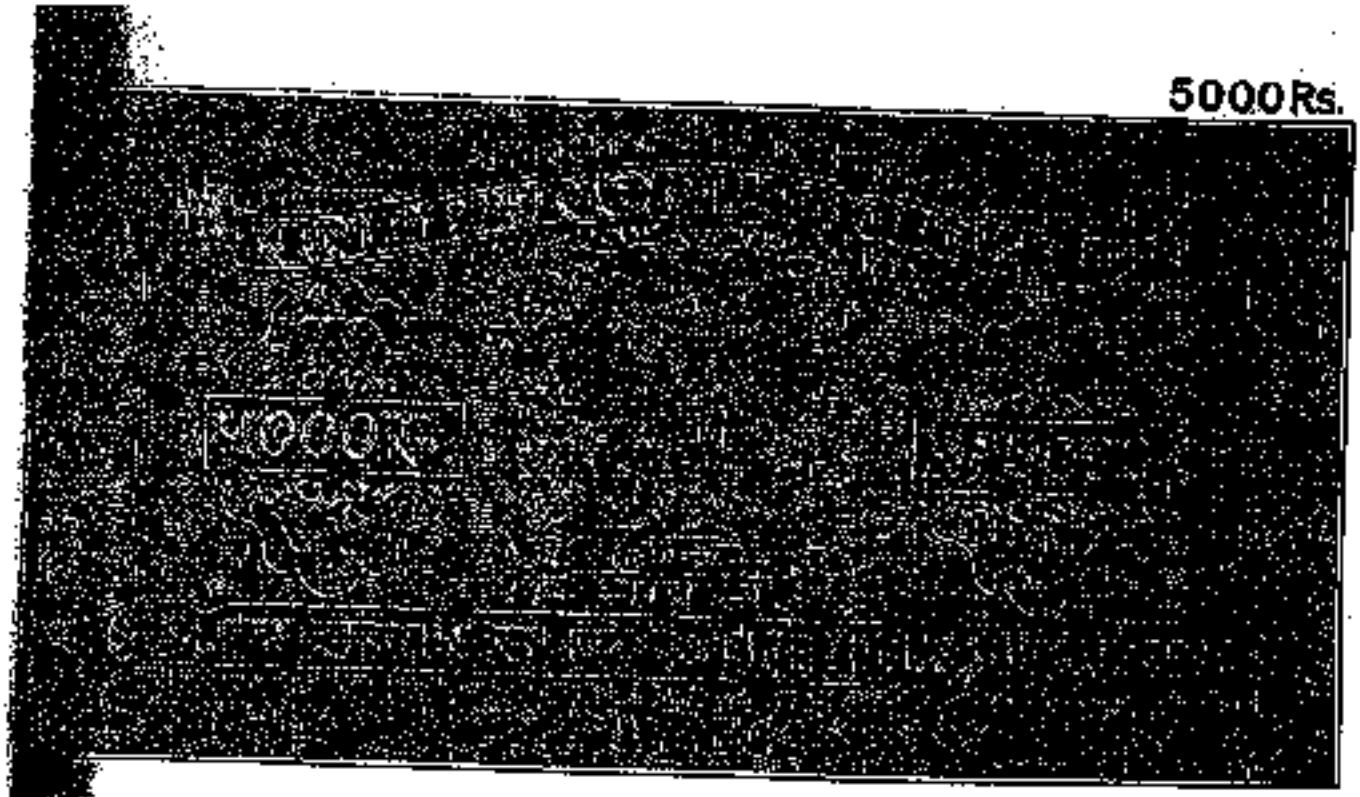

such conditions as the State Government may prescribe.

No mining operations within 50 metres of public works etc.

5. The lessee/lessees shall not work or carry on or allow to be worked or carried on any mining operations at or to any point within a distance of

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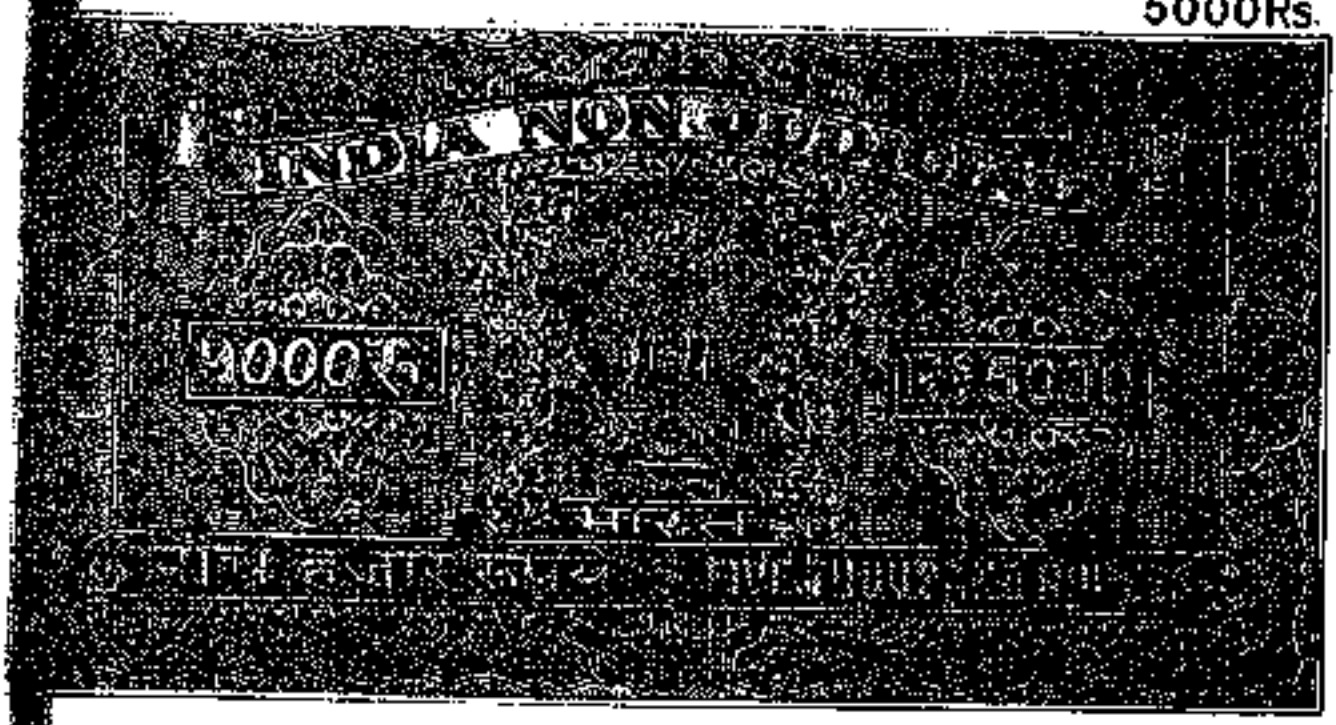

50 metres from any railway line except with the previous written permission of the Railway Administration concerned (or under or beneath any ropeway or any ropeway trestle or station, except under and in accordance with the

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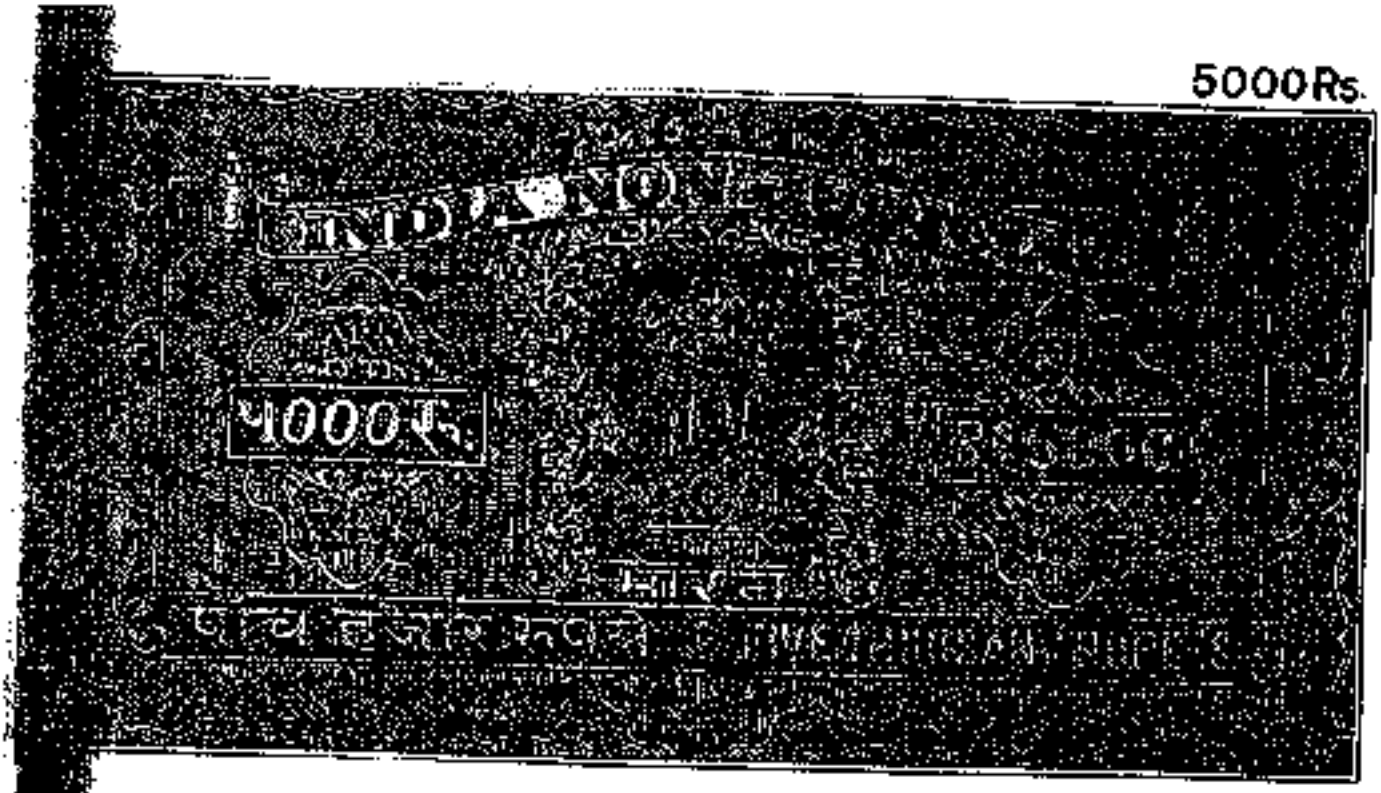

written permission of the authority owning the ropeway) or from any reservoir, canal or other public works such as public roads and buildings or inhabited site except with the previous written permission of the Deputy Commissioner/

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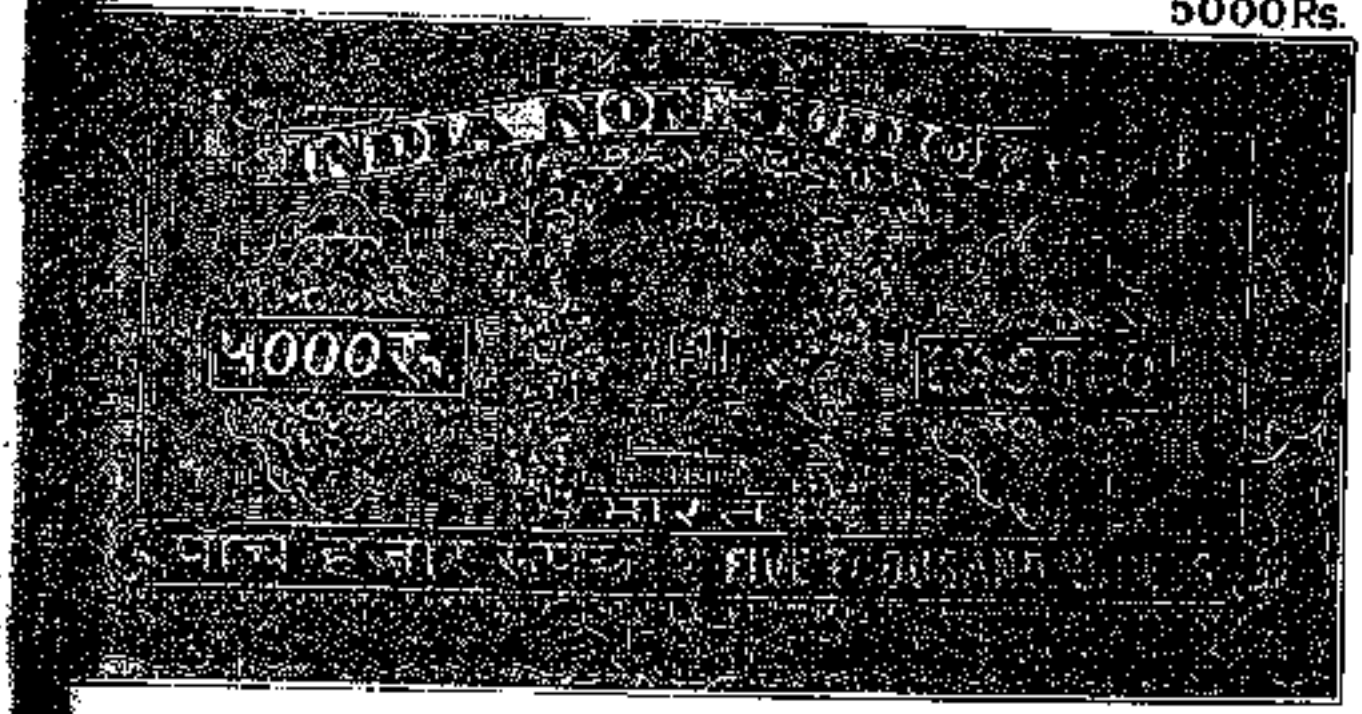

Collector or any other officer authorised by the State Government in this behalf and otherwise than in accordance with such instructions, restrictions and conditions either general or special which may be attached to such permission. The said

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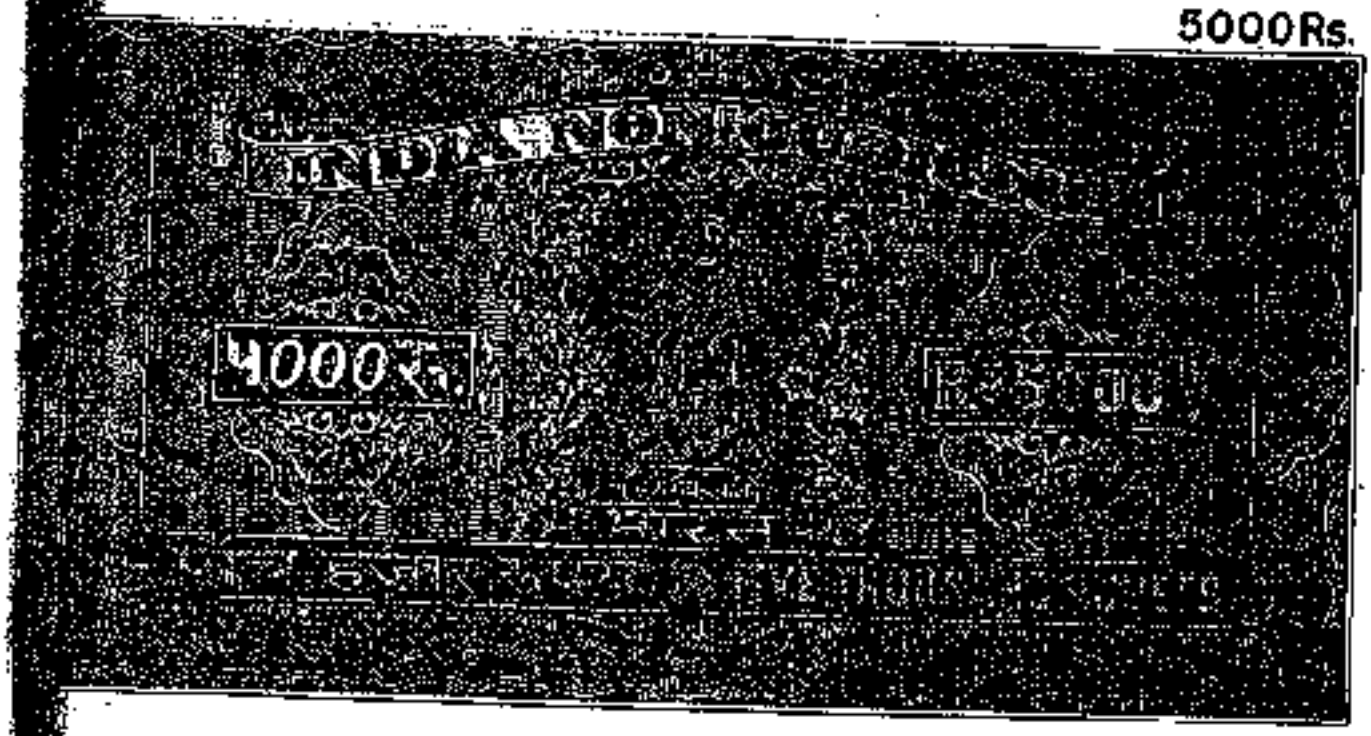

distance of 50 metres shall be measured in the case of railway, reservoir or canal horizontally from the outer toe of the bank or the outer edge of the cutting as the case may be and in case of a building horizontally from the plinth thereof.

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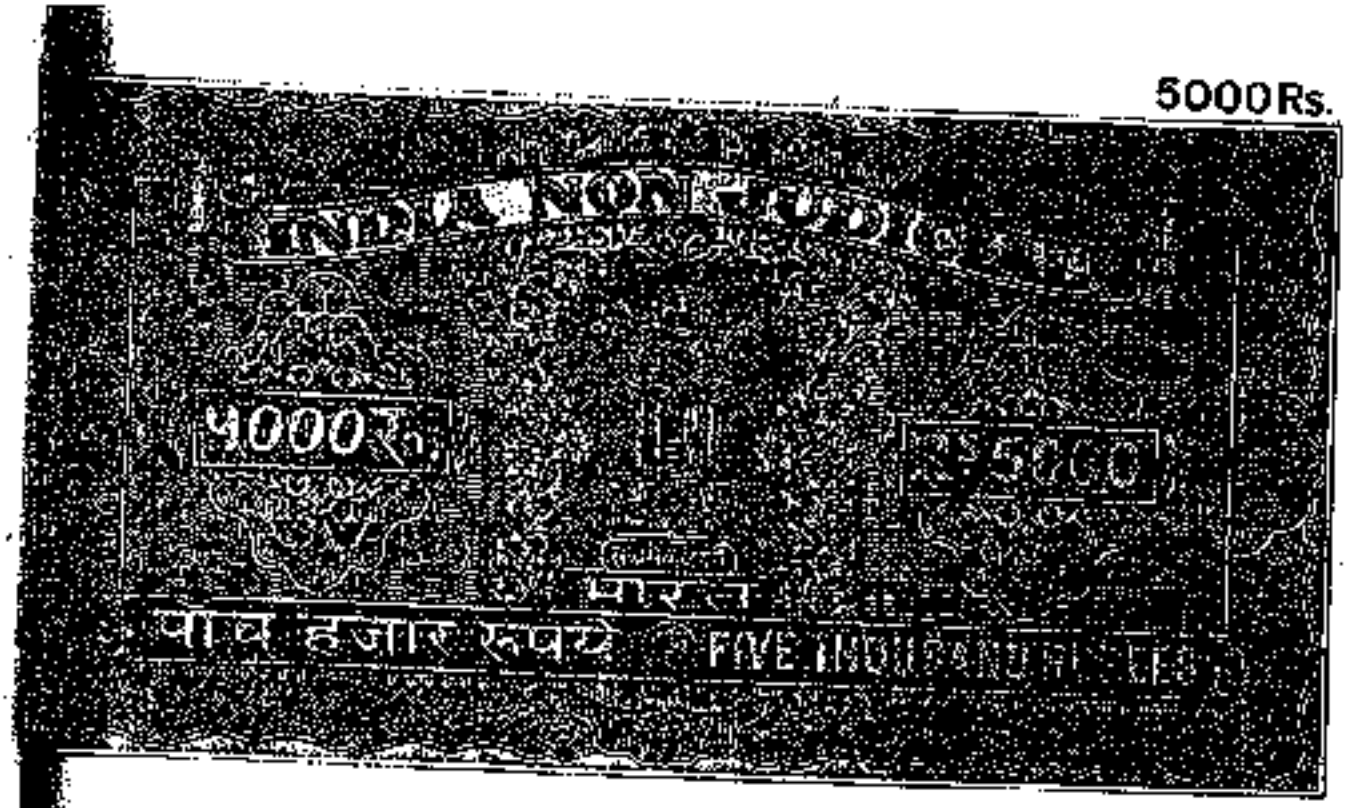

In the case of village roads no working shall be carried on within a distance of 10 metres of the outer edge of the cutting except with the previous permissionof the Deputy Commissioner/Collector or any other officer duly authorised by the state

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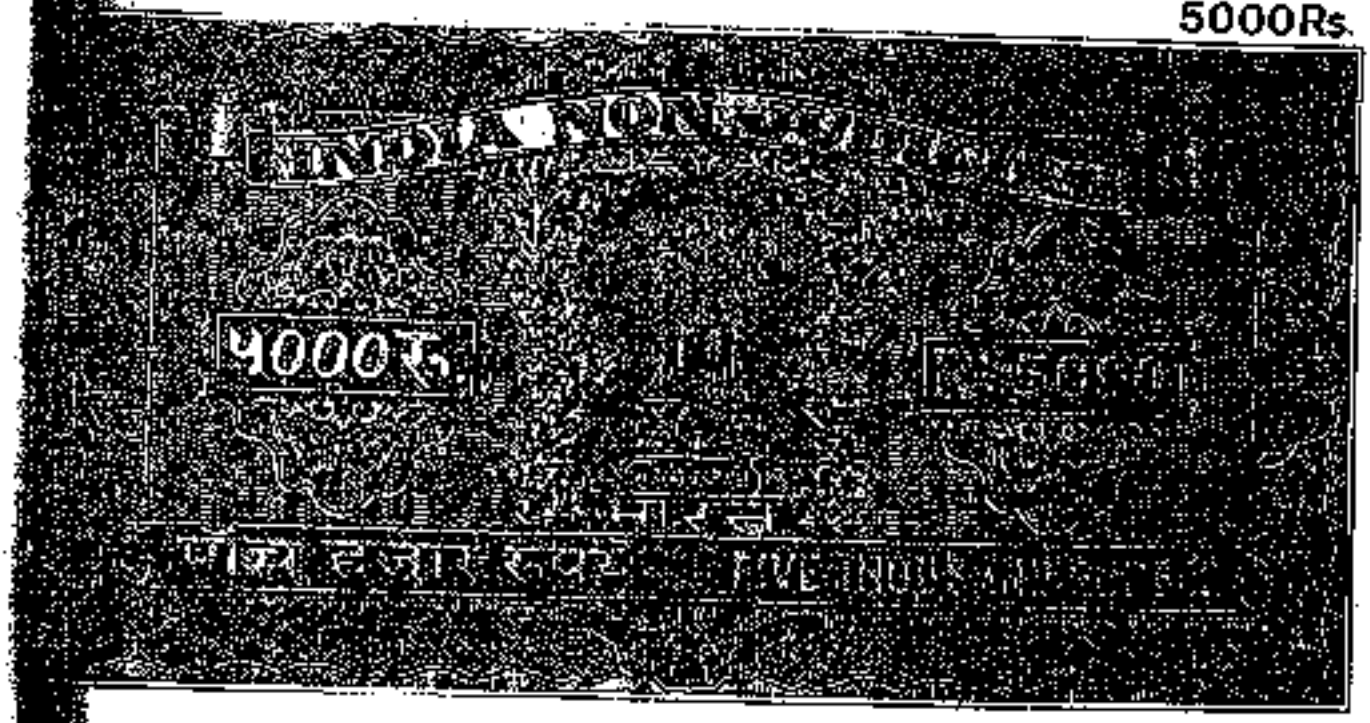

Government in this behalf and otherwsie than in accordance with such directions, restrictions and additions, either general or special, which may be attached to such permission.

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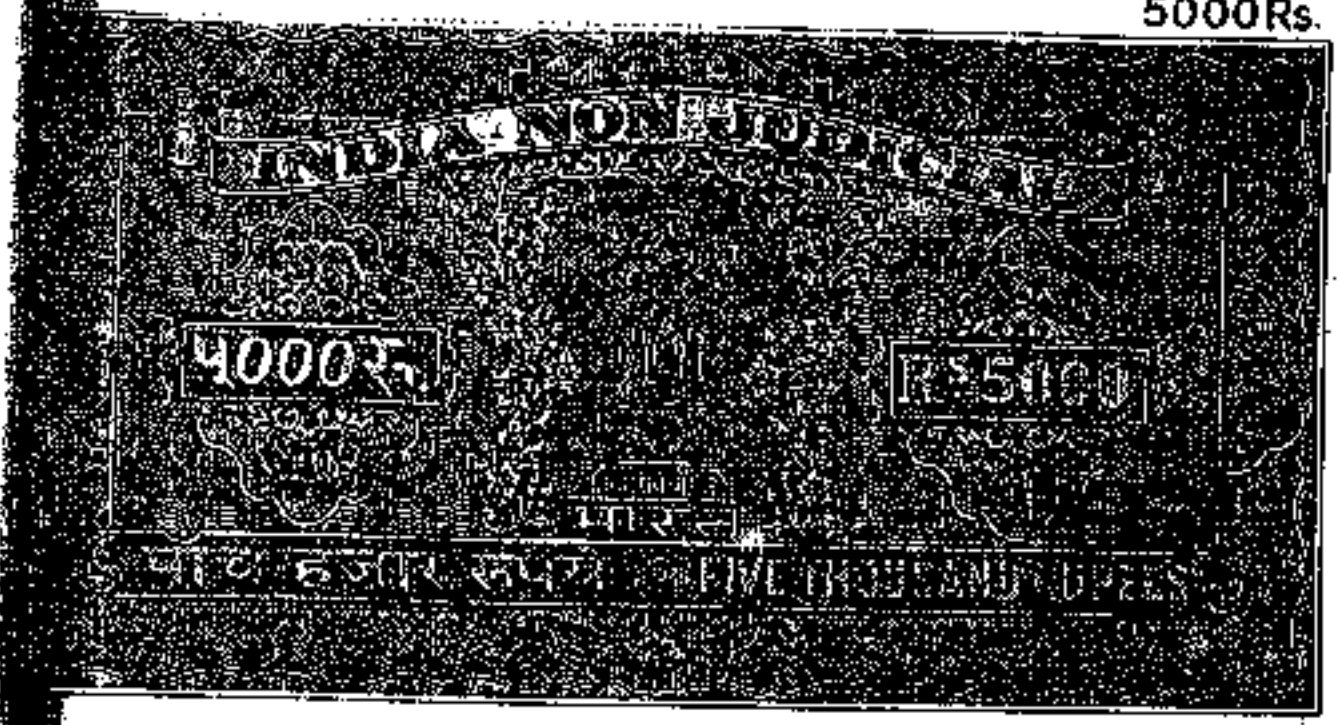

Explanation :- For the purpose of this clause the expression 'Railway Administration' shall have the same meaning as it is defined to have in the Indian Railways Act, 1890, by clause (6) of section 3 of that Act. 'Public Road' shall mean a road

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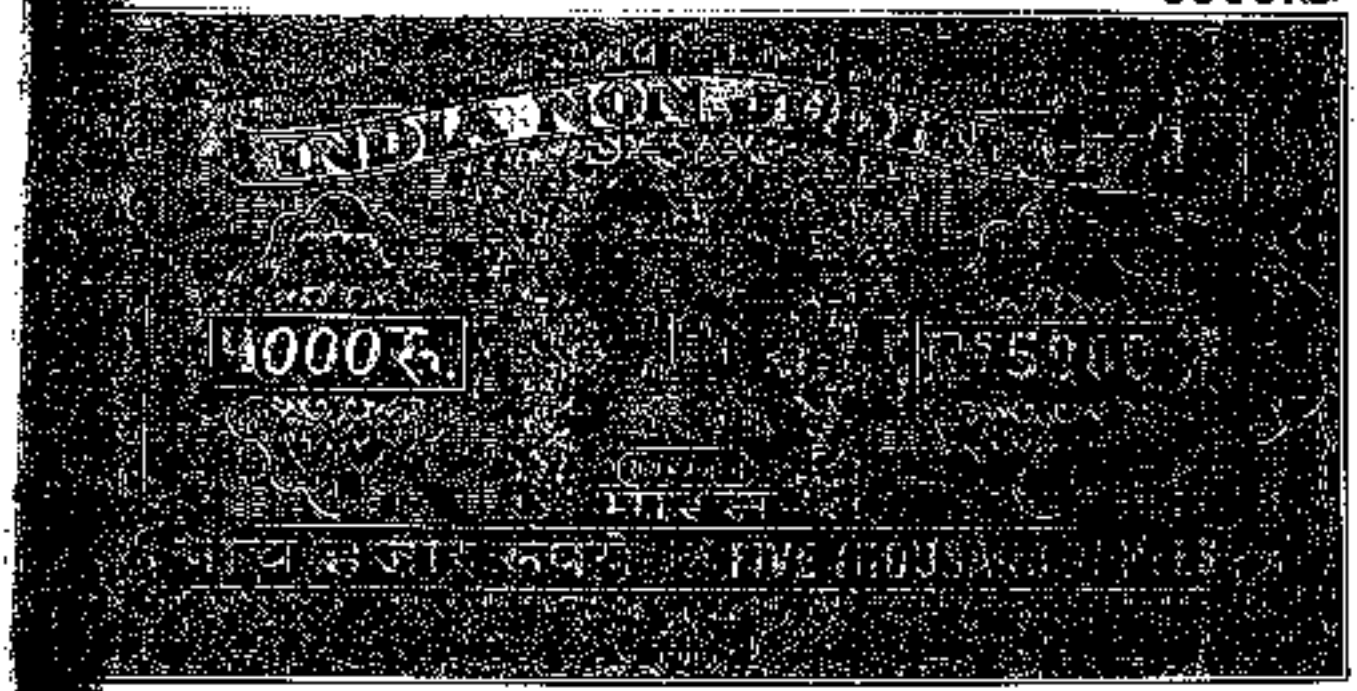

which has been constructed by artificially surfaced as distinct from a track resulting from repeated use. Village road will include any track shown in the Revenue record as village road.

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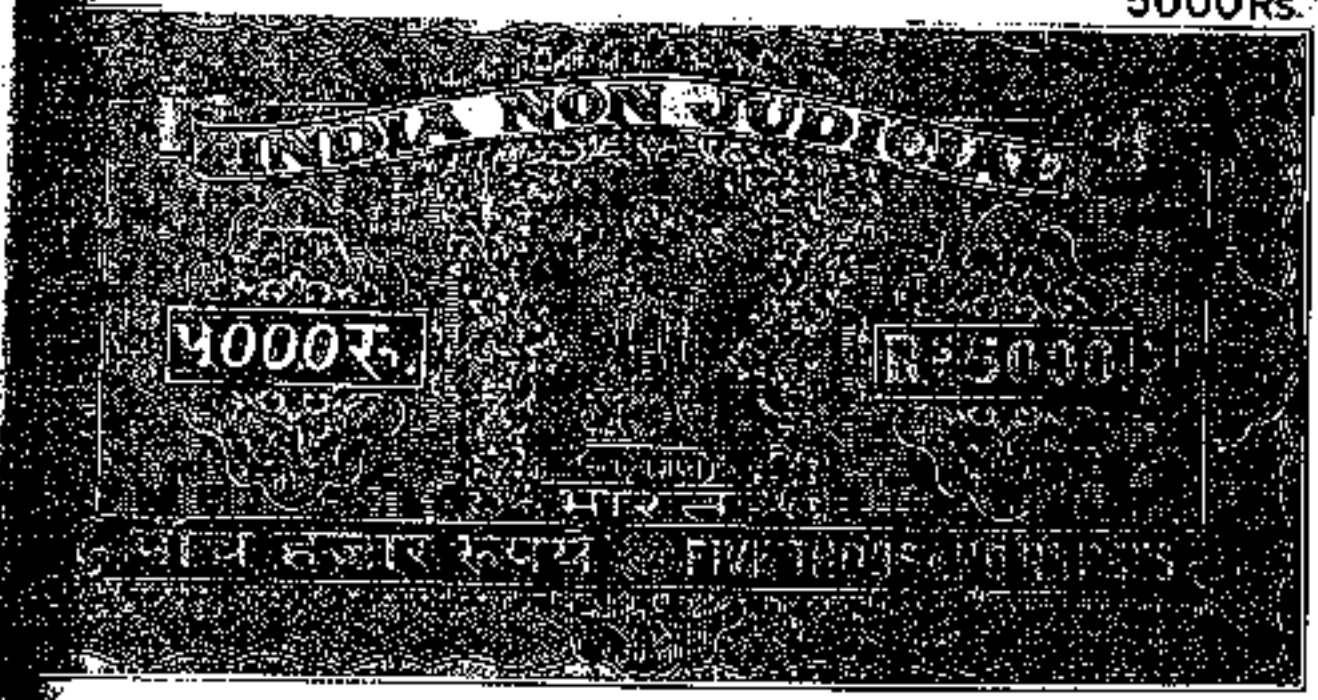

Facilities for adjoining Govt licences and leases.

6. The lessee/lessees shall allow existing and future holders of Government licences or leases over any land which is comprised in or adjoins or is reached by the land held by the lessee/lessees reasonable facilities of access thereto:

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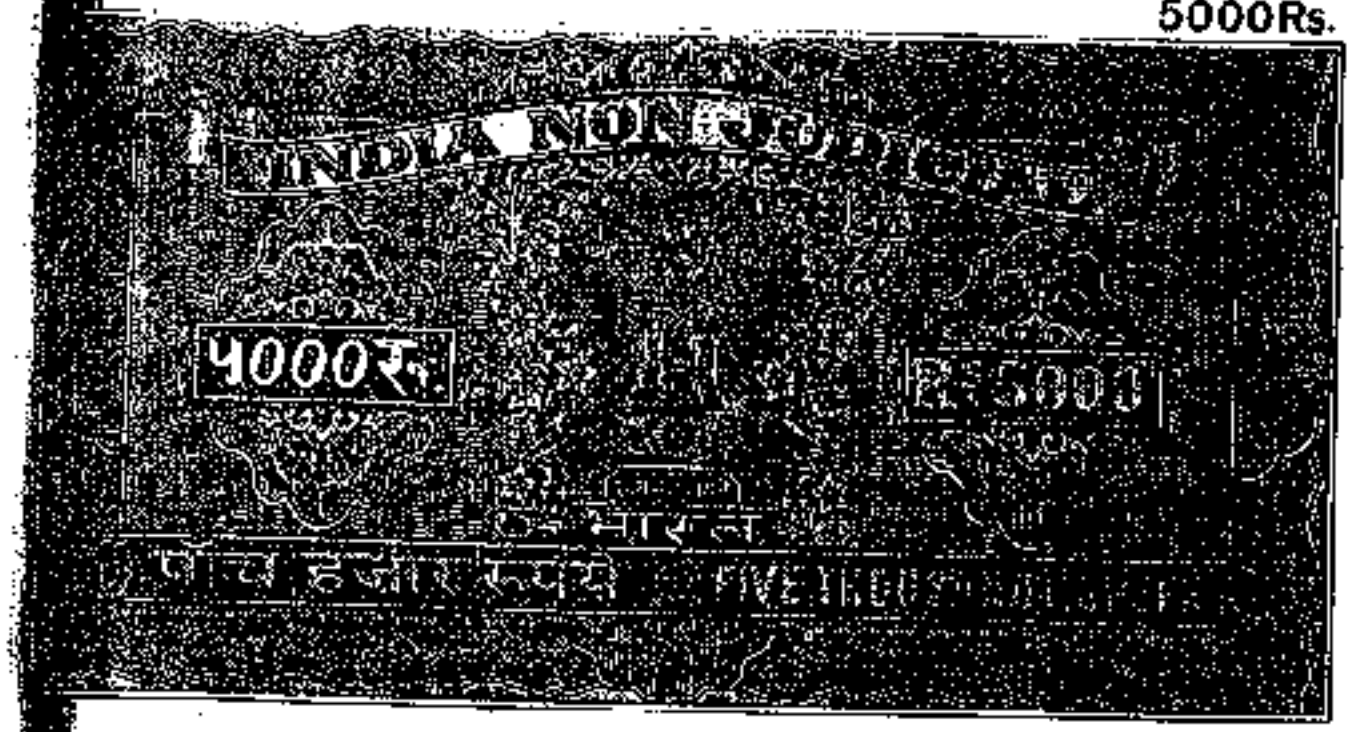

PROVIDED THAT no substantial hindrance or interference shall be caused by such holders of licences or leases to the operations of the lessee/ lessees under these presents and fair compensation (as may be mutually agreed upon or in the event of

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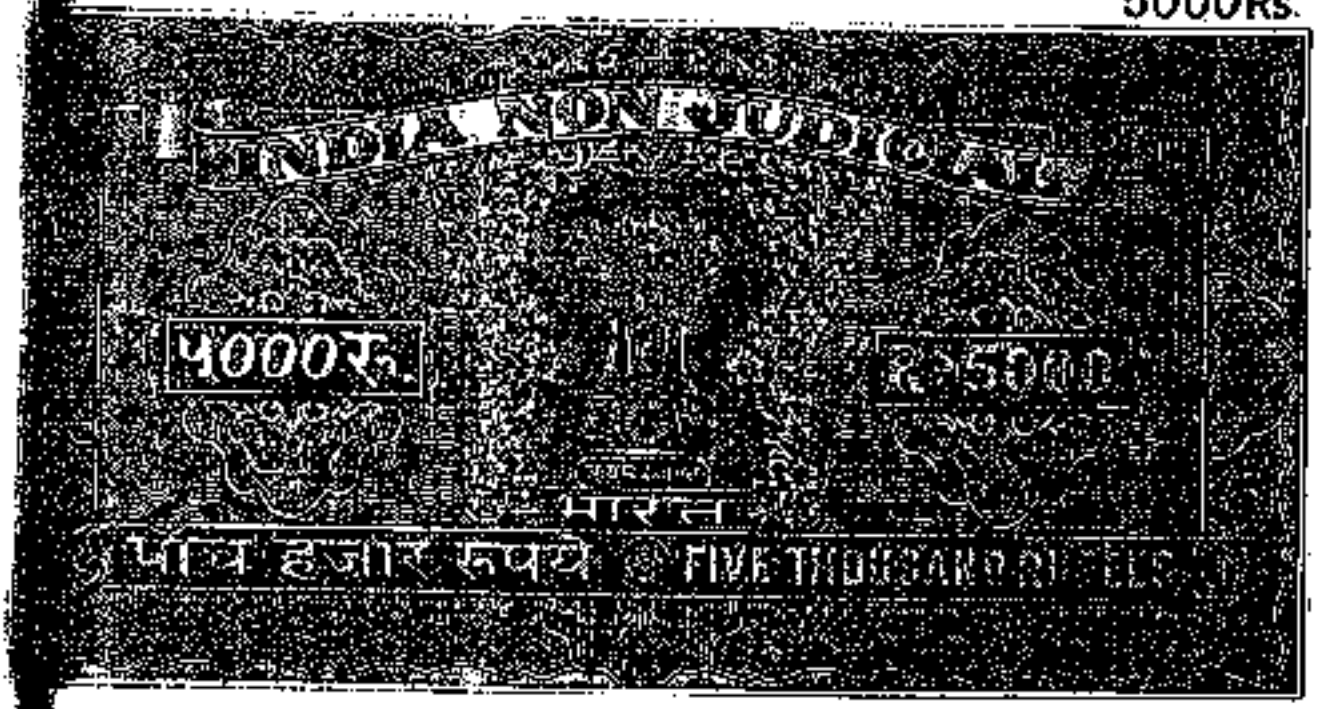

disagreement as may be decided by the State Government) shall be made to the lessee/lessees for loss or damage sustained by the lessee/lessees by reason of the exercise of this liberty.

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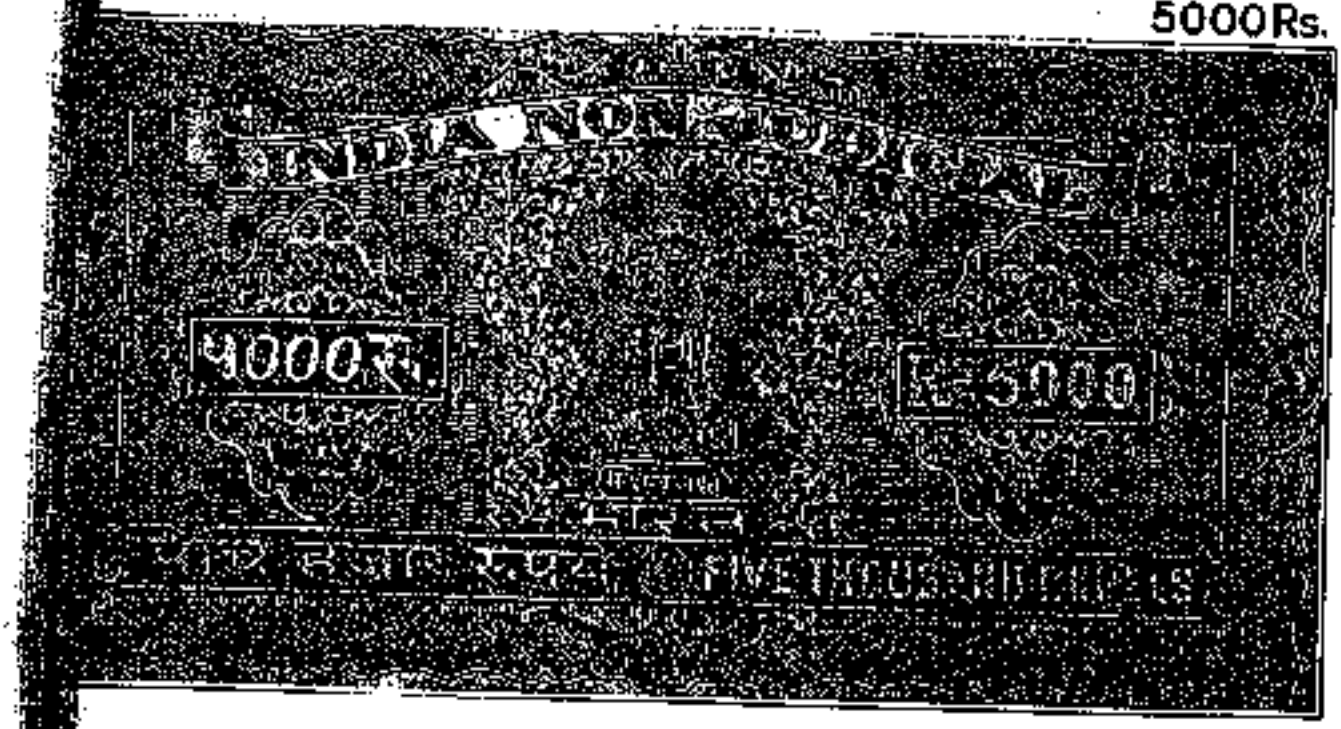

PART IV

LIBERTIES, POWERS AND PRIVILAGES RESERVED TO THE STATE GOVERNMENT

To work other minerals.

1 Liberty and power for the State Government, or to any lessee or persons authorised by it in that behalf to enter into and upon the said

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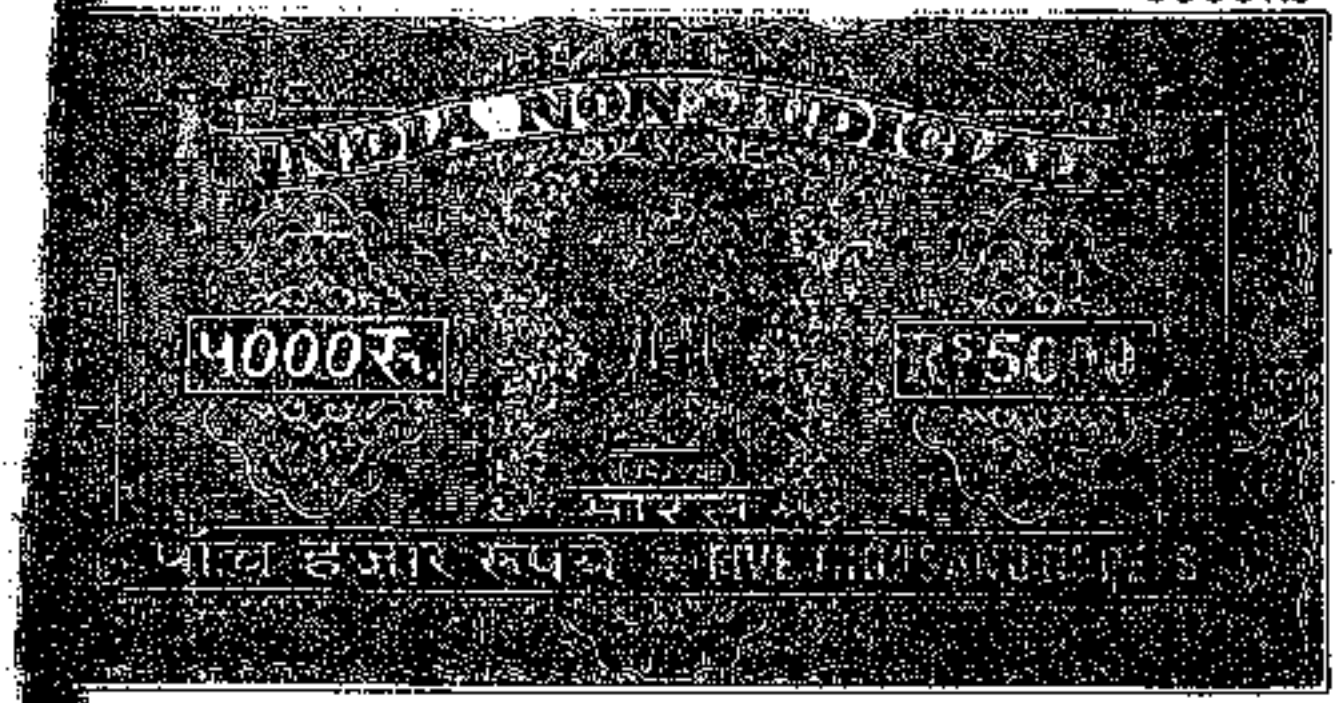

lands and to search for, win, work, dig, get, raise, dress, process, convert and carry away minerals other than the said minerals and anyother substances and for those purposes to sink, drive, make, erect, construct, maintain and use such pits,

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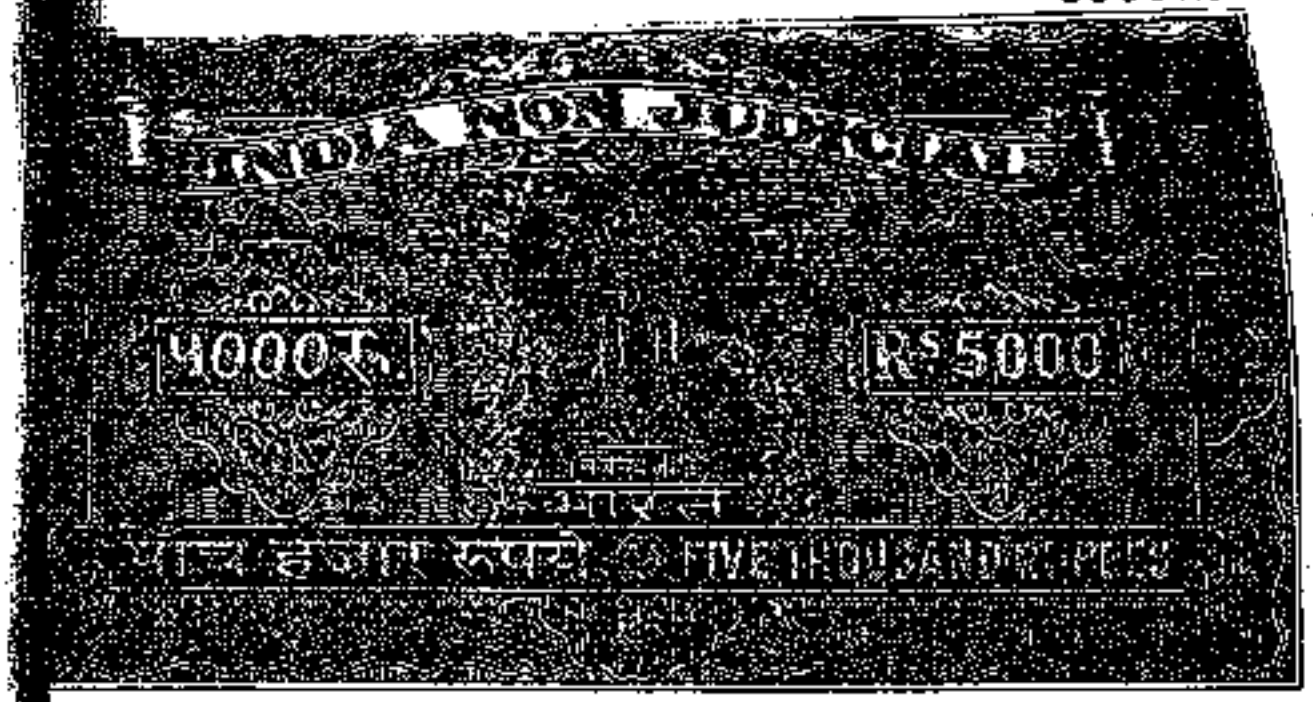

shafts, inclines, drifts, levels and other lines, waterways, airways, water courses, drains, reservoirs, engines, machinery, plant, buildings, canals, tramways, railways, roadways and other works and

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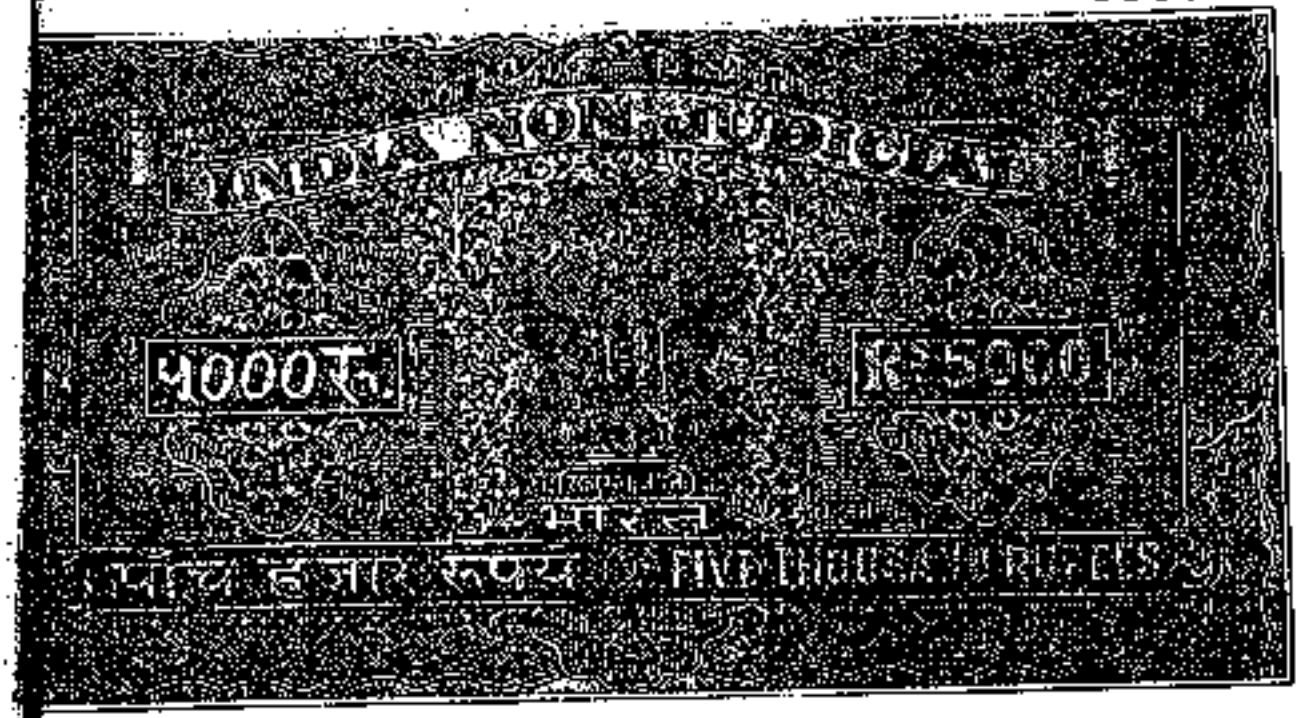

conveniences as may be deemed necessary or convenient.

PROVIDED THAT in the exercise of such liberty and power no substantial hindrance or interference shall be caused to or with the

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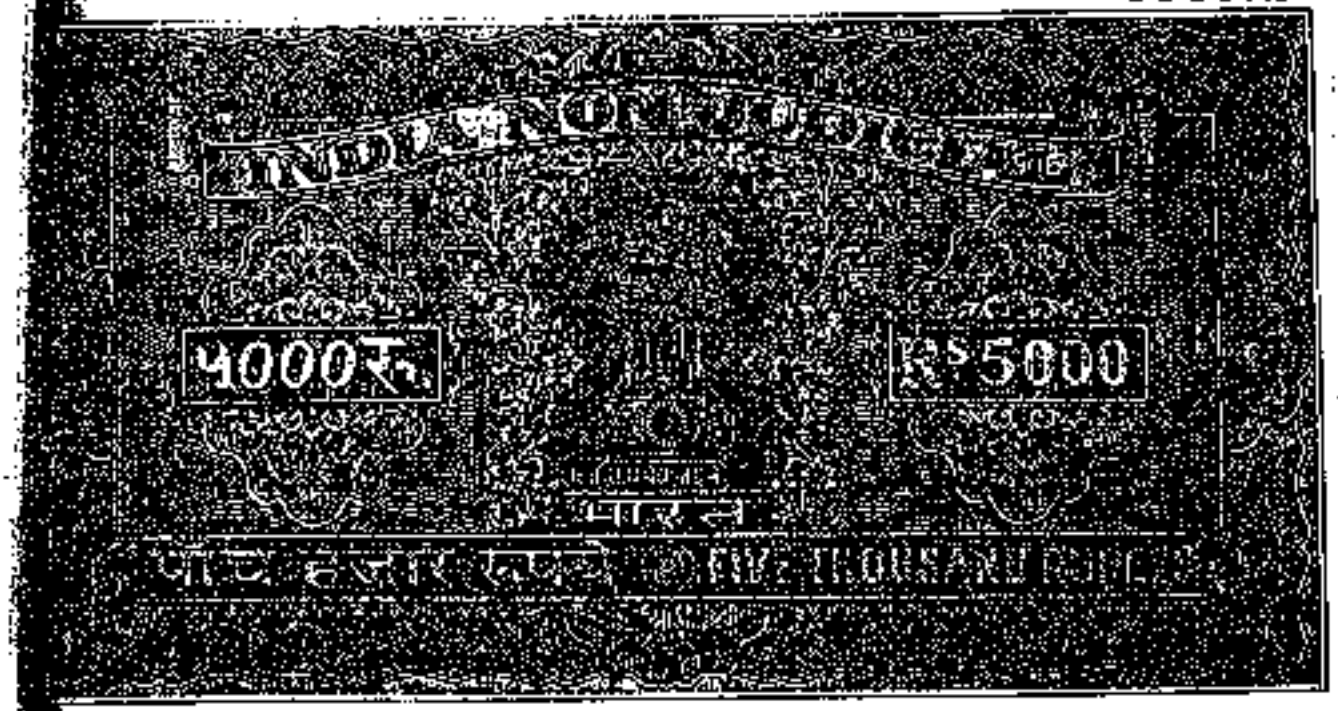

liberties, powers and privileges of the lessee/lessees under these presents and that fair compensation (as may be mutually agreed upon or in the event of disagreement as may be decided by the State Government) shall be made to the lessee/lessees

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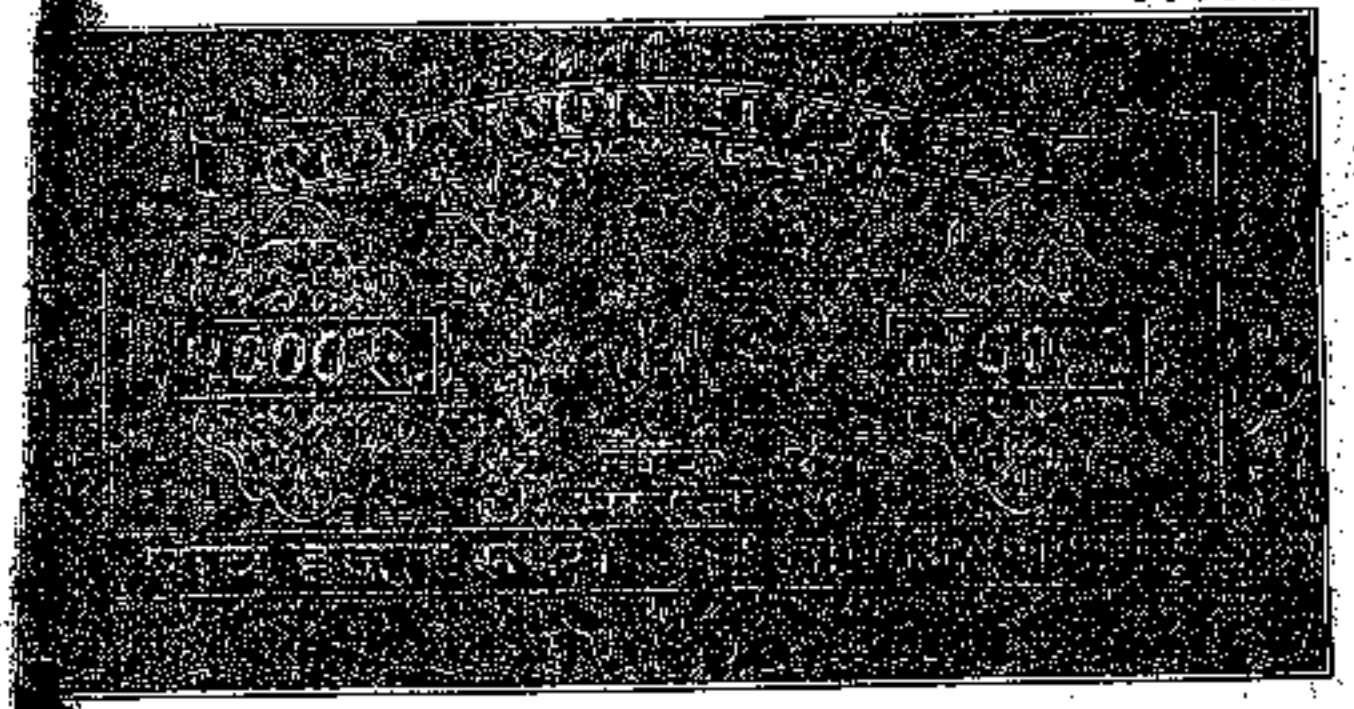
COLLECTOR, KASARGOD



for all loss or damage sustained by the lessee/lessees by reason or in consequence of the exercise of such liberty and power.

To make railways and roads.

2. Liberty and power for the State Government or any lessee or person

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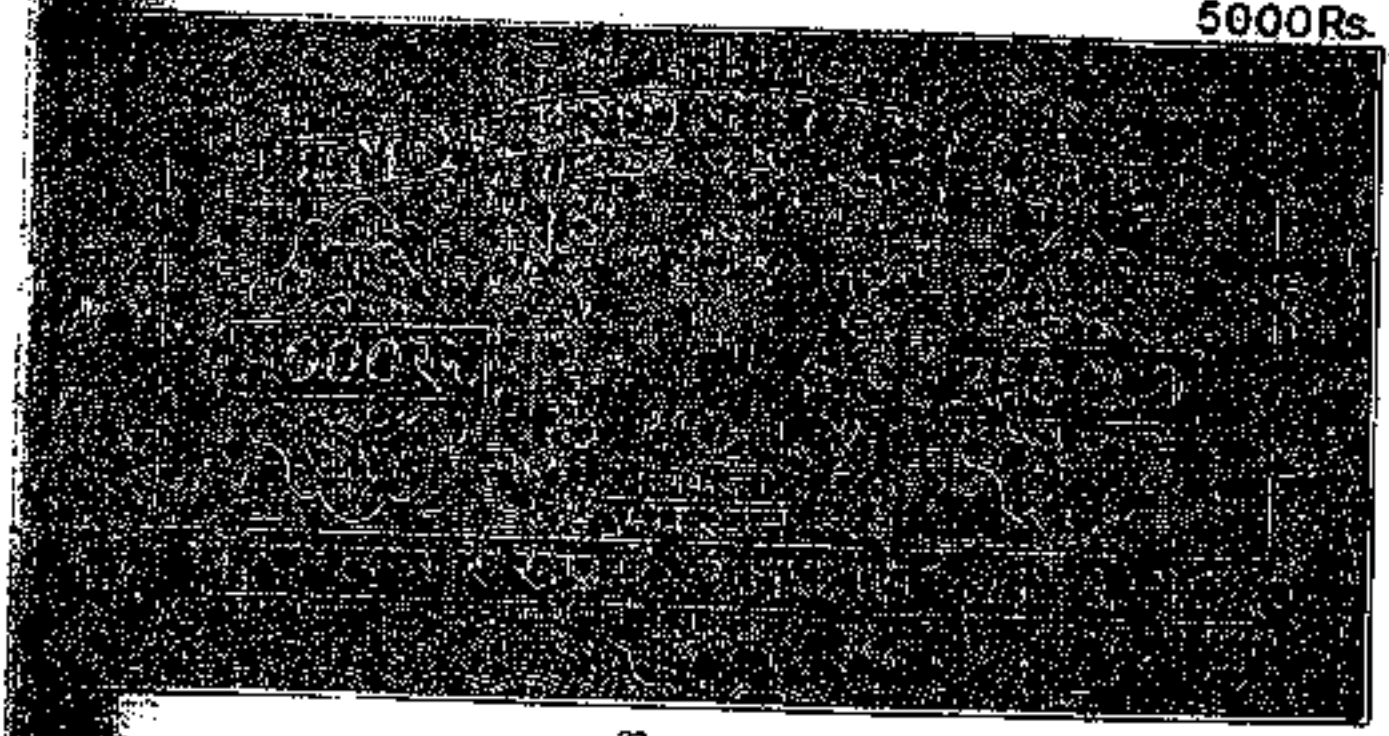

authorised by it in that behalf to enter into and upon the said lands and to make upon over or through the same any railways, tramways, roadways or pipolines for any purpose other than these mentioned in Part-II of these presents and to get from the said

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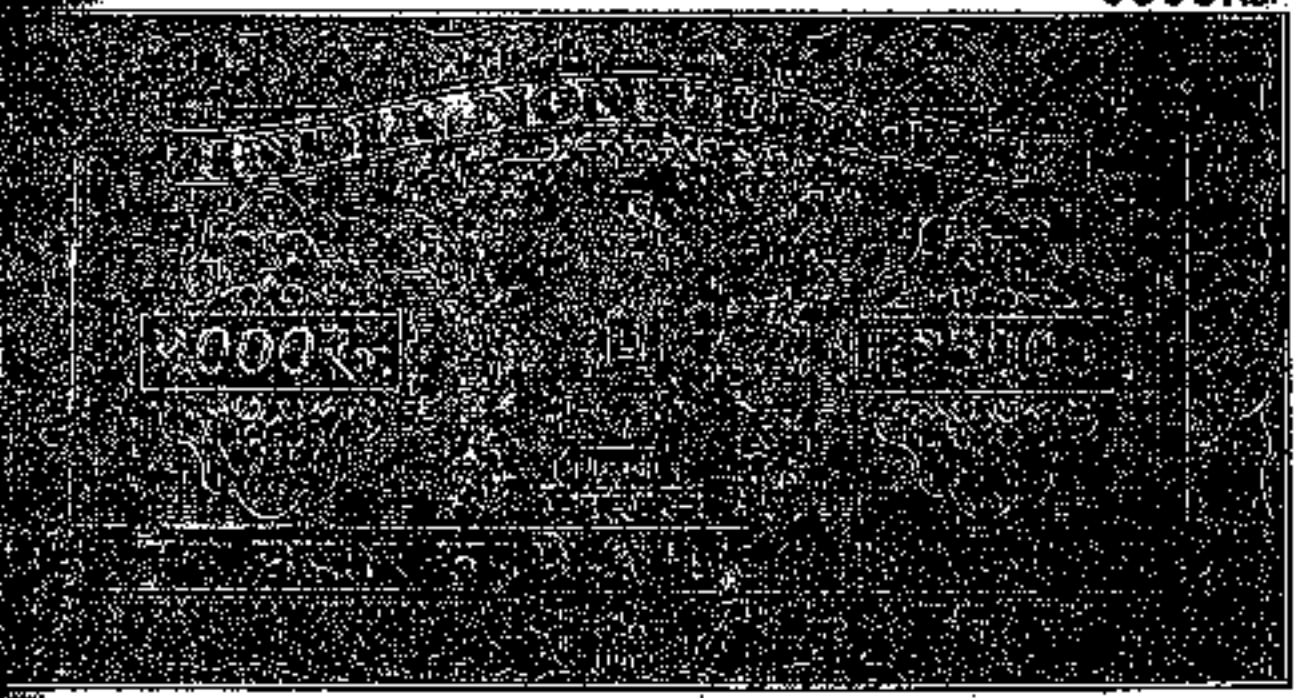

lands stones, gravel, earth and other materials for making, maintaining and repairing such railways, tramways and roads or any existing railways and roads and to and repass at all times with or without horses, cattle or other animals, carts,

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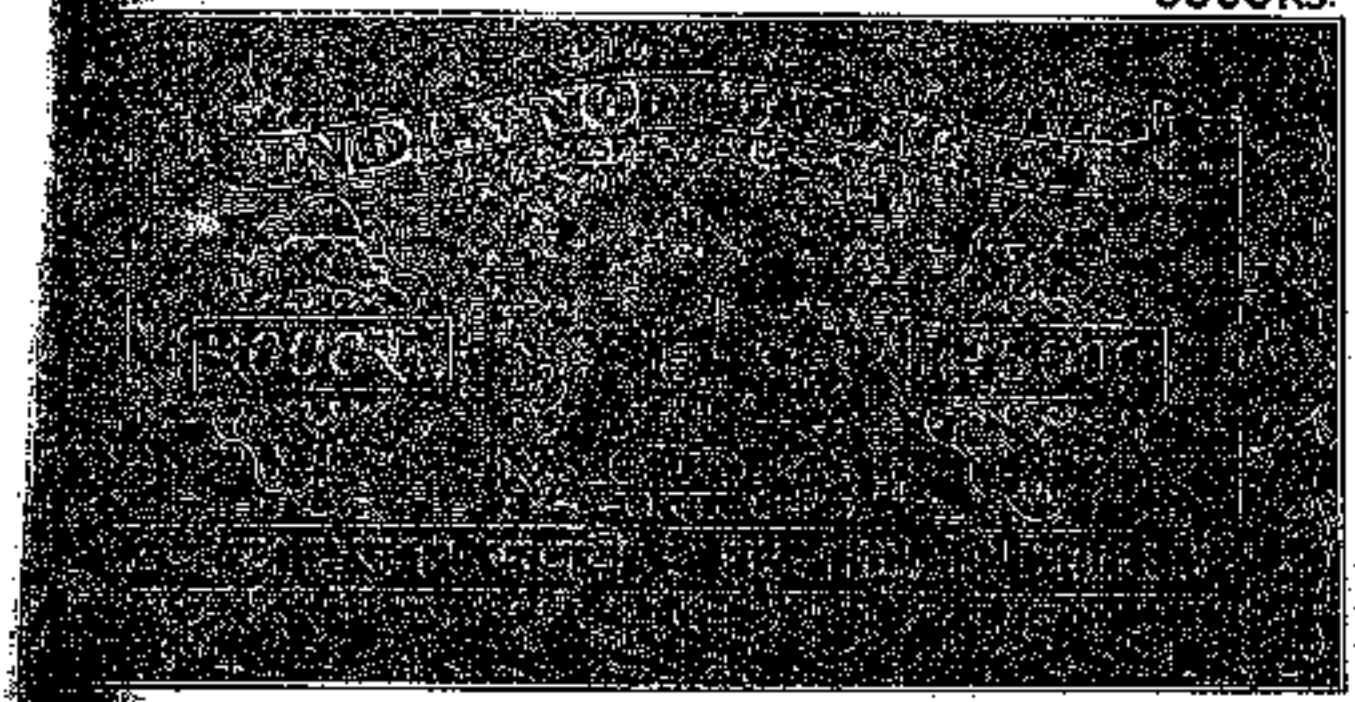

wagons, carriages, locomotives or other vehicles over or along any such railways, tramways, road lines and other ways for all purposes and as occasion may require, provided that in the exercise of such liberty and power by such other lessee or person

Cont....

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no substantial hindrance or interference shall be caused to or with the liberties, powers and privileges of the lessee/lessees under these presents and that fair compensation as may be mutually agreed upon or in the event of

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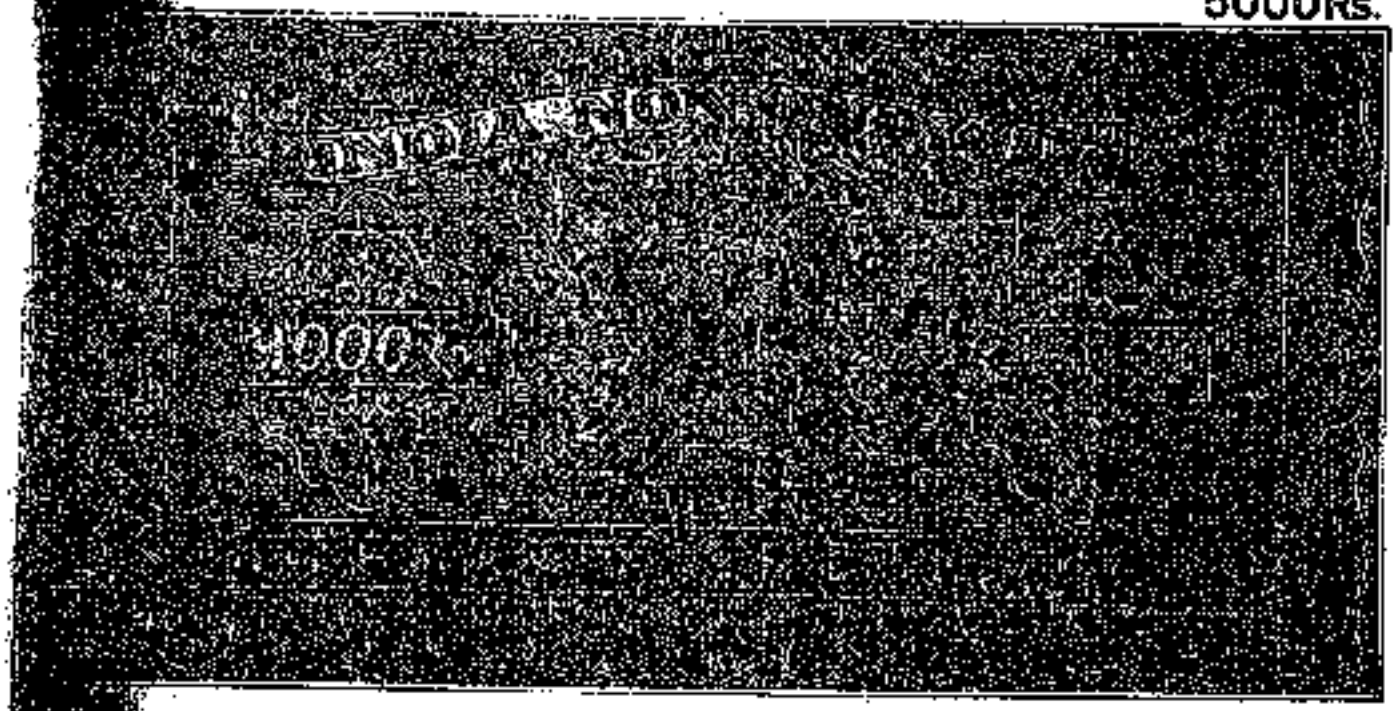

disagreement as may be decided by the State Government shall be made to the lessee/lessees for all loss or damage substantial hindrance or interference shall be caused to or with the exercise by such lessee or person of such liberty and power.

Cont...

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PART V

RENTS AND ROYALTIES RESERVED BY THIS LEASE

To pay dead rent or royalty whichever is higher.

1. The lessee shall pay, for every year except the first year of the lease, dead rent as specified in clause 2 of this Part :

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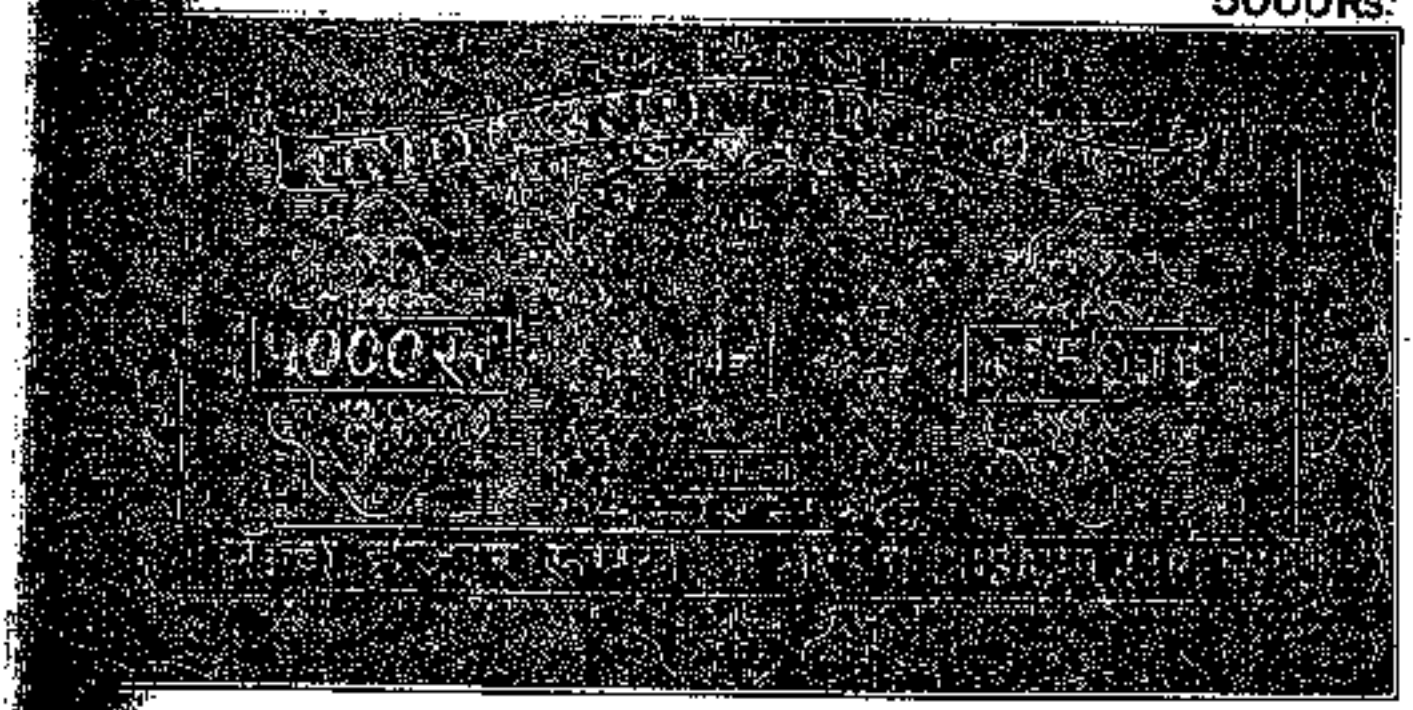

Provided that, where the holder of such mining lease becomes liable under section 9 of the Act, to pay royalty for any mineral removed or consumed by him or by his agent, manager, employee, contractor or

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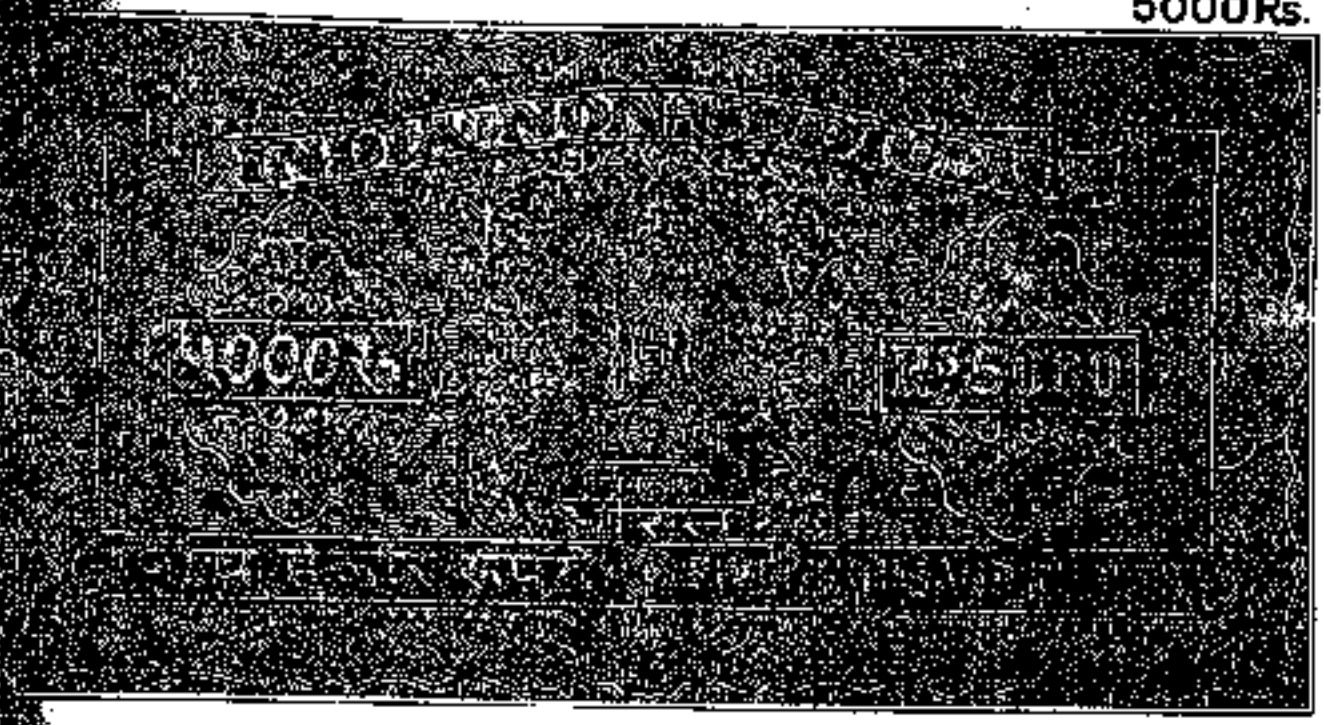

sub-lessee from the leased area, he shall be liable to pay either such royalty or the dead rent in respect of that area, whichever is higher.

Rate and mode of payment of dead rent.

2. Subject to the provisions of clause 1 of this Part, during the subsistence

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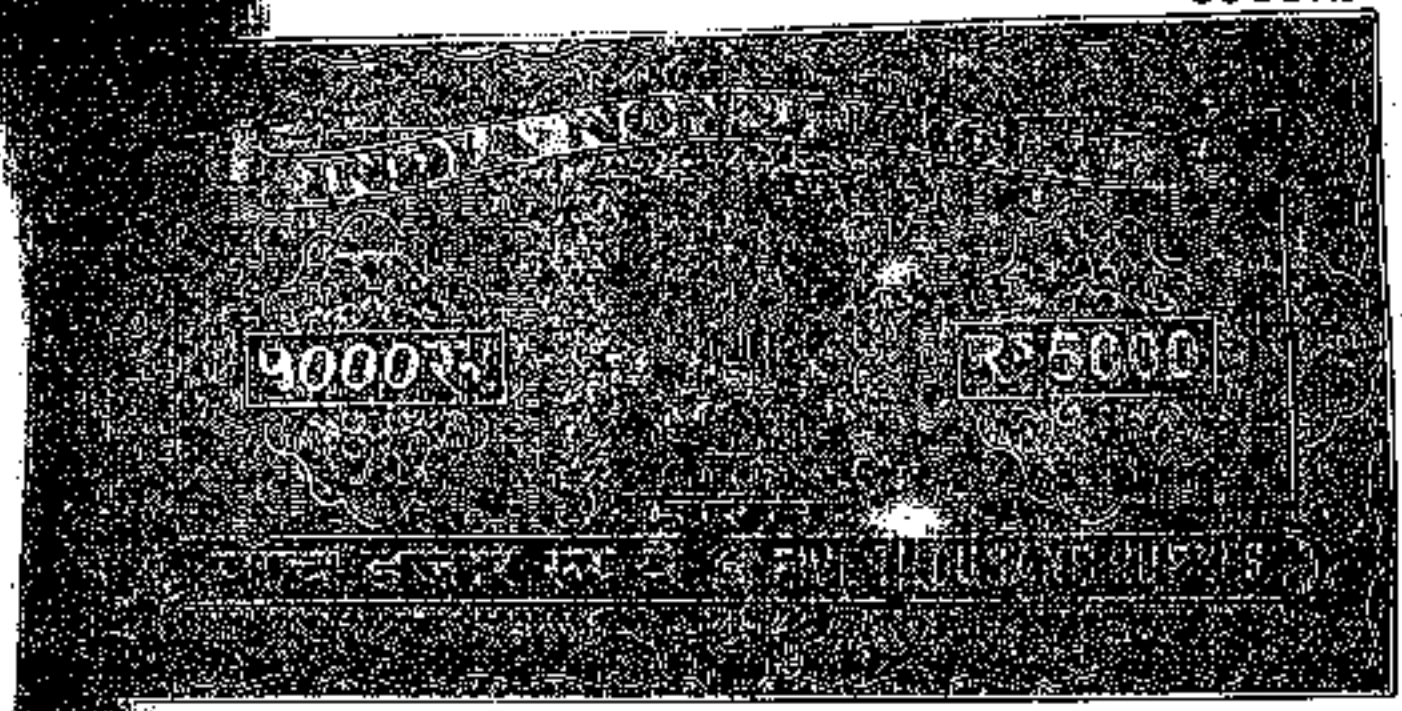

of the lease, the lessee/lessees shall pay to the State Government annual dead rent for the lands demised and described in Part I of this Schedule at the rate of the time being specified in the Third Schedule to the Act, in

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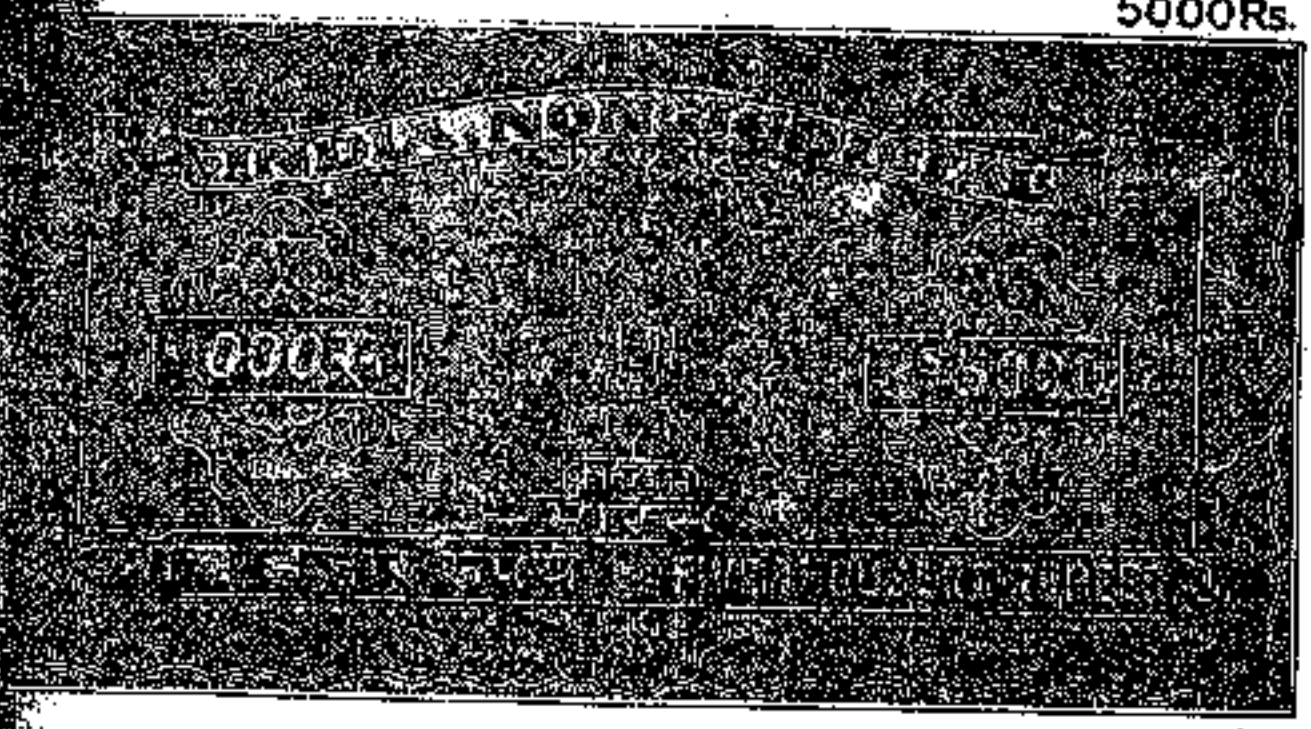

such manner as may be specified in this behalf by the State Government.

Rate and mode of payment of royalty

3. Subject to the provision of clause-1 of this Part, the lessee/lessees shall during the subsistence of this lease pay to the State Government at such

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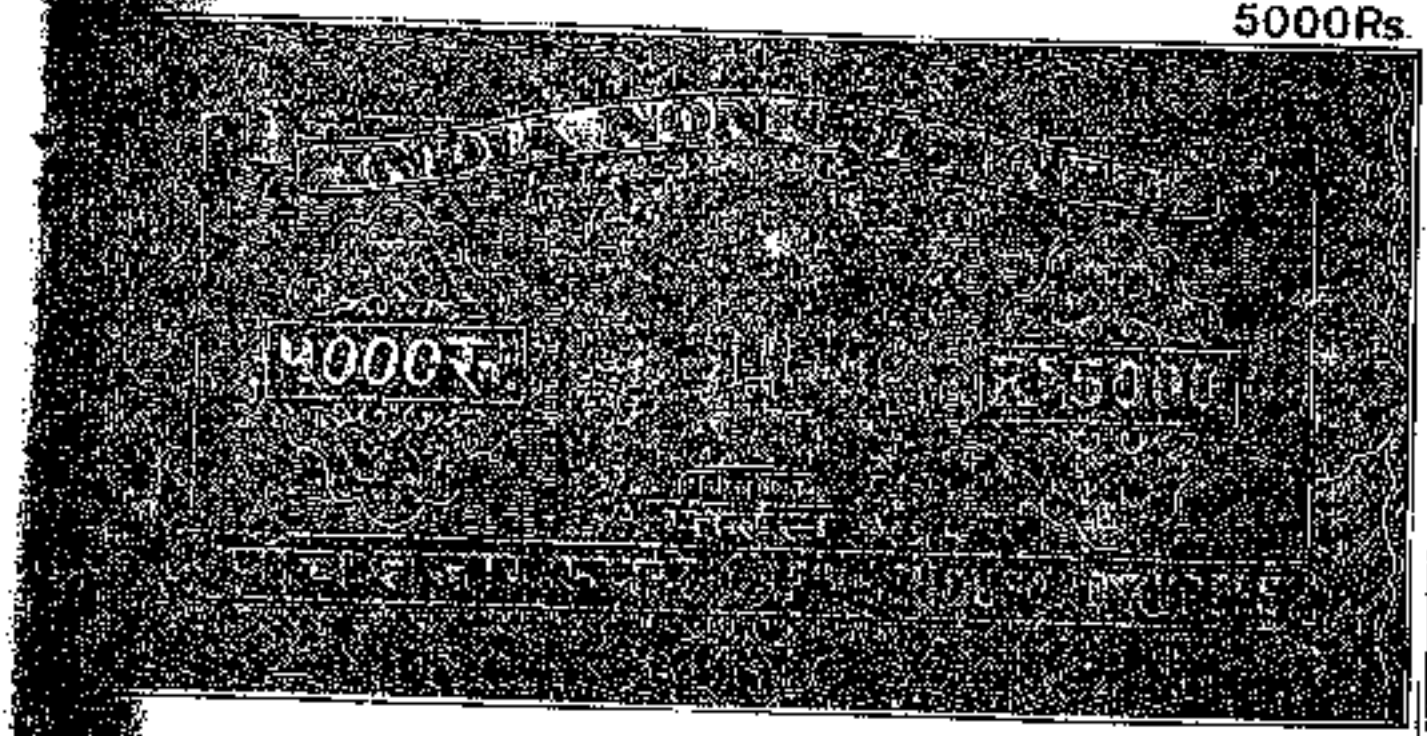

times and in such manner as the State Government may prescribe royalty in respect of any mineral/minerals removed by him/them from the leased area at the rate for the time being specified in the Second Schedule to the Mines and Minerals

Cont....

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(Regulation and Development)

Act, 1957.

Payment of surface rent, and water rate

4. The lessee/lessees shall pay rent and water rate to the State Government in respect of all parts of the surface of the said lands which shall from

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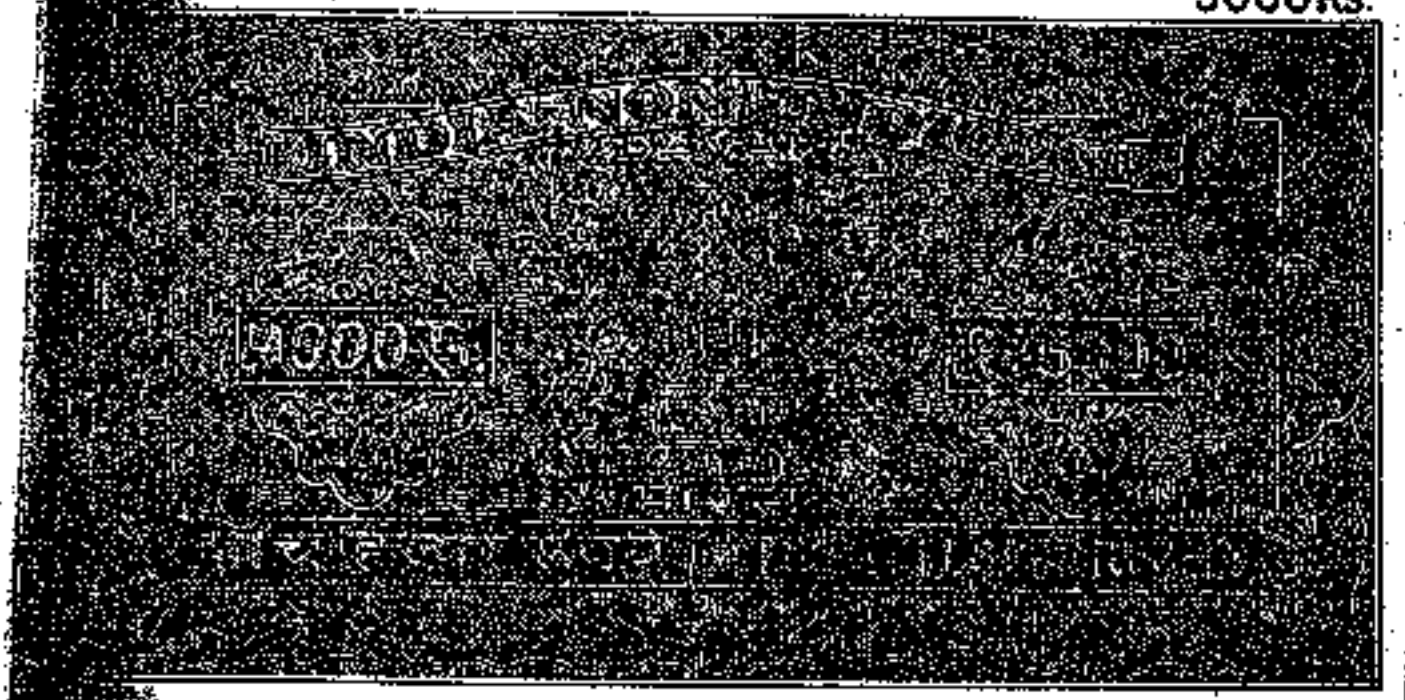

time to time be occupied or used by the lessee/lessees under the authority of these presents at the rate of Rs.10/- for waste lands and at rates not exceeding rates of land revenue and cesses for cultivated lands and water rent at the rates as may fixed

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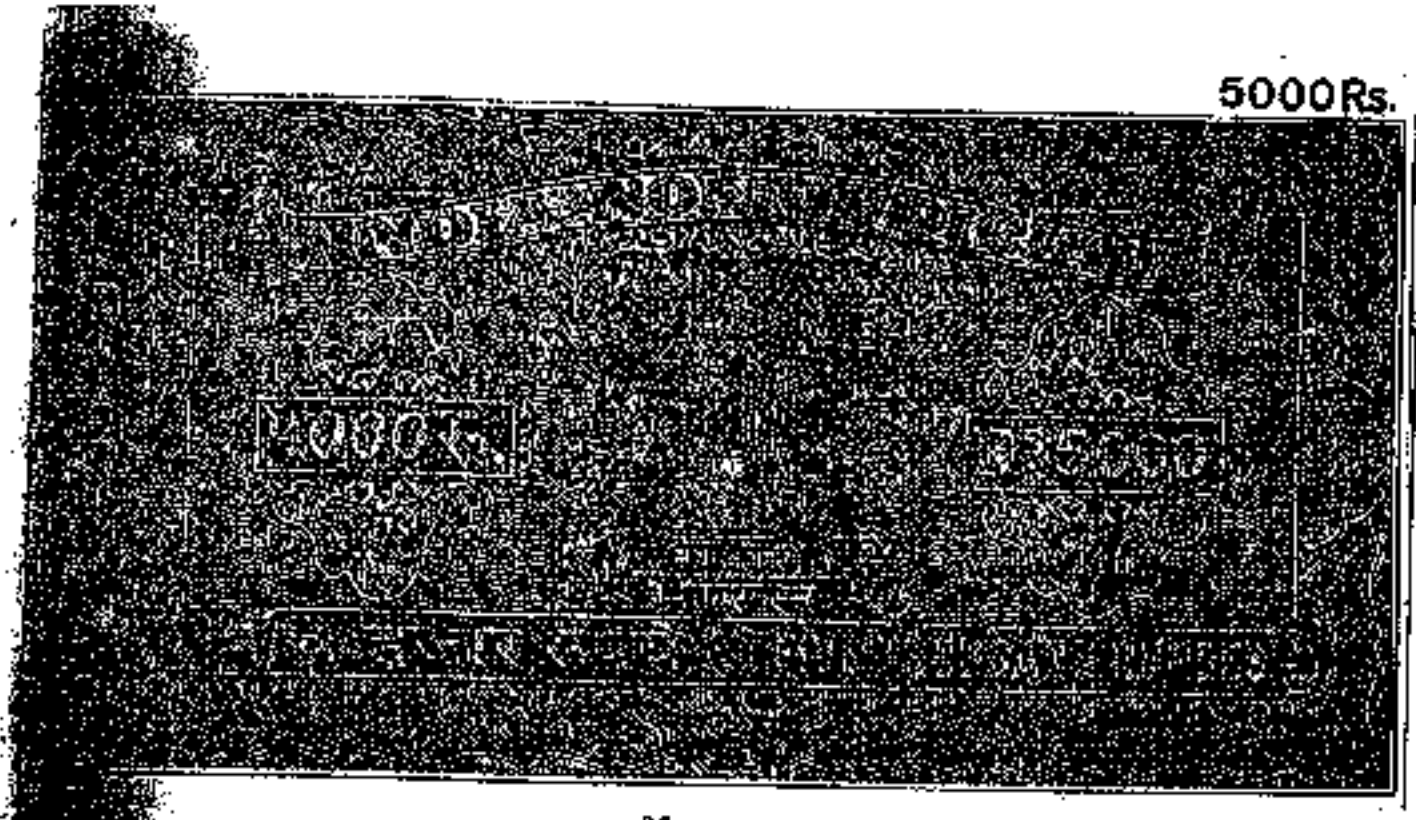

from time to time per annum per hectare of the area so occupied or used and so in proportion for any area less than a hectare during the period from the commencement of such occupation or used until the area shall cease to be so occupied or

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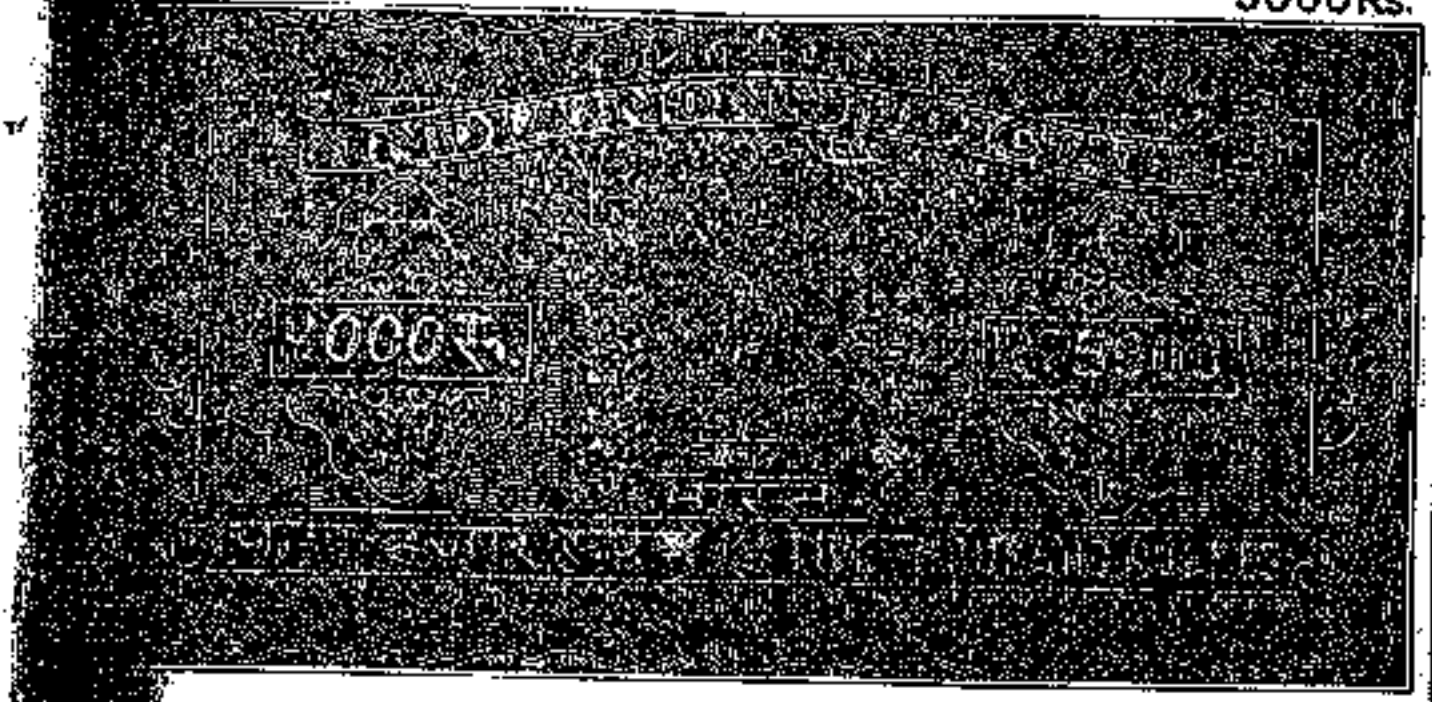

used and shall as far as possible restore the surface land so used to its original condition. Surface rent and water rate shall be paid as hereinbefore detailed, in clause 2. PROVIDED THAT NO such rent/water rate shall be payable in

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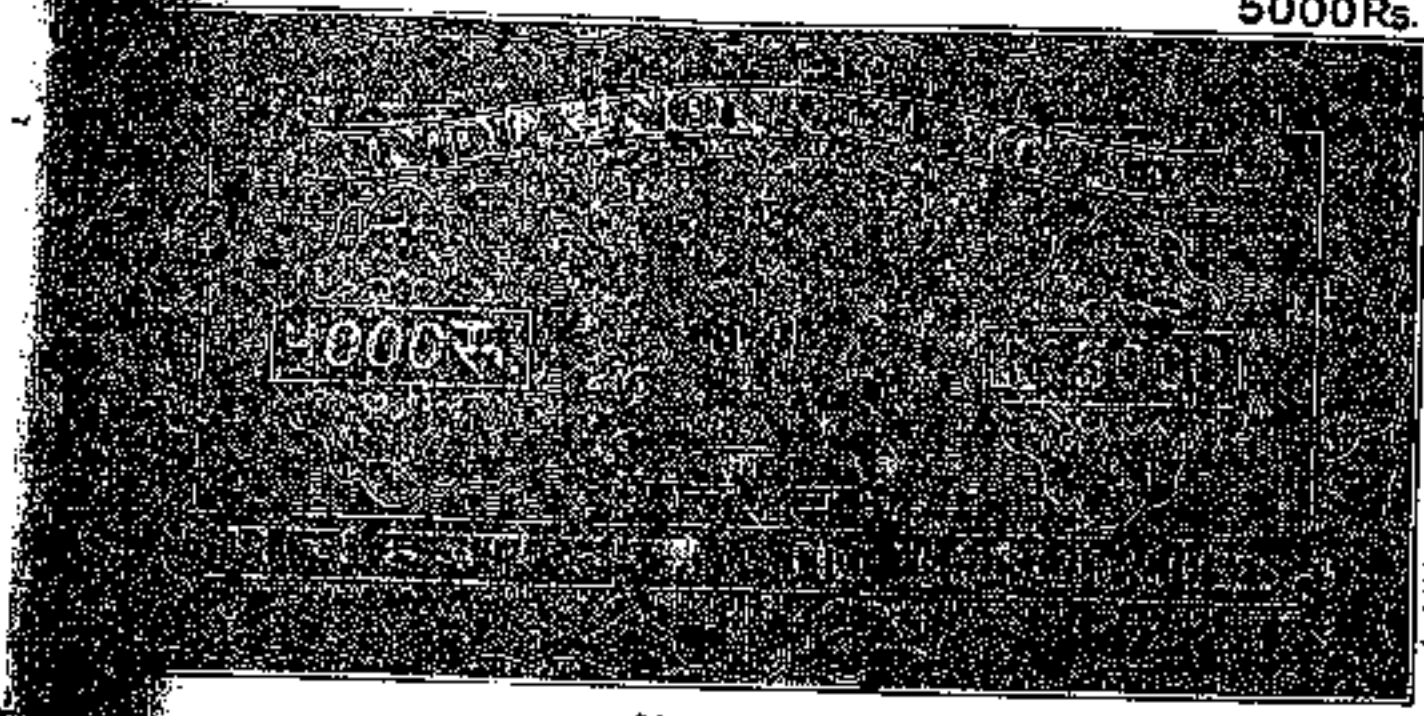

used and shall as far as possible restore the surface land so used to its original condition. Surface rent and water rate shall be paid as hereinbefore detailed in clause 2; PROVIDED THAT NO such rent/water rate shall be payable in

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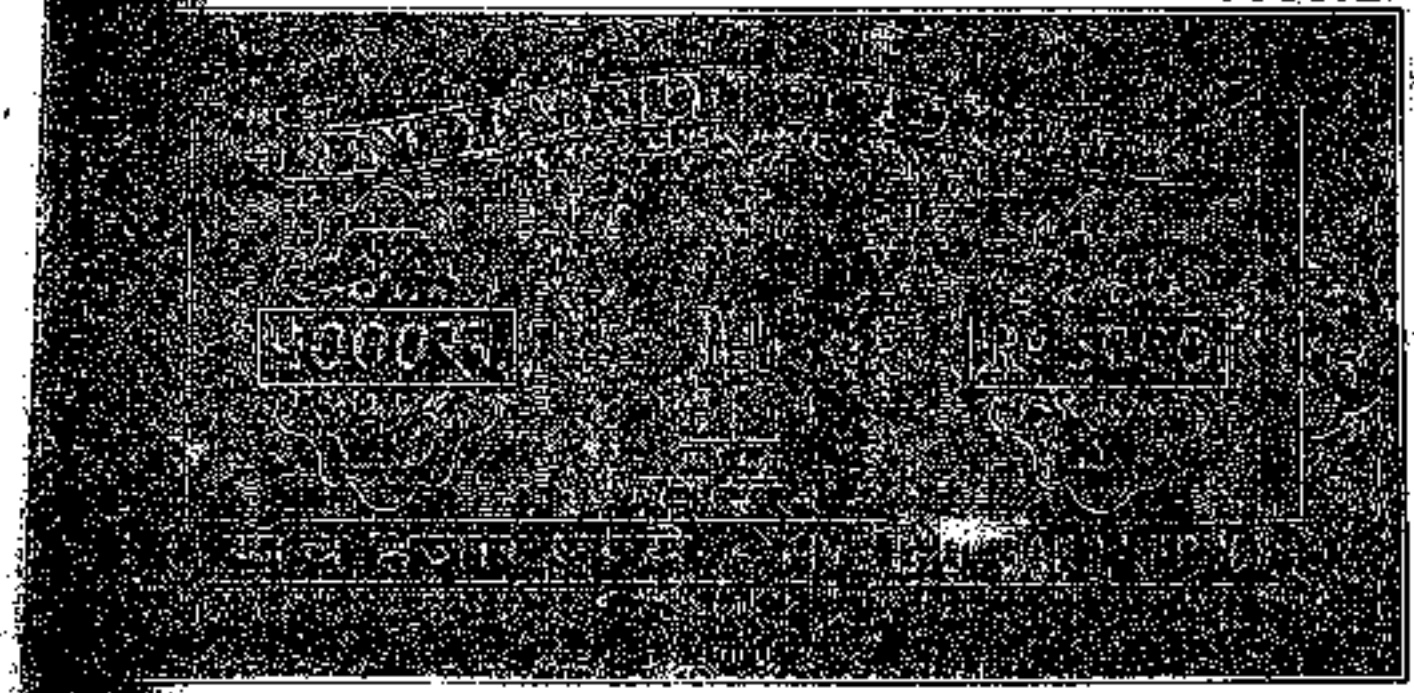

respect of the occupation and use of the area comprised in any roads or ways to which the public have full right of access.

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PART VI

PROVISIONS RELATING TO THE RENTS AND ROYALTIES

Rent and royalties to be free from deduction etc.

1. The rent, water rate and royalties mentioned in Part V of this Schedule shall be paid free from any deductions to the State

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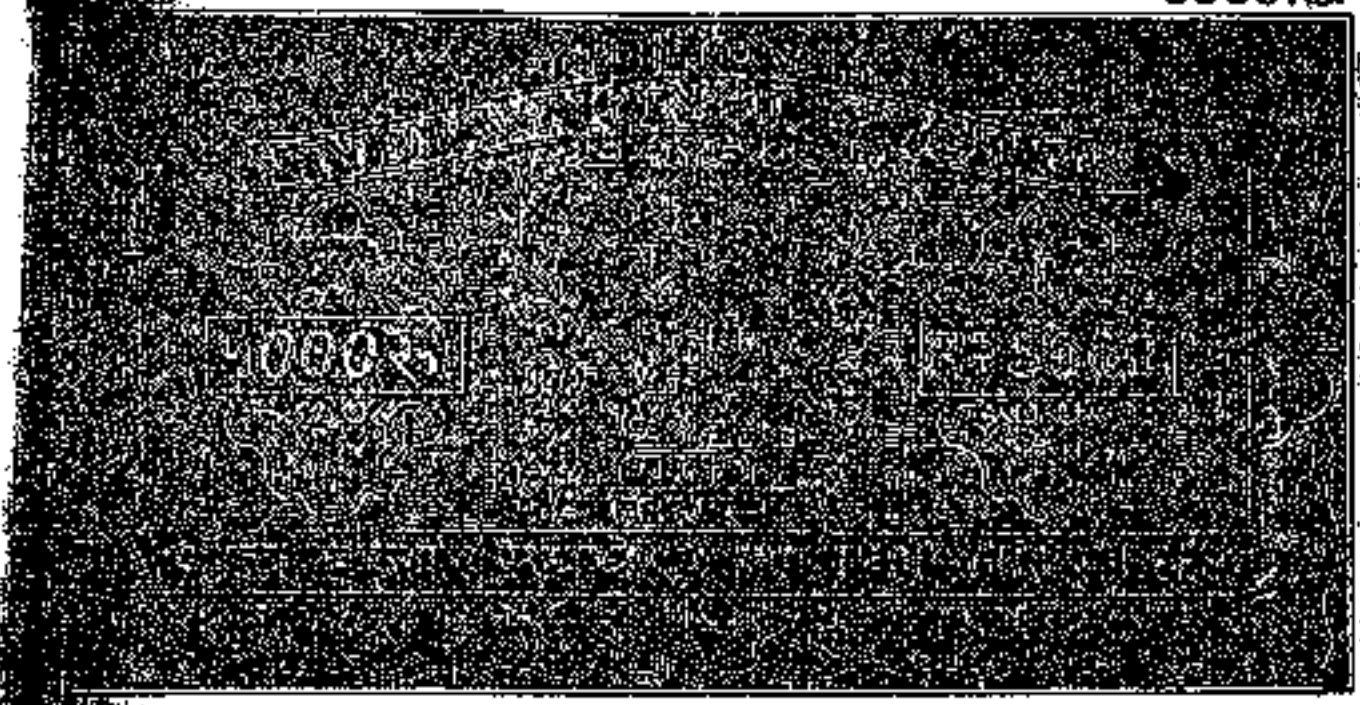

Government at Jajpur Road Sub-Treasury and such manner as the State Government may prescribe PROVIDED ALWAYS and it is hereby agreed that Rs.2,000/- the balance standing to the credit of the lessee/lessees on account of the

Cont...

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deposit made by him/them as a licensee/Licensees over an area which included the said lands shall be retained and accepted by the State Government in satisfaction of the rents and royalties mentioned in Part V until they reach that amount.

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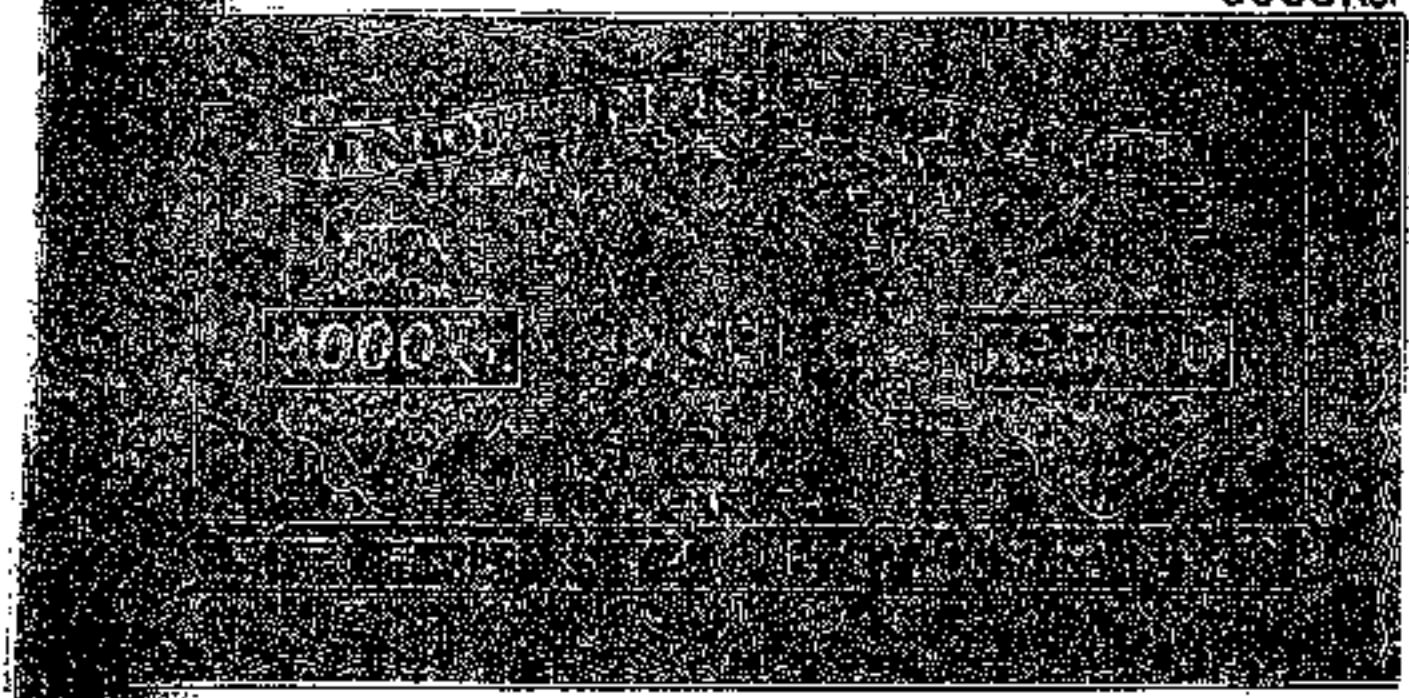

Mode of computation of royalty

2. For the purposes of computing the said royalties the lessee/lessees shall keep a correct account of the mineral/minerals produced and despatched. The accounts as well as the weight of the mineral/minerals in

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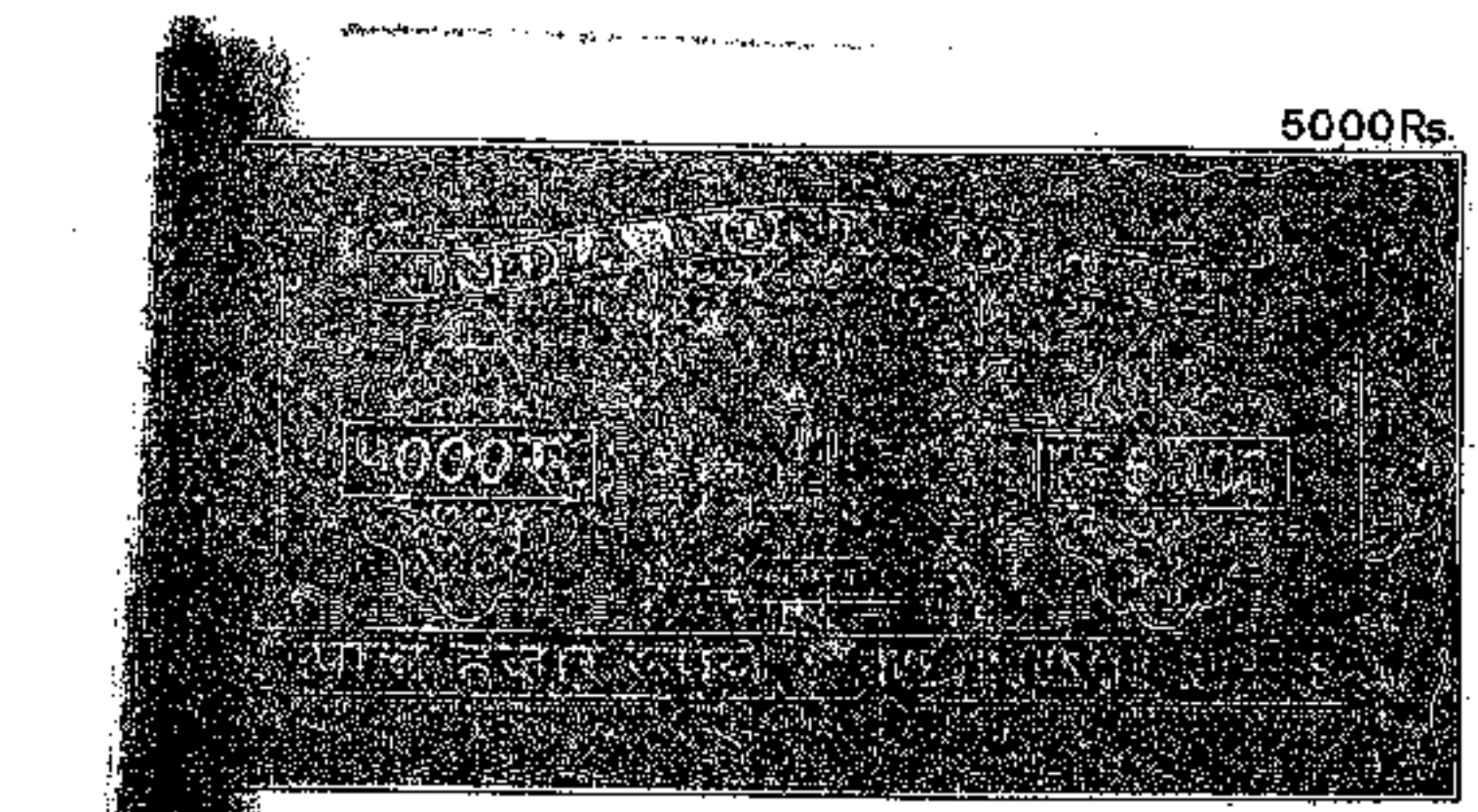

stock or in the process of export may be checked by an officer authorised by the Central or State Government.

** (a) Notwithstanding any proof that may be produced by the lessee/lessees of sale at pit's mouth of the ore at any lower price, for the

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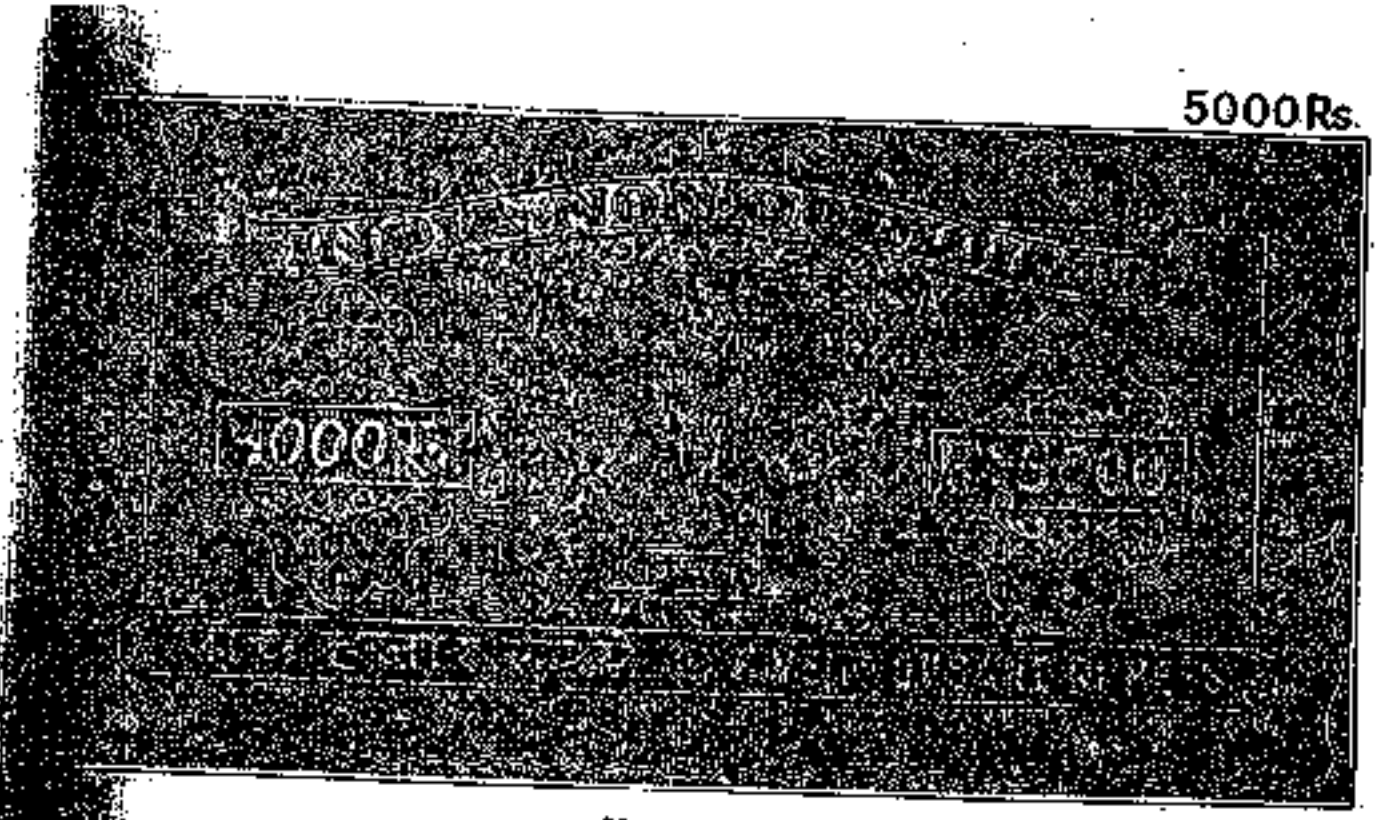

purpose of calculation of royalty, the sale price at the pit's mouth shall be calculated back from the price of the ore of recognised markets for the ore in the country. The State Government shall declare from time to time the Commercial Bulletins or

Cont....

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Government Statistical Bulletins from which the prevailing price shall be ascertained for the important markets for the mineral. The State Government shall also declare from time to time what they consider fair price of the mineral at the market or

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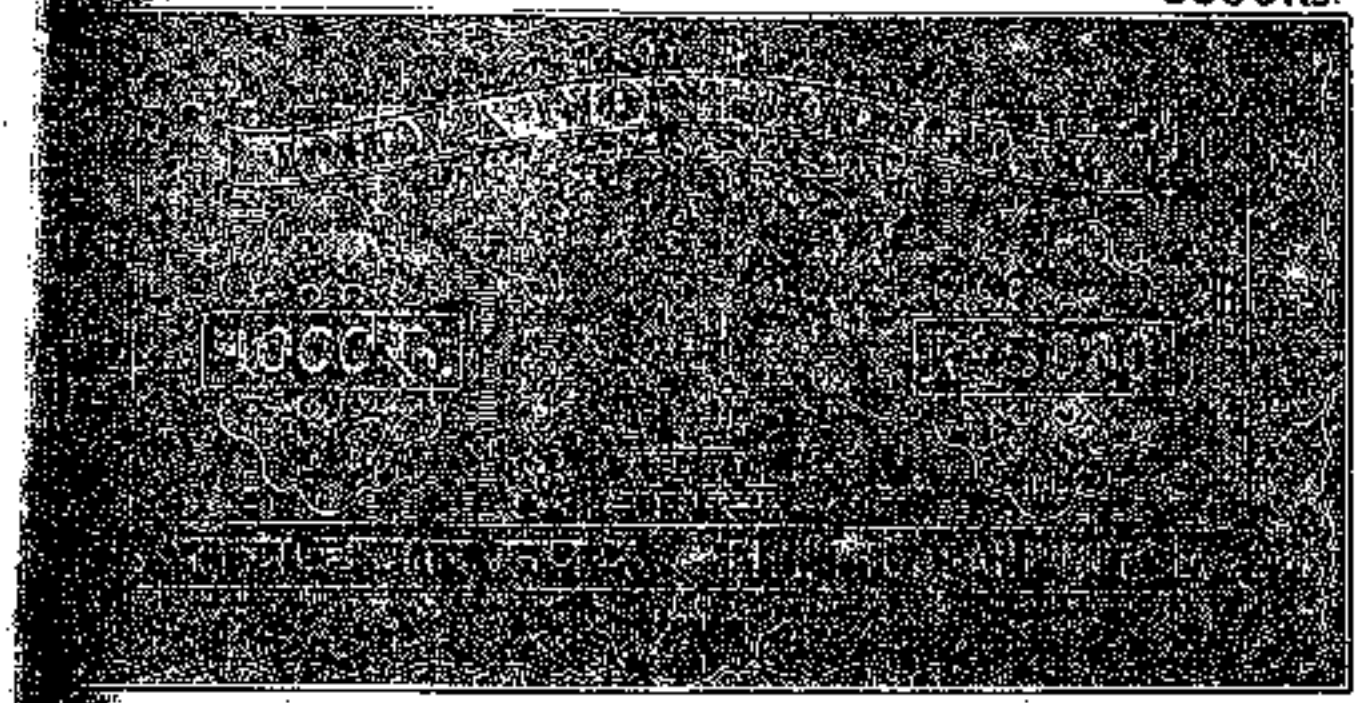

markets recognised by the trade and also what they consider fair transport and handling charges for the mineral from the pit's head to the important markets either in general or specific mines. The highest price at pit's head on the basis of such prices and

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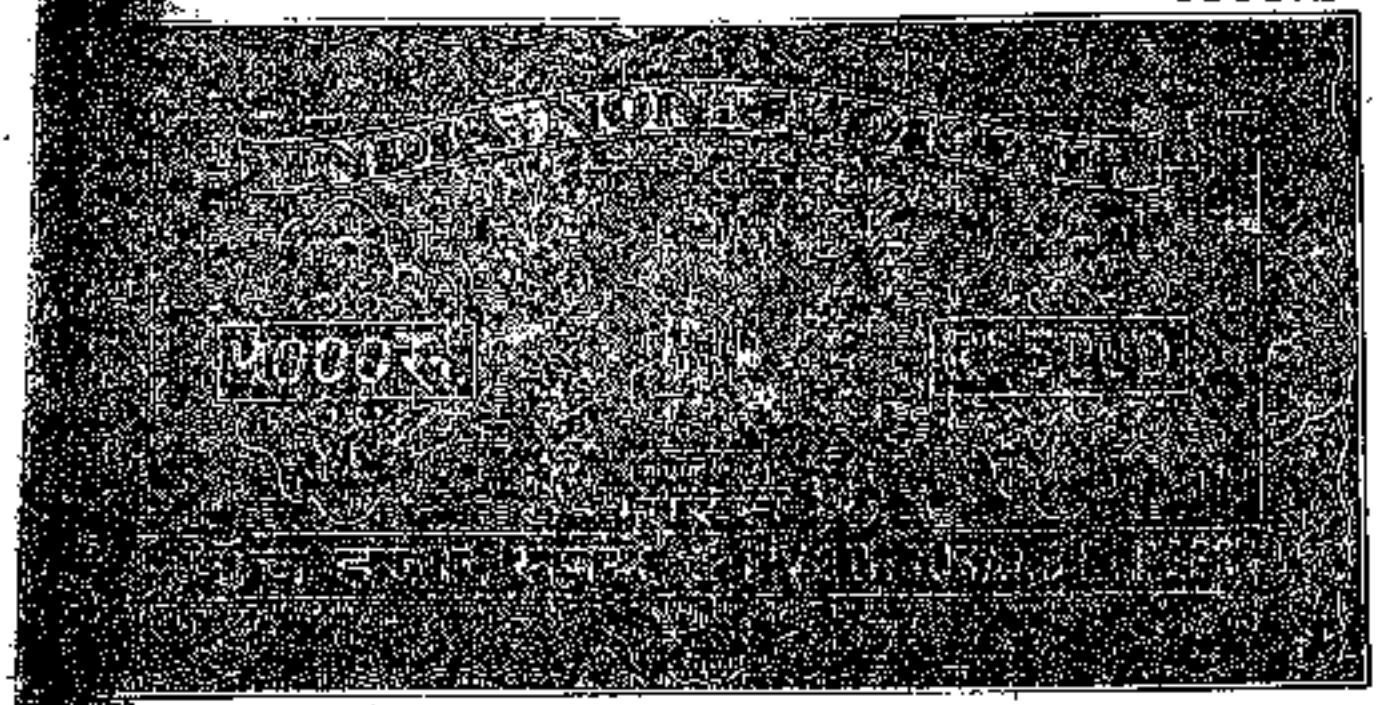

transport and handling charges shall be taken as the sale price at pit's mouth.

(b) For the purpose of computing the said royalties the quality of the ore shall be ascertained as follows:

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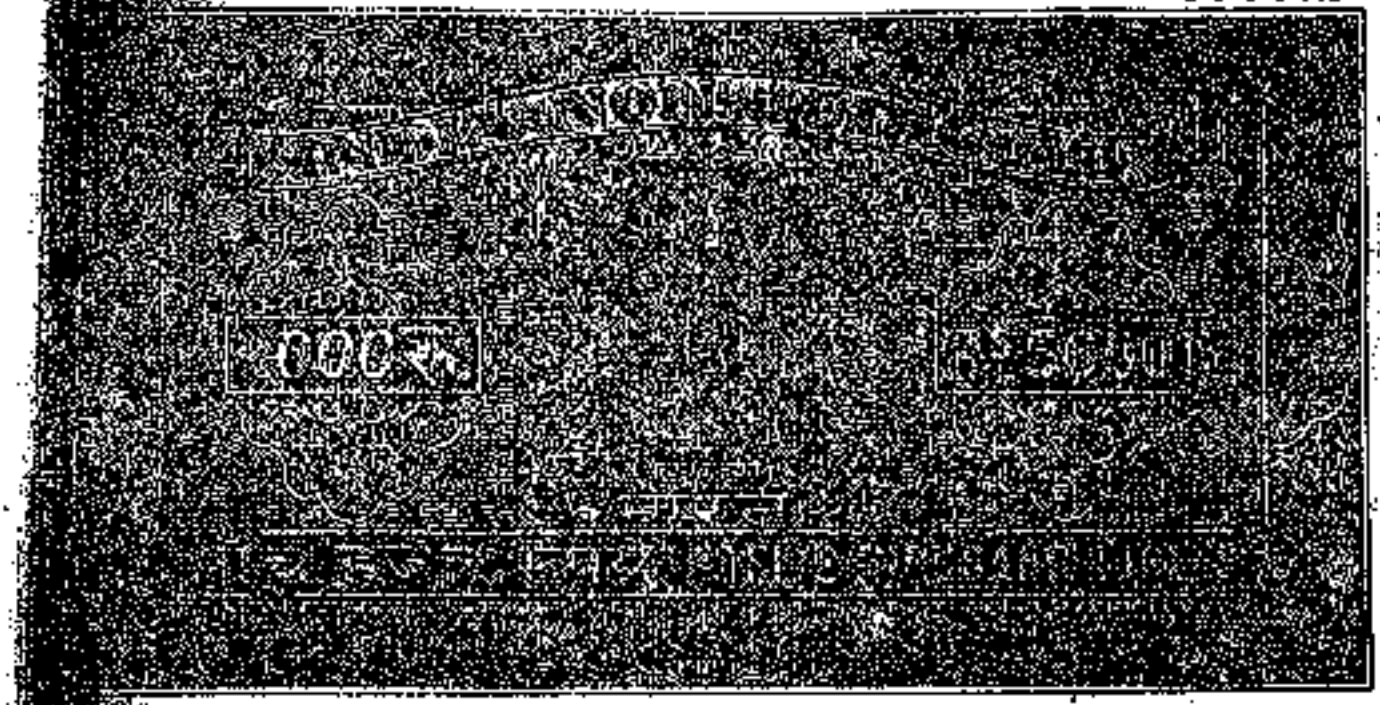

The lessee shall, before despatch, whether the ore has been sold at site or not, or before beneficiation shall grade the ore into such qualities as may be prescribed by the State Government and every consignments

Cont...

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despatched or sent for beneficiation shall not contain ore of more than one such grade. The lessee shall produce evidence of analysis of each consignment despatched or sold or beneficiated by laboratory recognised in the trade for such

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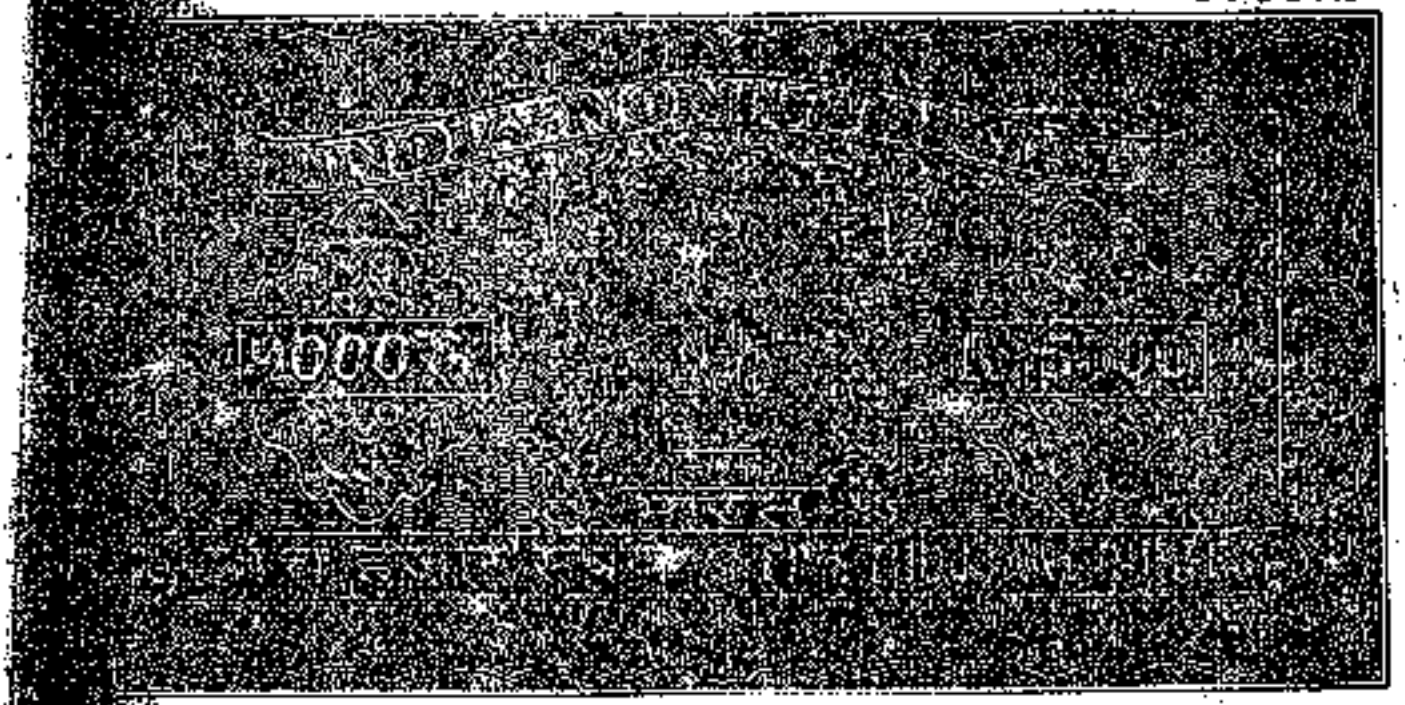

analysis within two months of the sale, despatch or beneficiation and such analysis report which shall contain analysis of the various factors which the State Government may specify in this behalf shall be taken subject to the following

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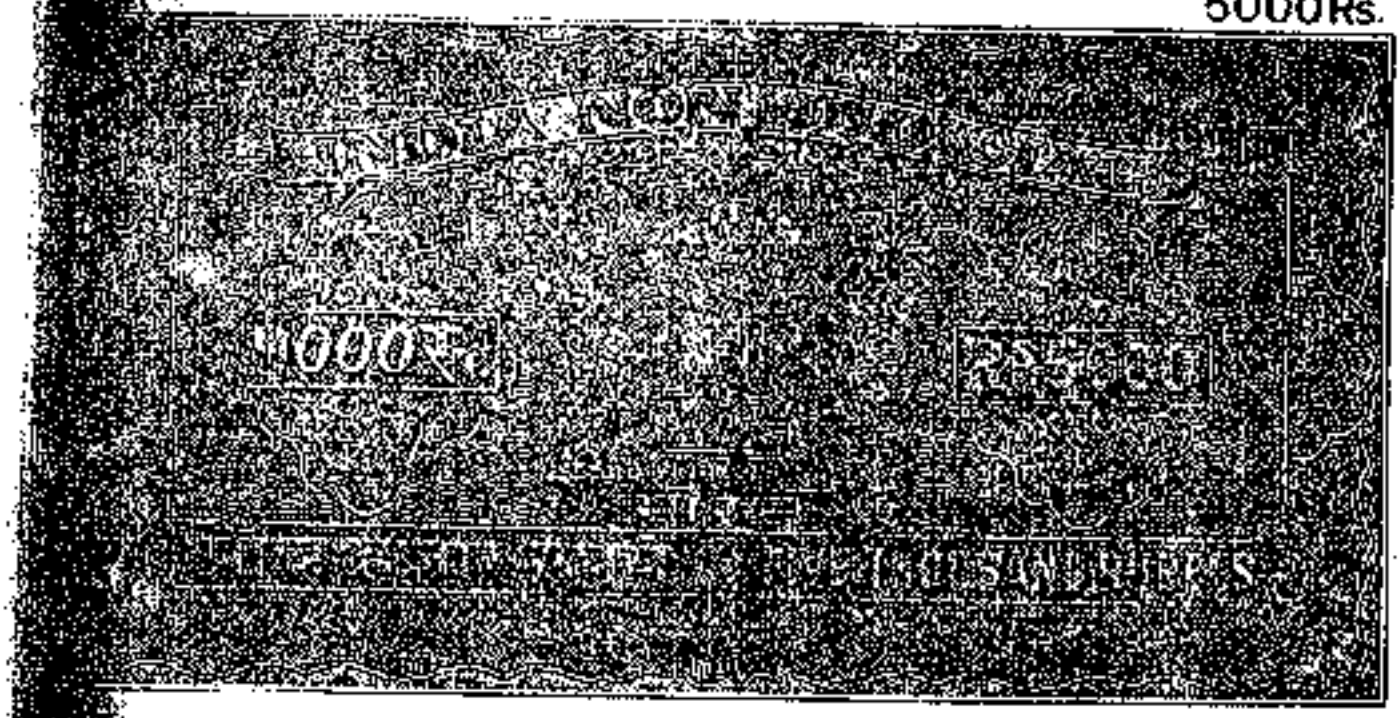

proviso as the quality report for assessing quality of the Ore;

PROVIDED that the lessor may take out samples of the ore sold, despatched or beneficiated and get the same analysed through a recognised ANALYST in case such

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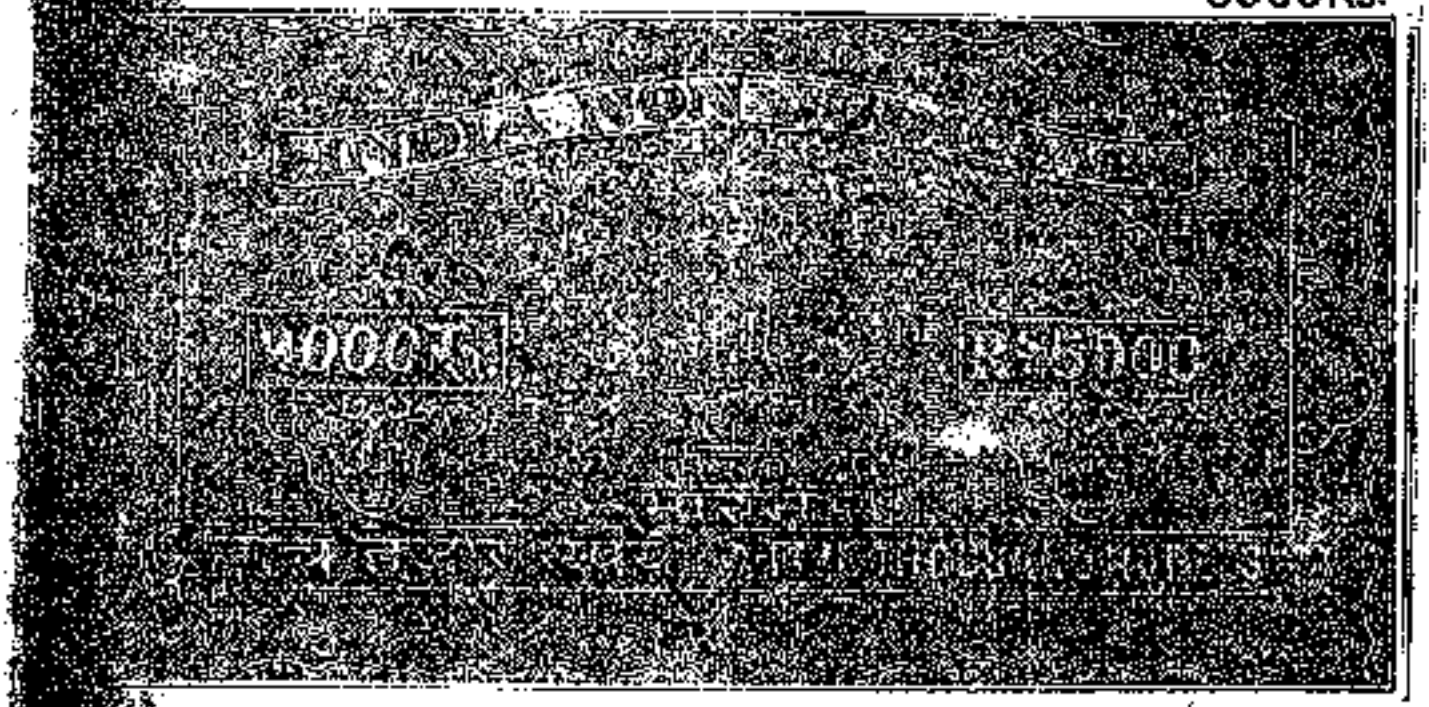

ANALYST discloses a more favourable quality for the lessor, adopt such quality for computation of the said royalty and in addition, if such analysis report discloses a difference of one per cent or more in the quality of high grade ore, or two

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percent or more in the case of low grade ore, the cost of such analysis by the lessor shall also be recoverable from the lessee.

Course of action if rents and royalties are not paid in time.

3. Should any rent, royalty or other sums due to the State Government

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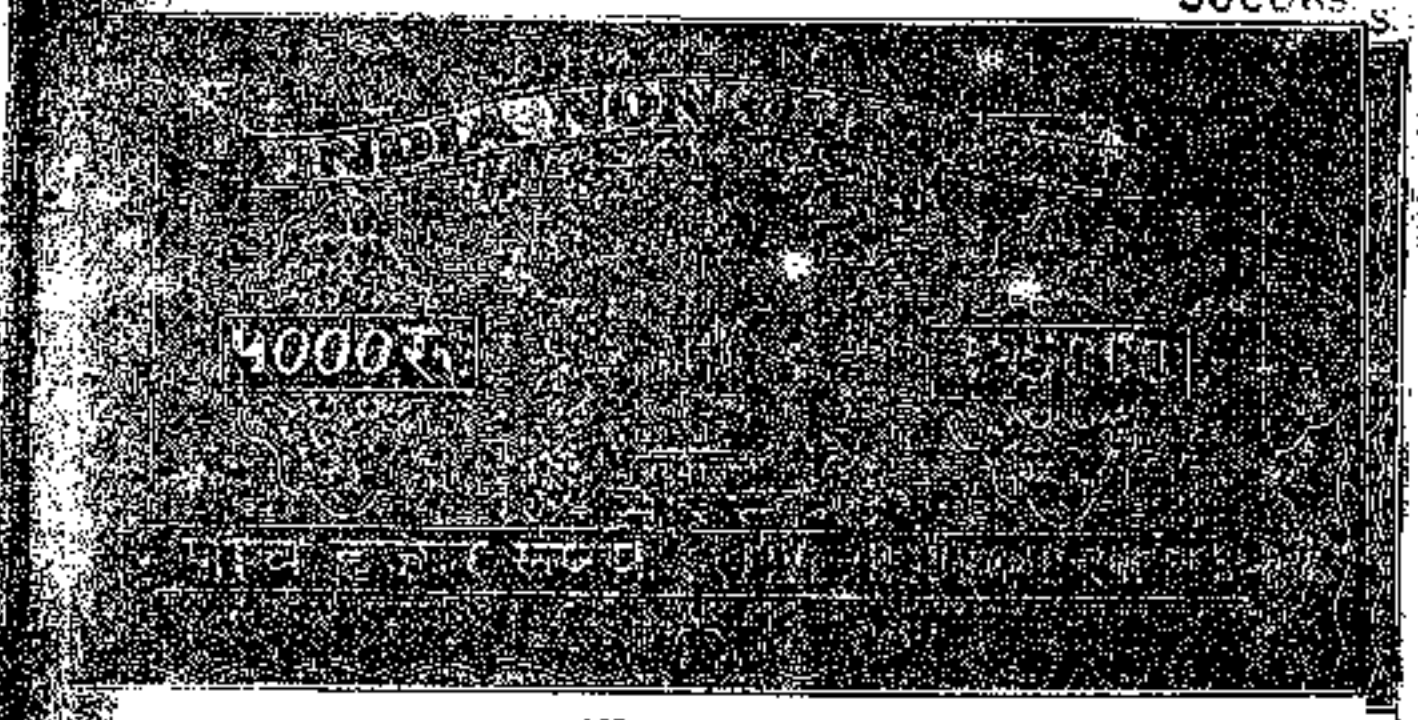

under the terms and conditions of these presents be not paid by the lessee/lessees within the prescribed time, the same, together with simple interest due thereon at the rate of twenty four percent per in annum may be recovered on a certificate of

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such officer as may be specified by the State Government by general or special order, in the same manner as an arrear of land revenue.

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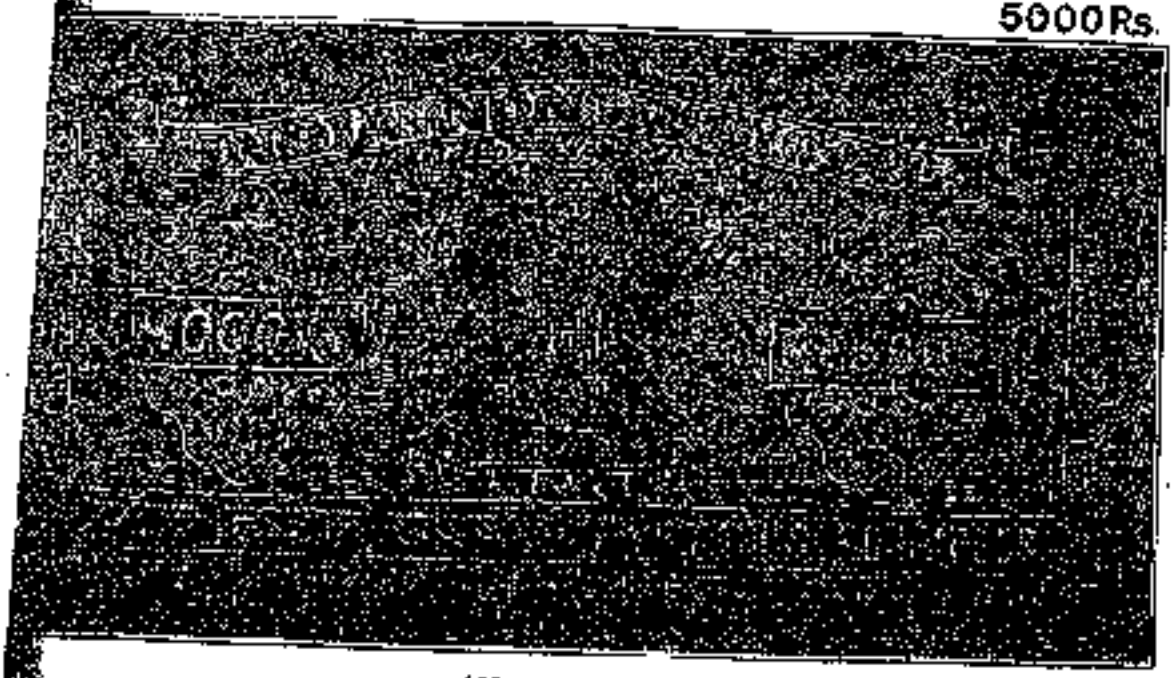

PART VII

THE COVENANTS OF THE LESSEE/LESSEES

Lessee to pay rents and royalties, taxes, etc

1. The lessee/lessees shall pay the rent, water rate and royalties reserved by this lease at such times and in the

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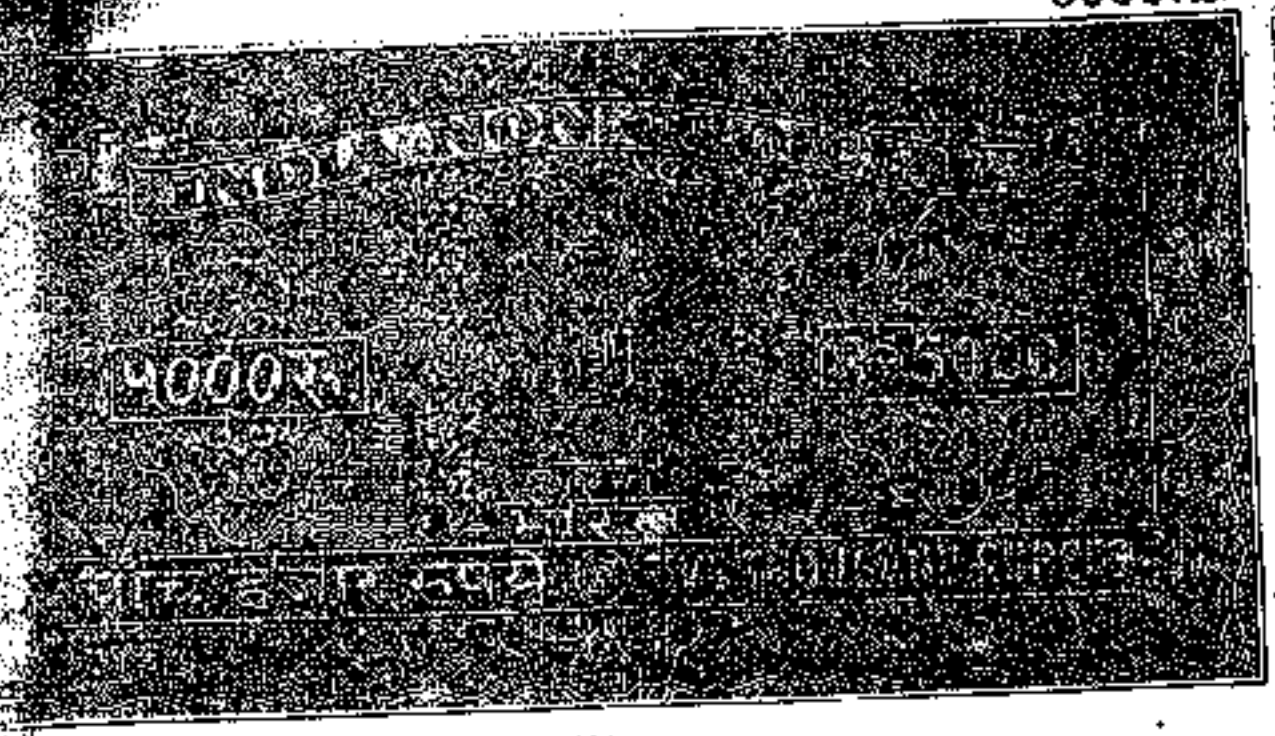

manner provided in PARTS V and VI of these presents and shall also pay and/ discharge all taxes, rates, assessments and impositions whatsoever being in the nature of public demands which shall from time to time be charged, assessed or

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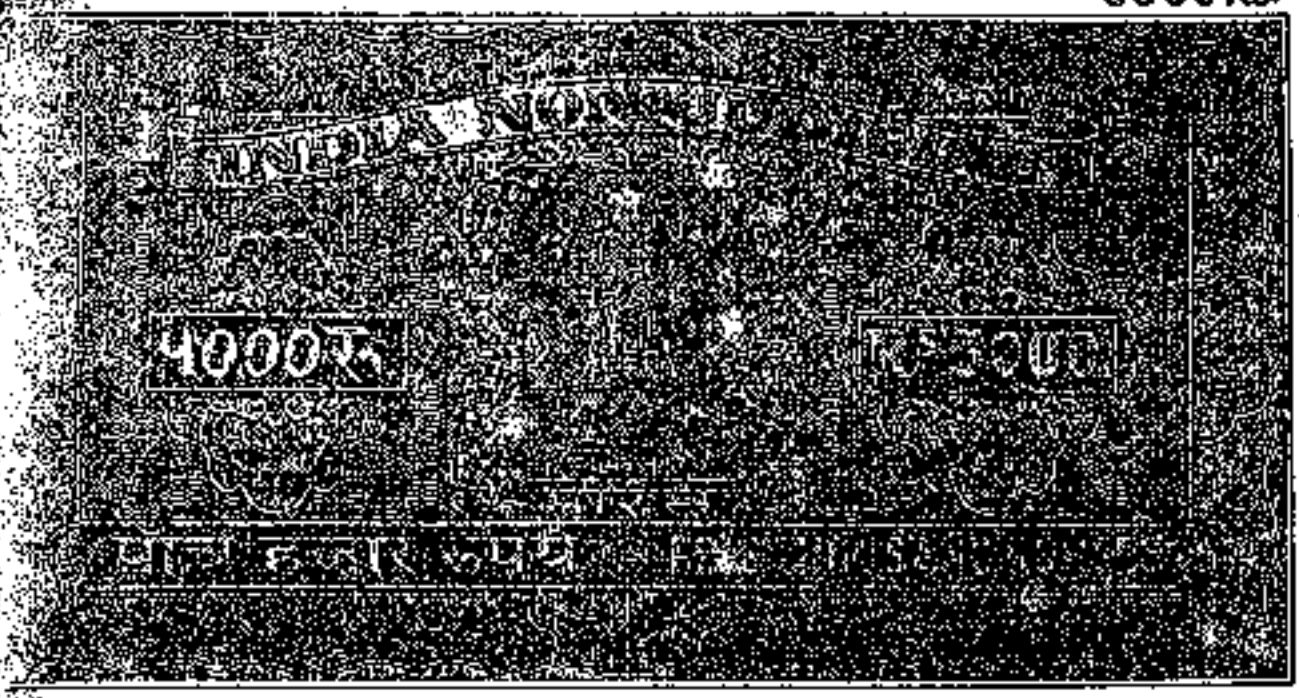

imposed by the authority of the Central and State Governments upon or in respect of the premises and works of the lessee/lessees in common with other premises and works of a like nature except demands for land revenues.

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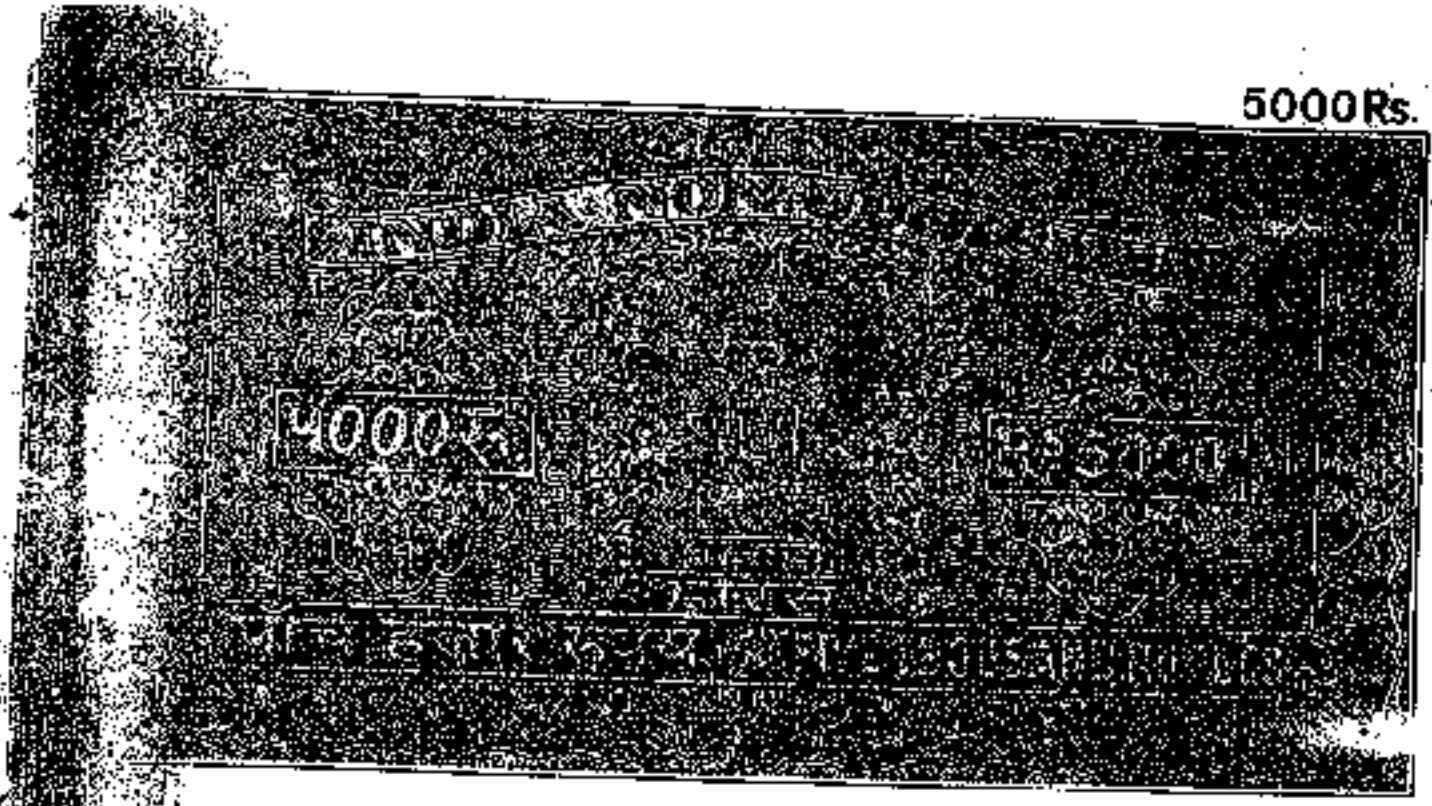

To maintain and keep boundary marks in good order.

2. The lessee/lessees shall at his/their own expense erect and at all times maintain and keep in repair boundary marks and pillars according to the demarcation to be shown in the plan annexed to this lease. Such marks

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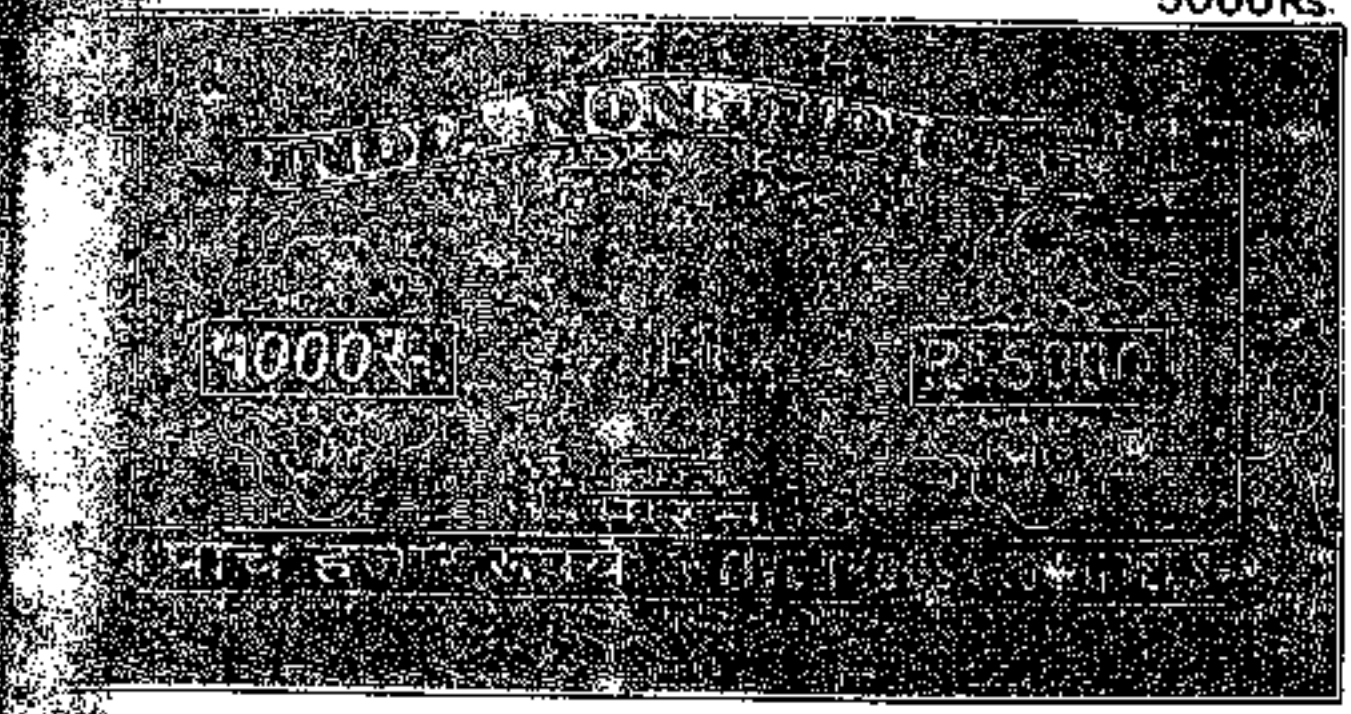

and pillars shall be sufficiently clear of the shrubs and other obstructions as to allow easy identification.

To commence operations within a year and work in a workman-like manner.

3. The lessee/lessees shall commence operation within one year from the date of execution of the lease and

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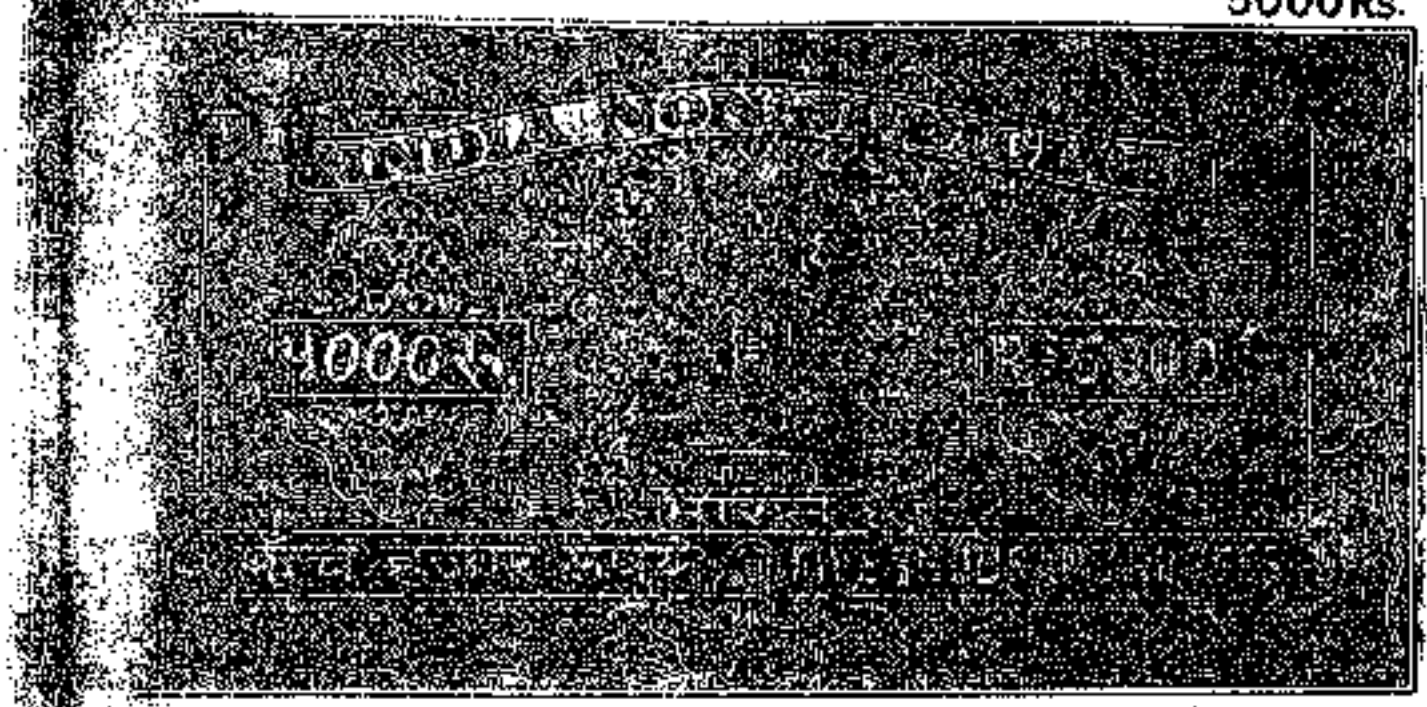

shall thereafter at all times during the continuance of this lease search for, win, work and develop, the said minerals without voluntary intermission in a skilful and workman-like manner and as prescribed under clause 12

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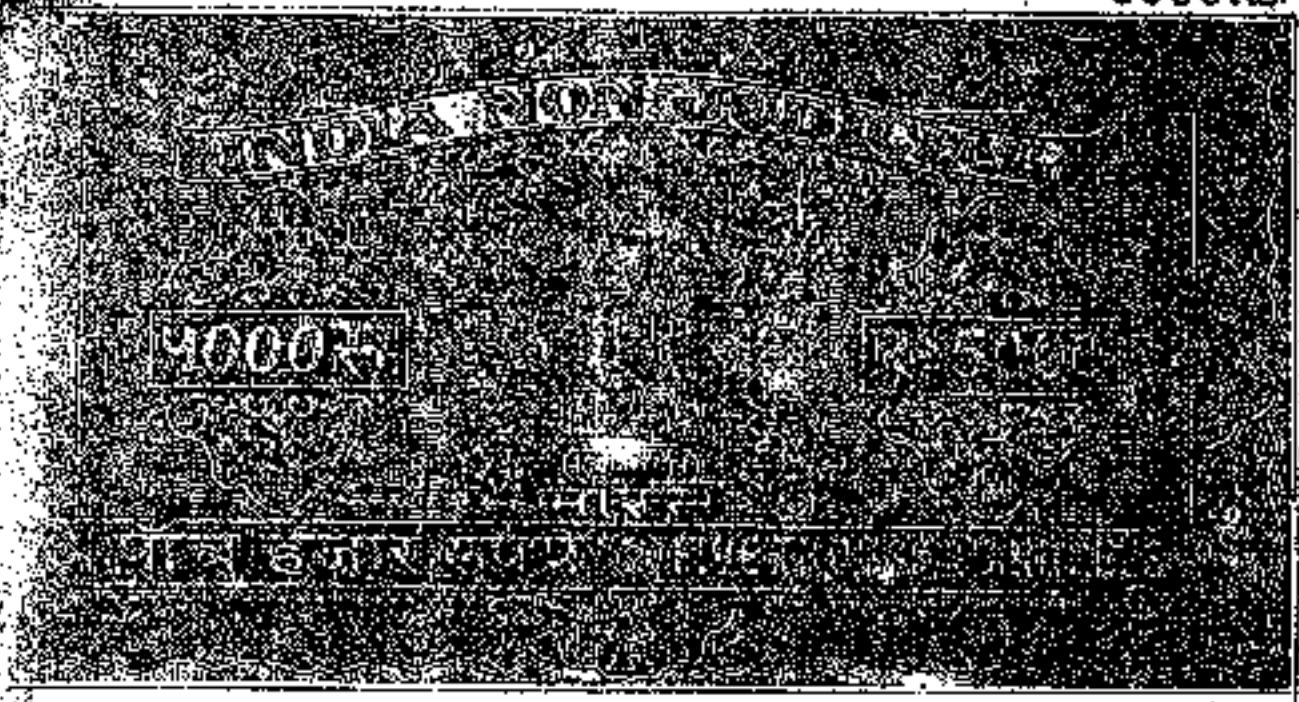

hereinafter without doing or permitting to be done any unnecessary or avoidable damage to the surface of the said lands or the crops, buildings, structures or other property thereon. For the purposes of this clause operatins shall include the

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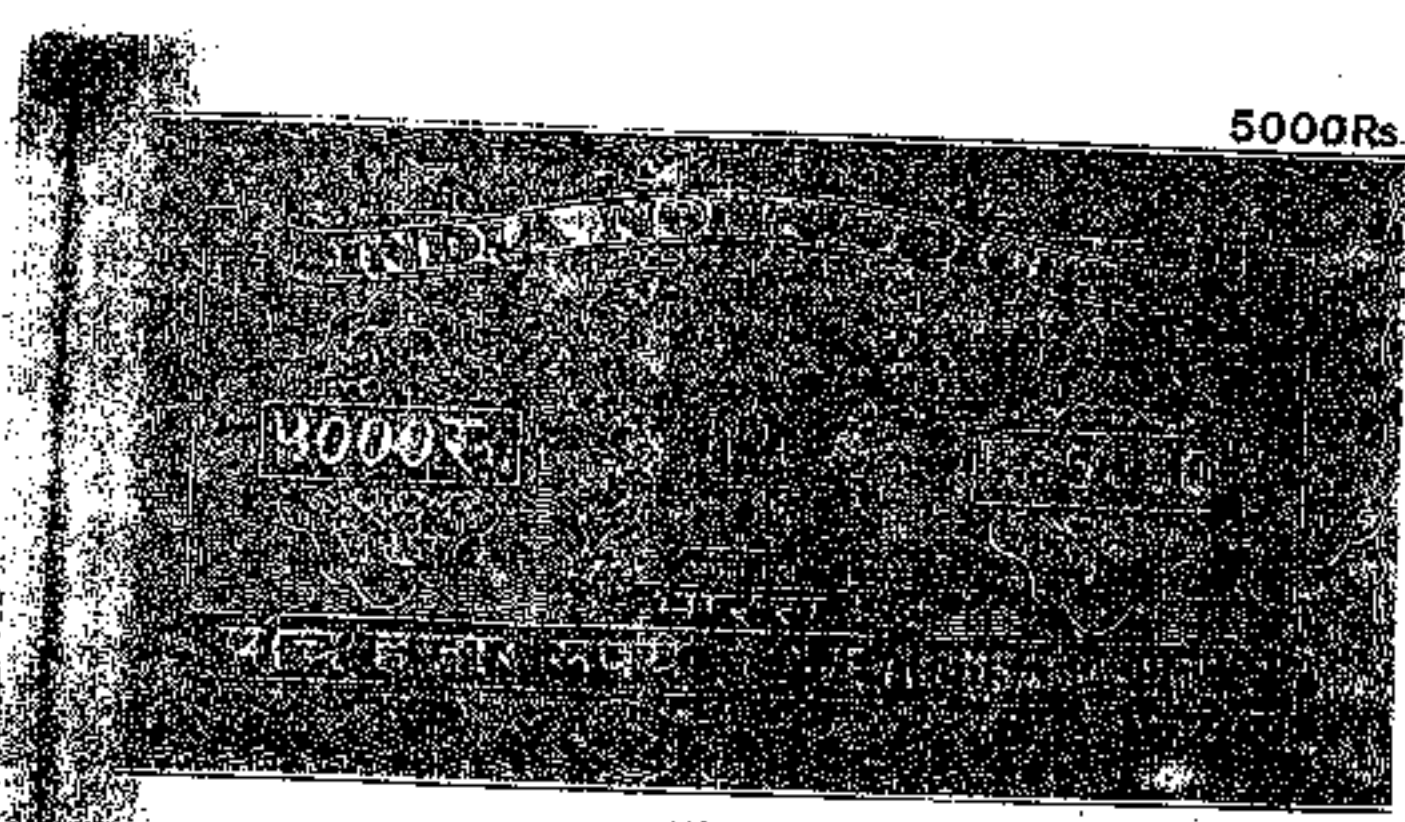

erection of machinery, laying of a tramway or construction of a road in connection with the mine.

To indemnify Government against all claims.

4. The lessee/lessees shall make and pay such reasonable satisfaction and compensation as may be assessed by

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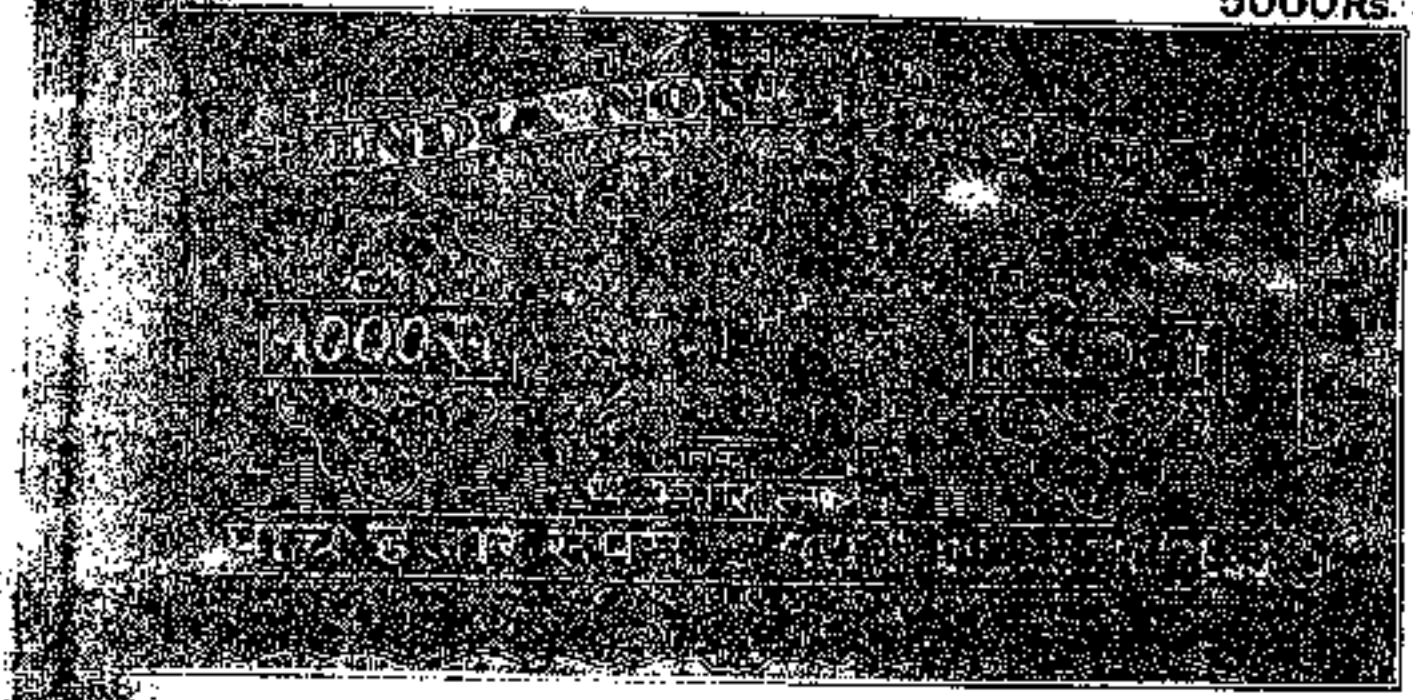

lawful authority in accordance with the law in force on the subject for damage, injury or disturbance which may be done by him/ them in exercise of the powers granted by this lease and shall indemnify and keep indemnified fully

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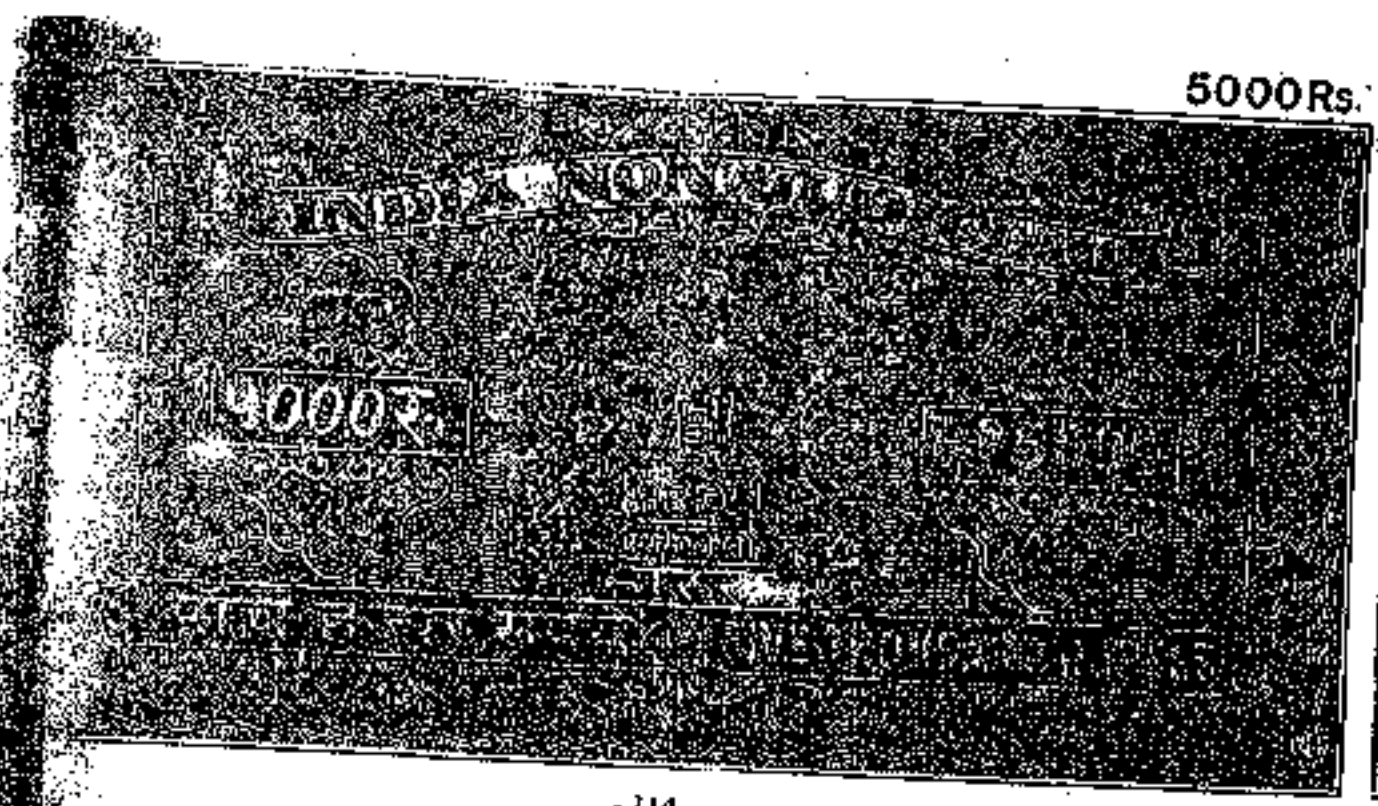

and completely the State Government against all claims which may be made by any person or persons in respect of any such damage, injury or disturbance and all costs and expenses in connection therewith.

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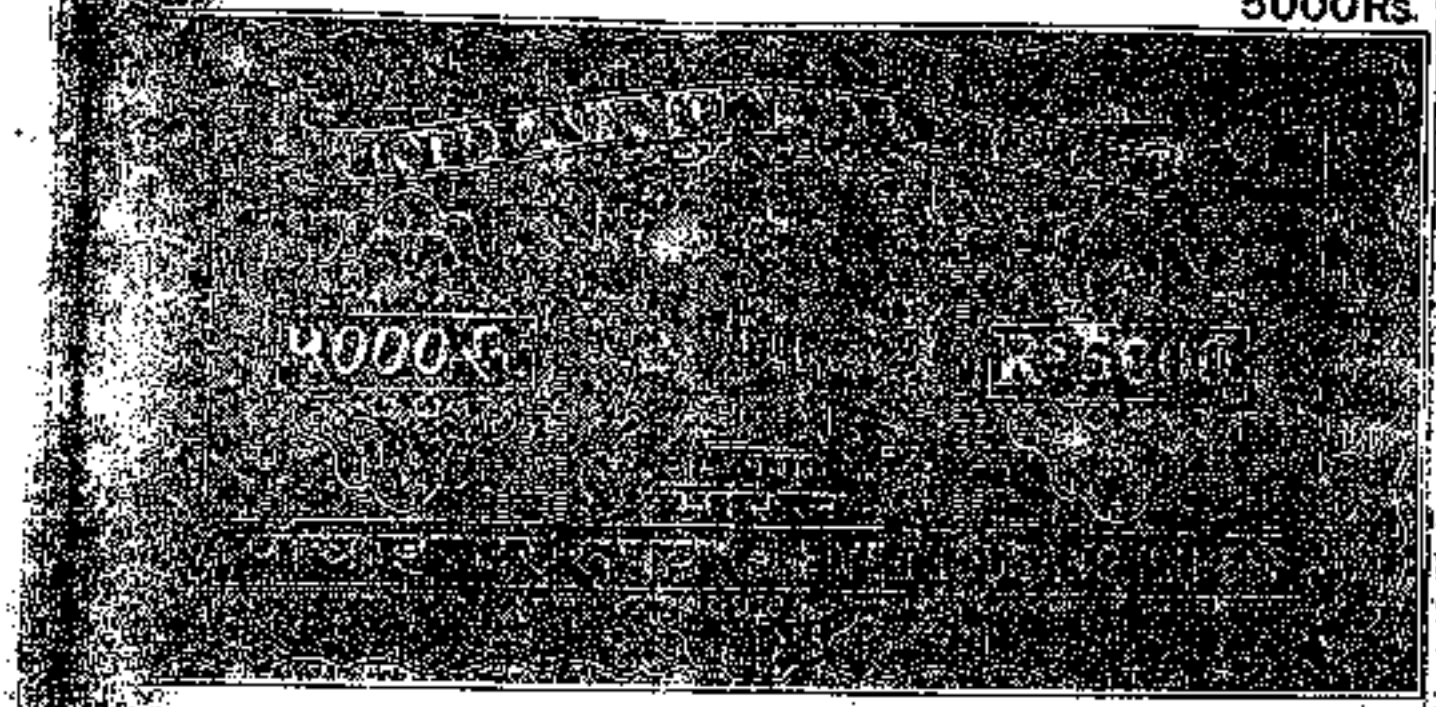

To secure and keep in good condition pits, shafts, etc.

5. The lessee/lessees shall during the subsistence of this lease well and sufficiently secure and keep open with timber or other durable means all pits, shafts and workings that may be made or used in the said lands

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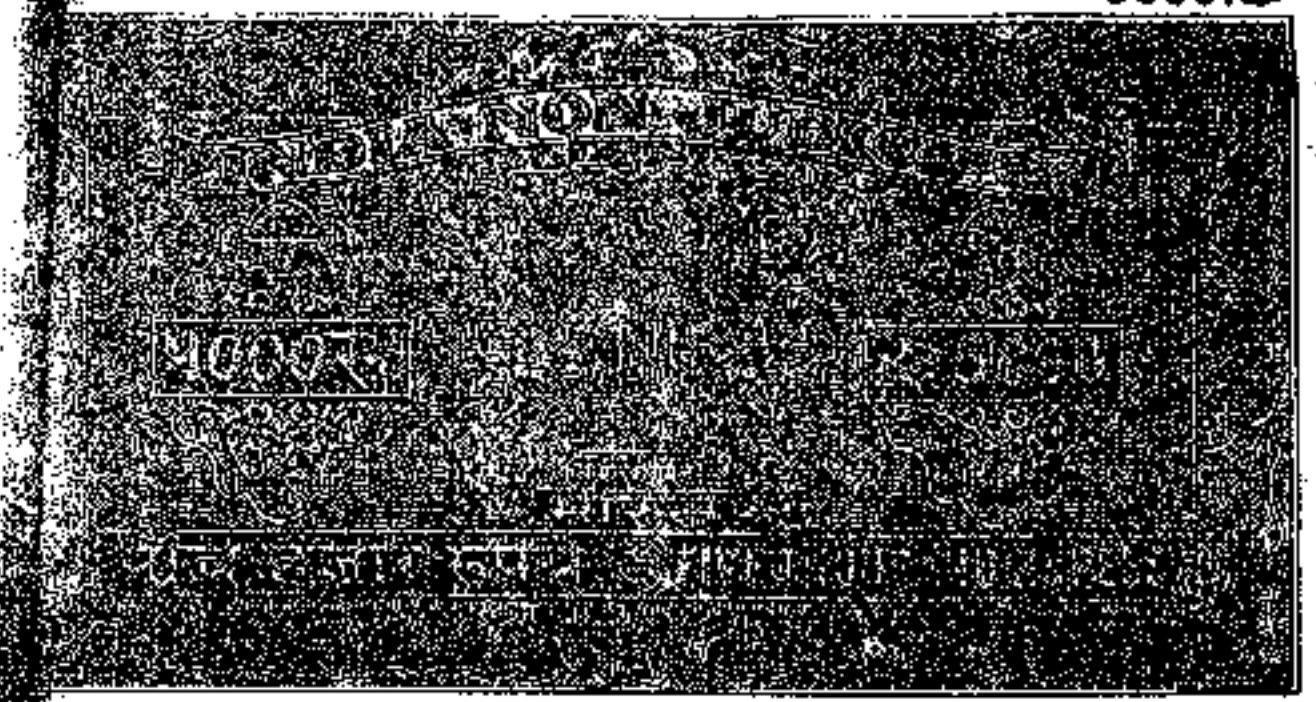

and make and maintain sufficient fences to the satisfaction of the State Government round every such pit, shaft or working whether the same is abandoned or not and shall during the same period keep all workings in the said lands except such as may be

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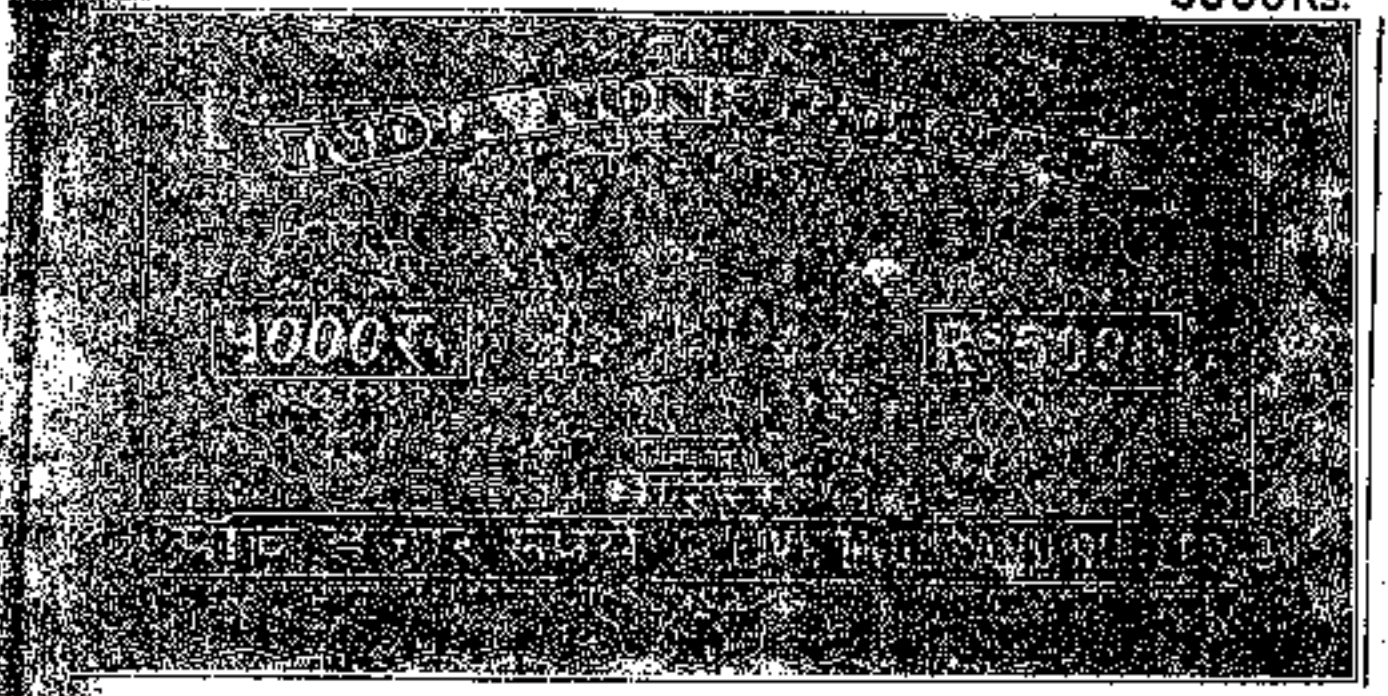

abandoned accessible free from water and foul air as far as possible.

To strengthen and support the mine to necessary extent.

6. The lessee/lessees shall strengthen and support to the satisfaction of the Railway Administration concerned or the State Government,

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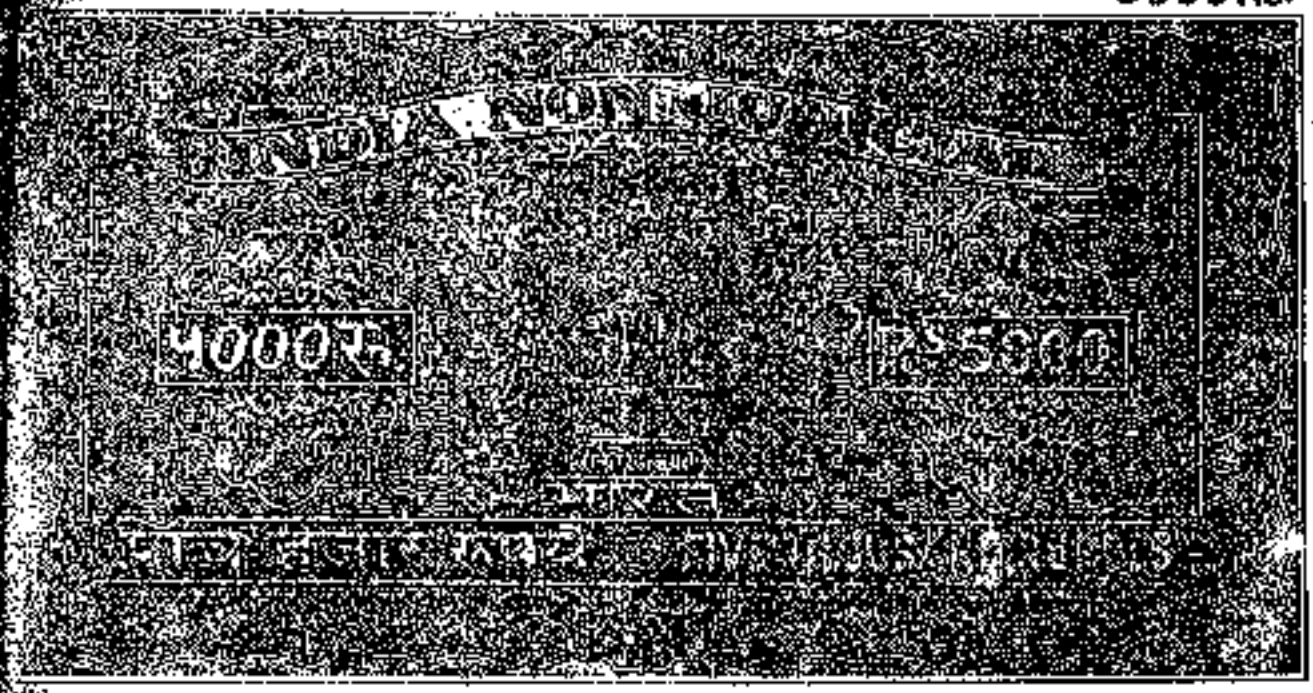

as the case may be any part of the mine which in its opinion requires such strengthening or support for the safety of any railway, reservoir, canal, road and any other public works or structures.

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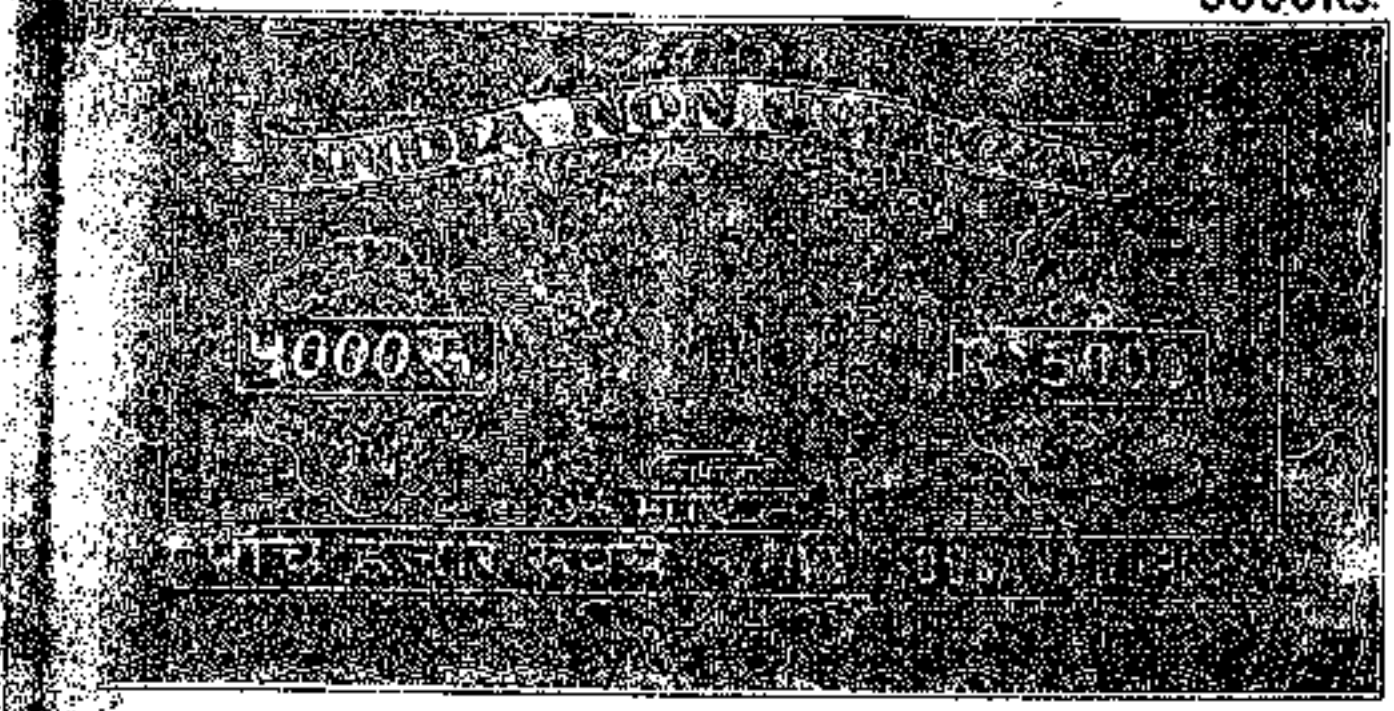

To allow inspection of workings

7. The lessee/ lessees shall allow any officer authorised by the Central Government or the State Government in that behalf to enter upon the premises including any building, excavation or land comprised in the

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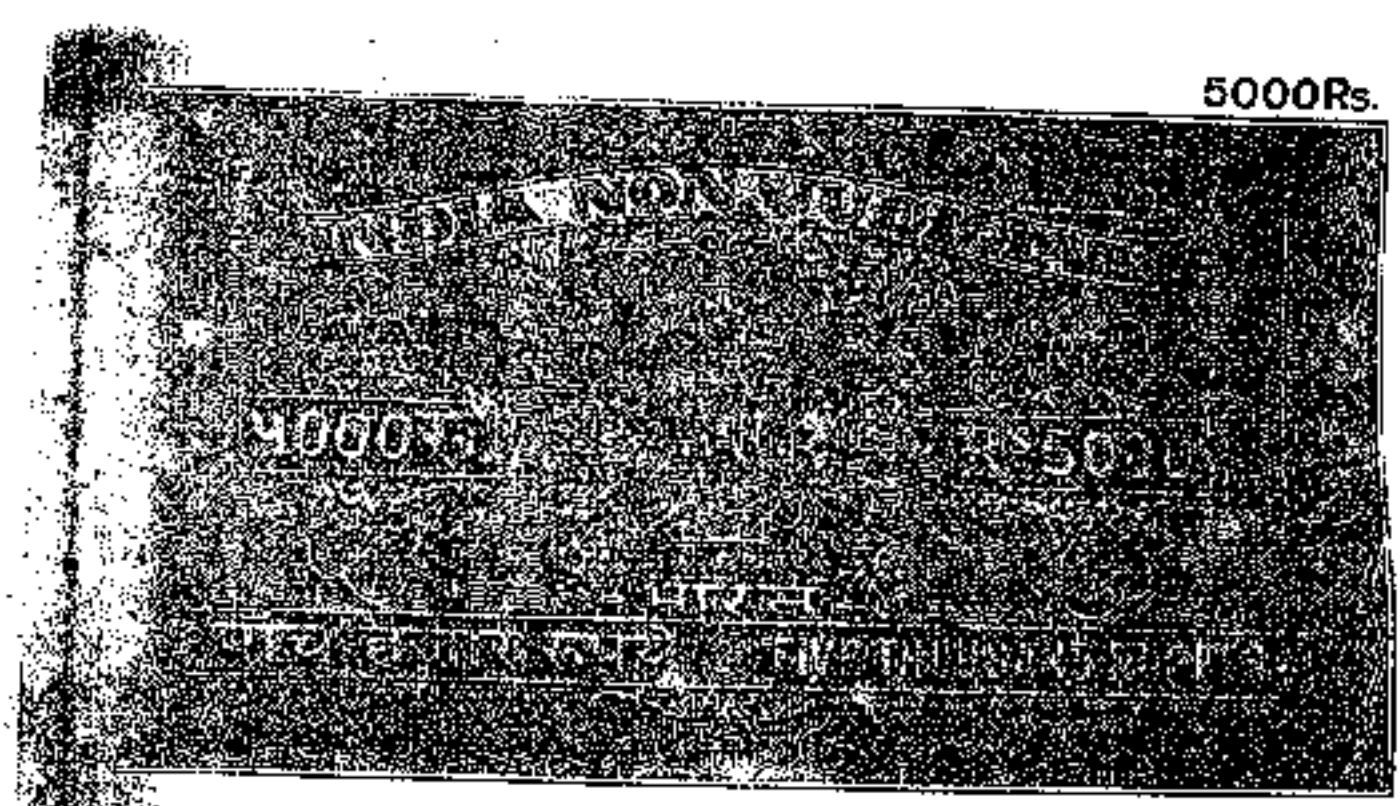

lease for the purpose of inspecting, examining, surveying, prospecting and making plans thereof sampling and collecting any data and the lessee/ lessees shall with proper person employed by the lessee/lessees and acquainted with

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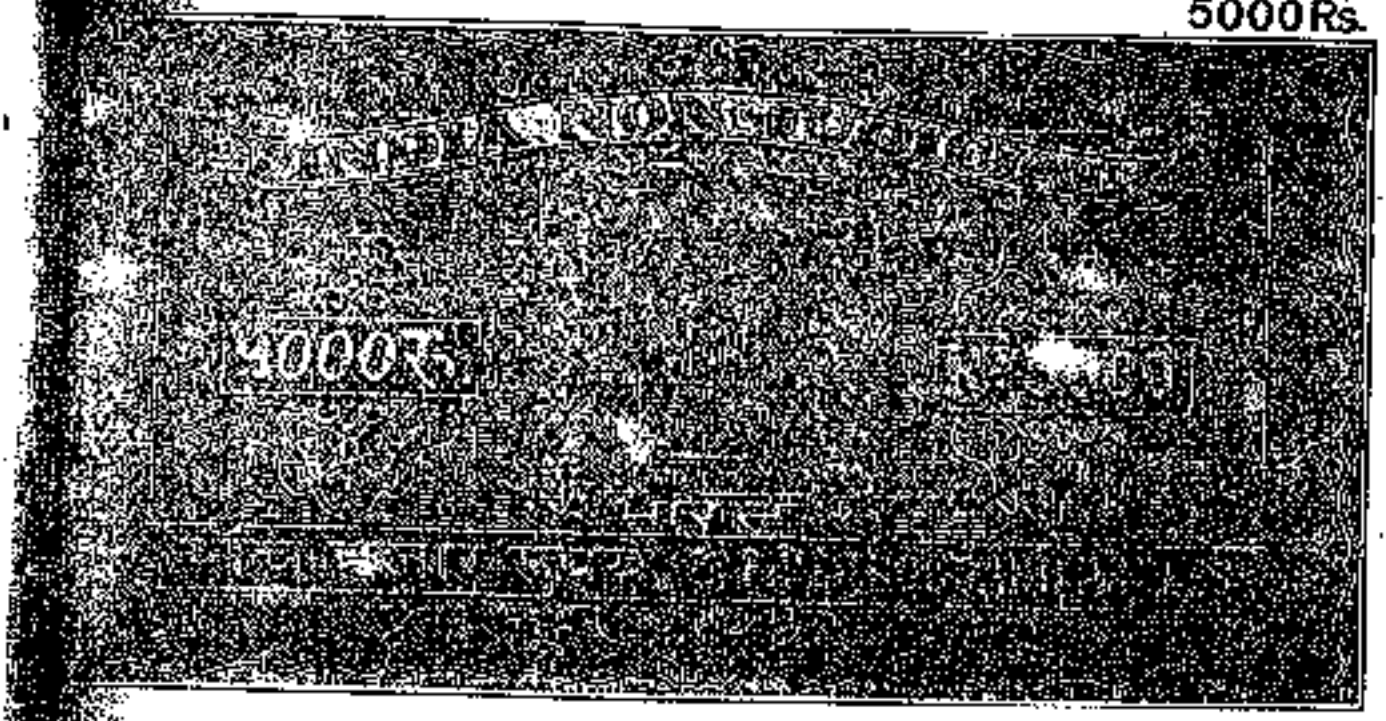

the mines and work effectually assist such officer, agents, servants and workmen in conducting every such inspection and shall afford them all facilities, information connected with the working of the mines which they may reasonably require and also

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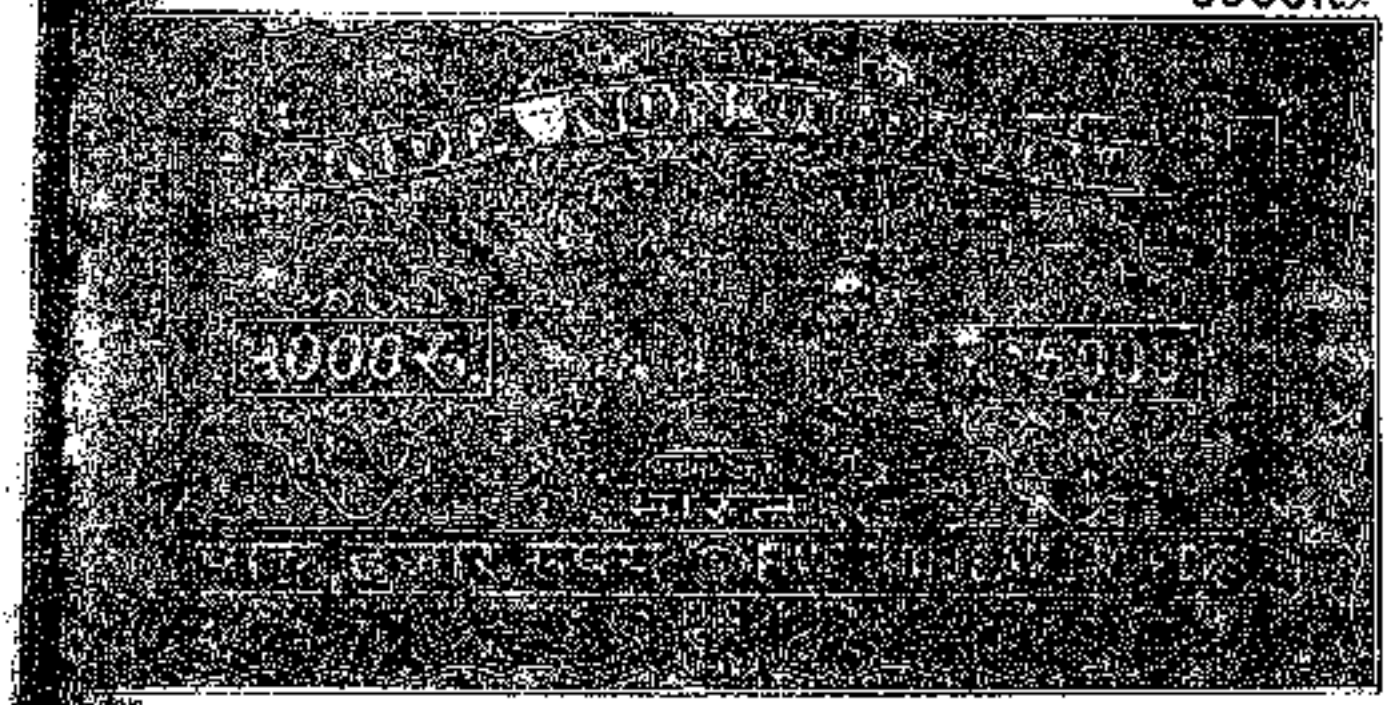

shall and will conform to and observe all orders and regulations which the Central and State Governments as the result of such inspection or otherwise may, from time to time, see fit to impose.

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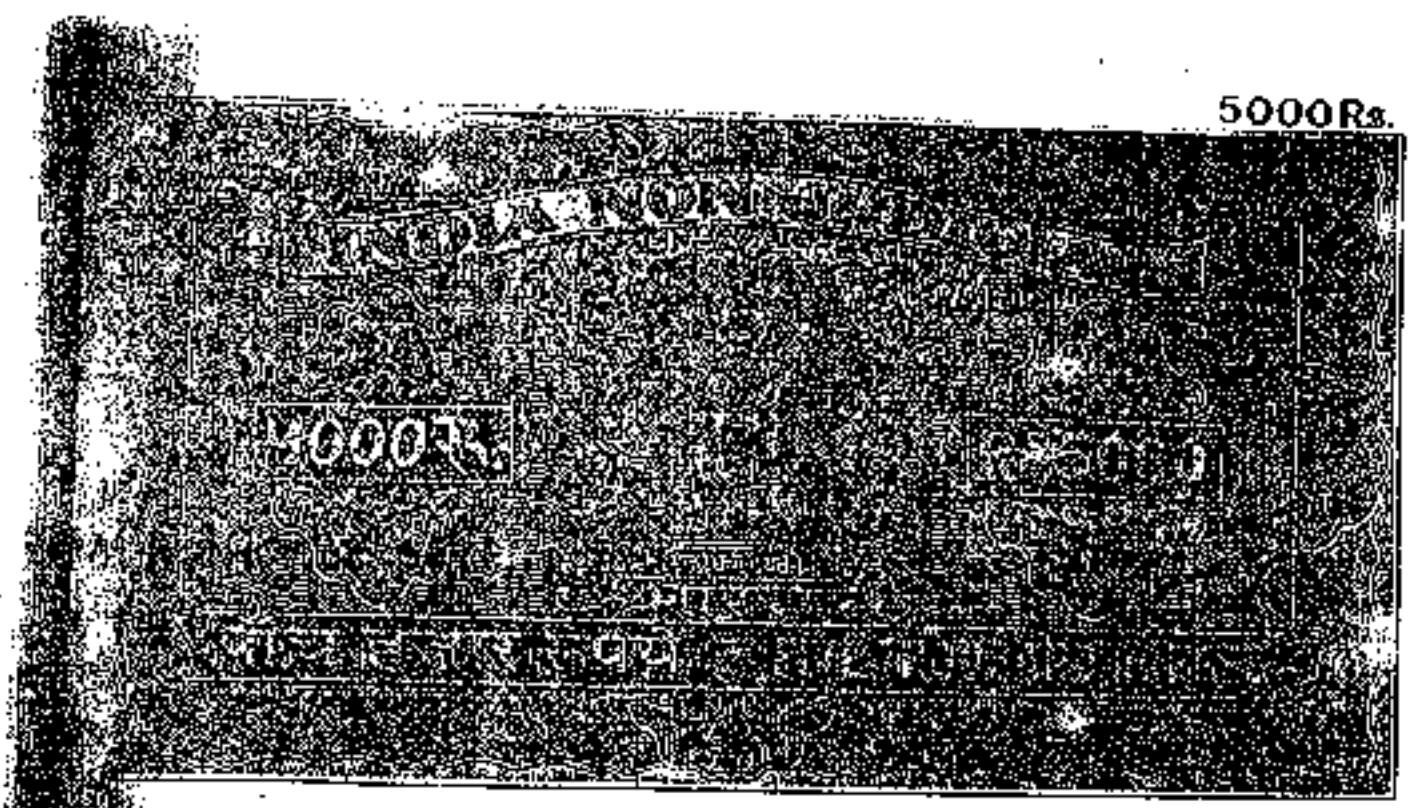

To report accident

8. The lessee/lessees shall without delay send to the Deputy Commissioner/Collector a report of any accident causing death or serious bodily injury or serious injury to property or seriously affecting or

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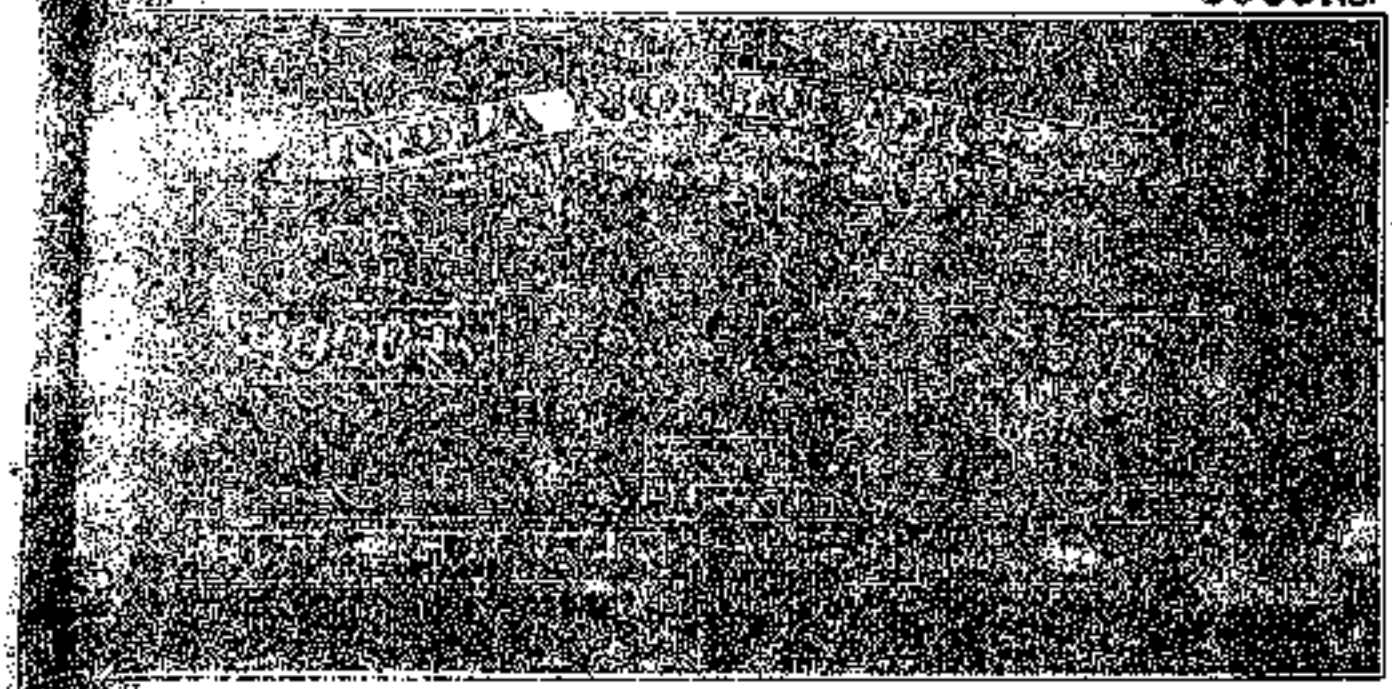

endangering life or property which may occur in the course of the operations under this lease.

To report discovery of other minerals.

9. The lessee/lessees shall report to the State Government the discovery in the leased area of any mineral not

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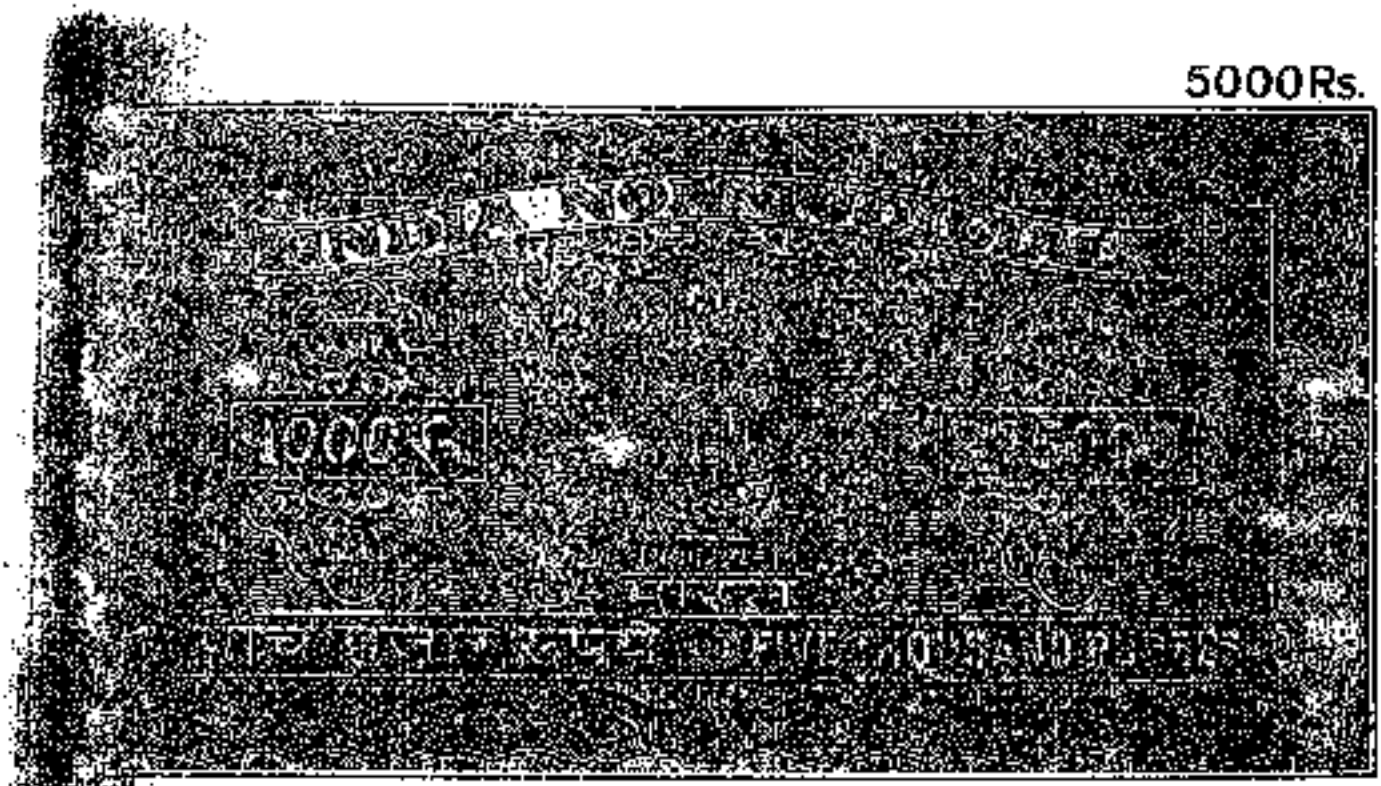

specified in the lease within sixty days of such discovery along with full particulars of the nature and position of each such find. If any mineral not specified in the lease is discovered in the leased area, the lessee/lessees shall not win and

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dispose of such mineral unless such mineral is included in the lease or a separate lease is obtained therefor.

To keep records and accounts regarding production and employees etc.

10. The lessee/lessees shall at all time during the said term keep or cause to be kept at an office to be situated

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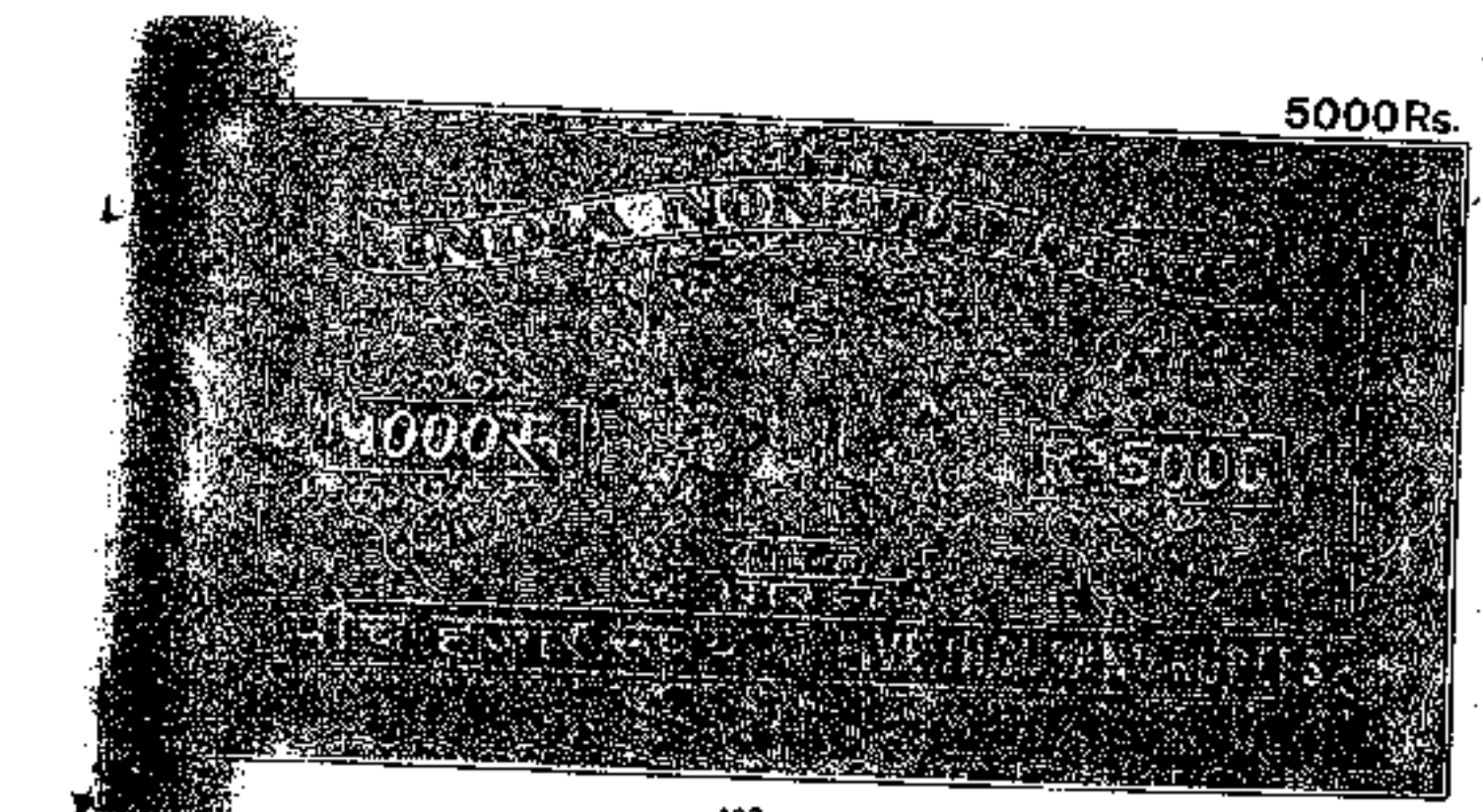

upon or near the said lands correct and intelligible books of accounts which shall contain accurate entries showing from time to time :-

(1) Quantity and quality of the said mineral/minerals realised from the said lands.

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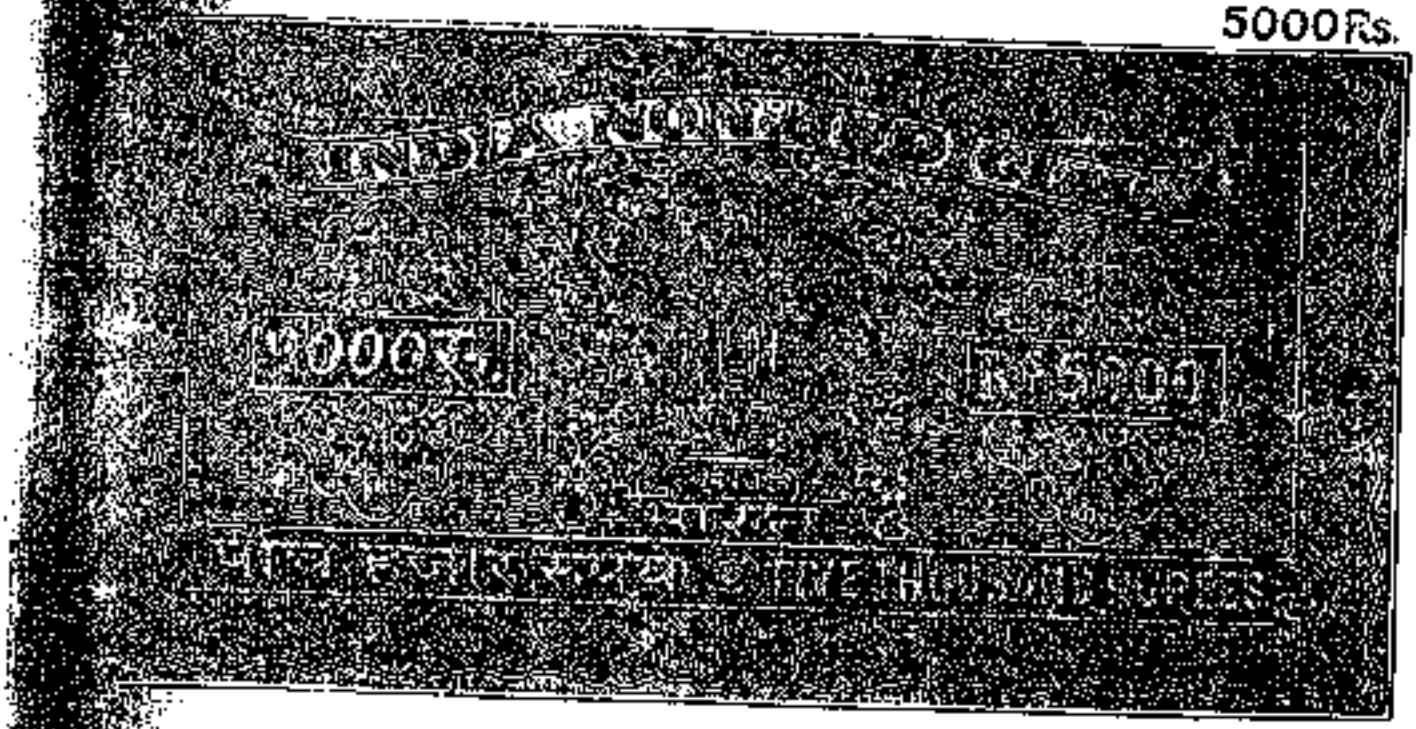

(2) Quantity of the various qualites of ores beneficiated or converted (for example coal converted into coke).

(3) Quantities of the various qualities of the said

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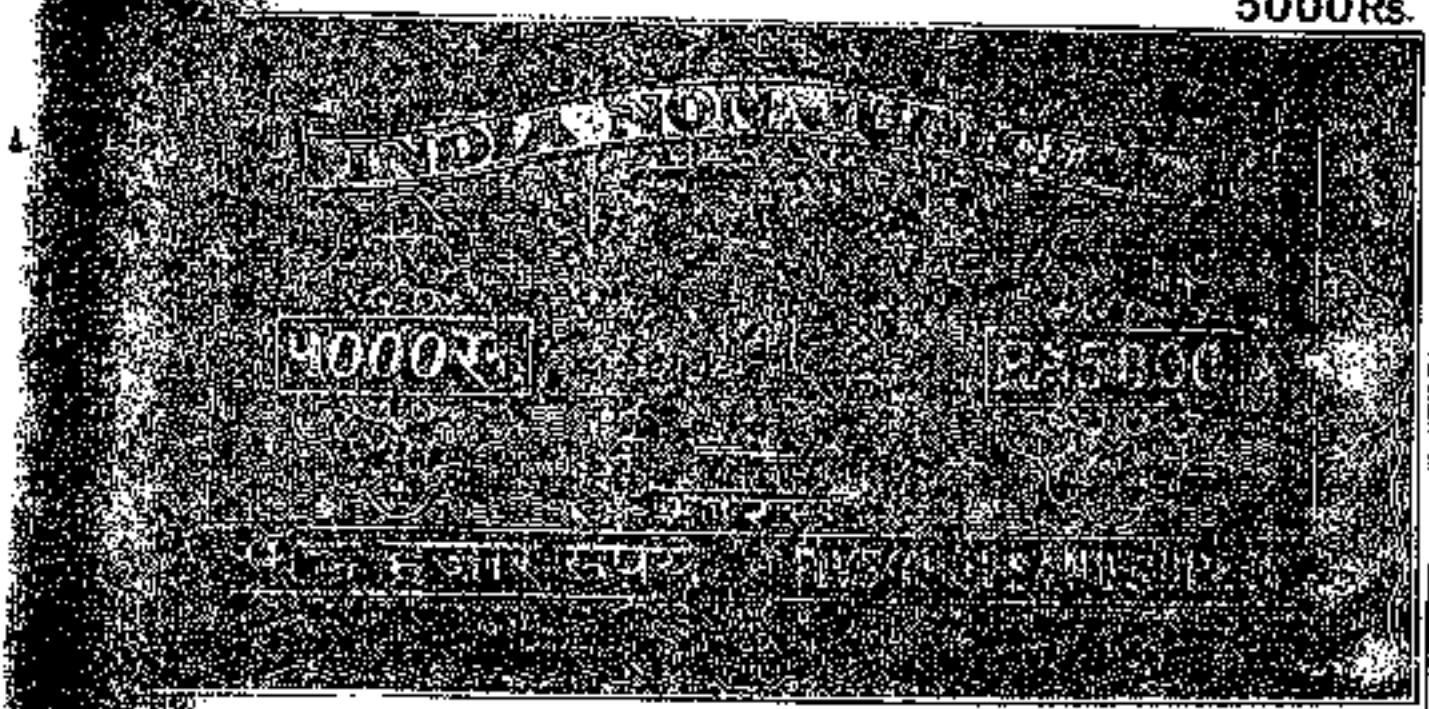

mineral/minerals sold and exported separately.

(4) Quantities of the various qualities of the said mineral/minerals otherwise disposed of and the manner and purpose of such disposal.

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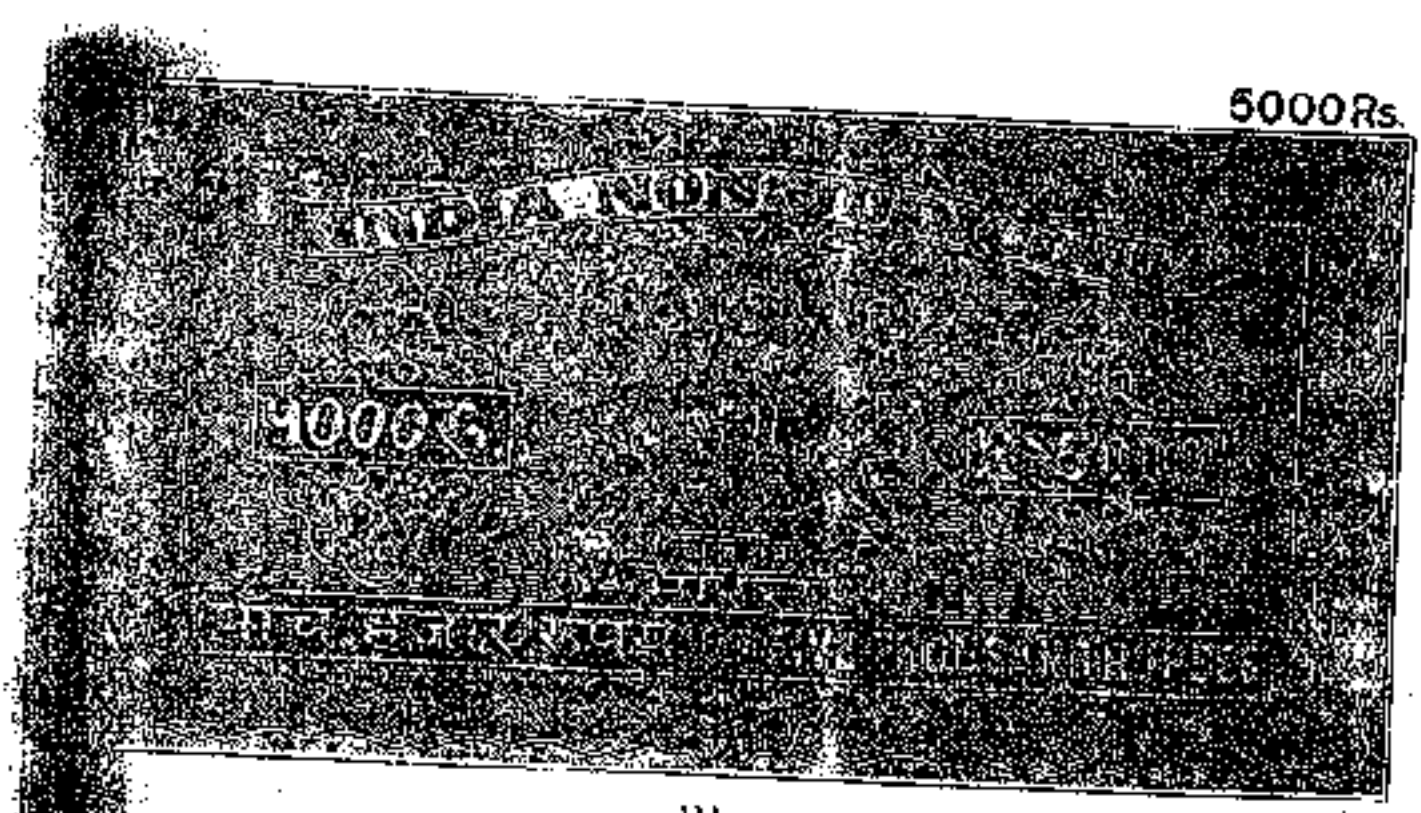

qualifications and pay of the technical personnel.

(7) Such other facts, particulars and circumstances as the Central or the State Governments may from time to time require and shall also

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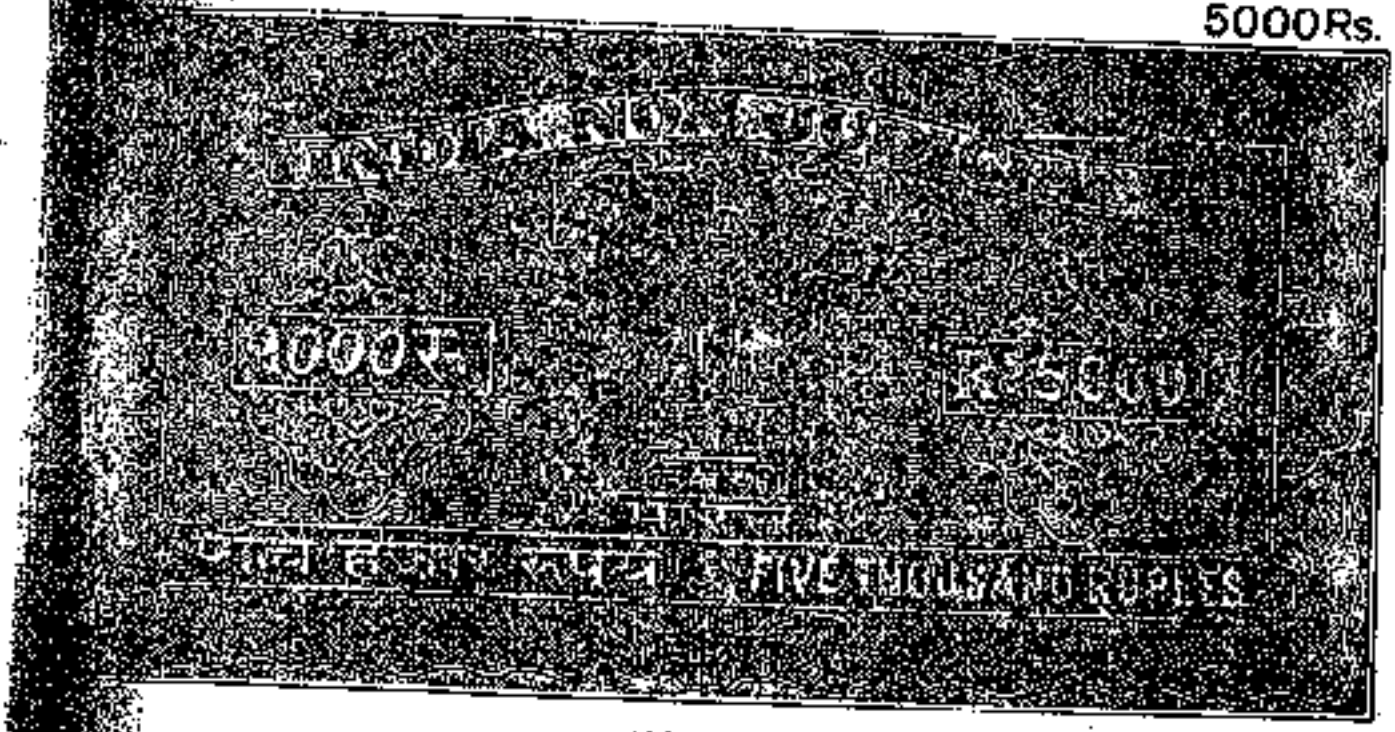

(5) The prices and all other particulars of all sales of said mineral/minerals.

(6) The number of persons employed in the mines or works or upon the said lands specifying nationality.

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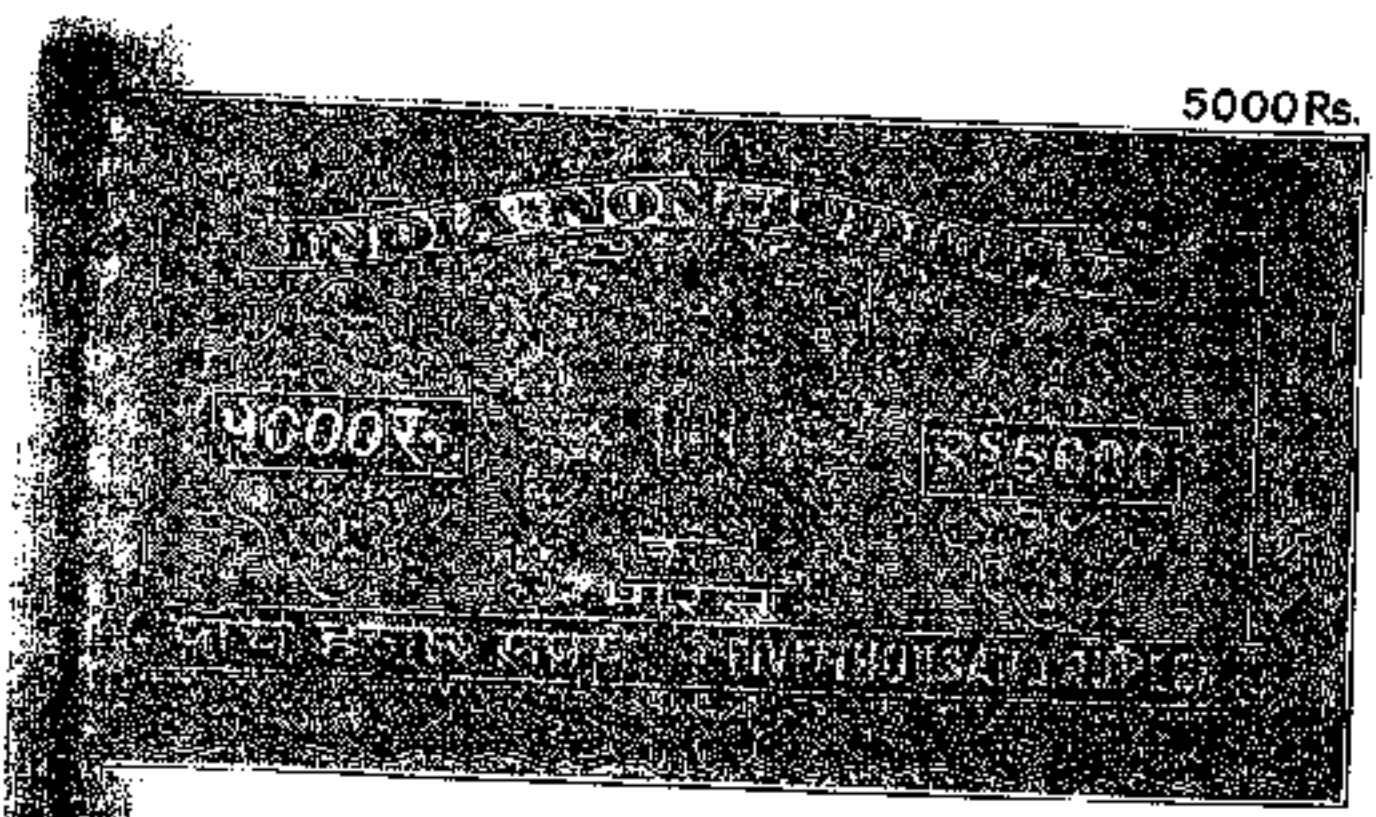

furnish free of charge to such officers and at such times as the Central and State Governments may appoint true and correct abstract of all or any such books of accounts and such information and

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returns to all or any of the matters aforesaid as the State Government may prescribe and shall at all reasonable times allow such officers as the Central Government or State Government shall in that

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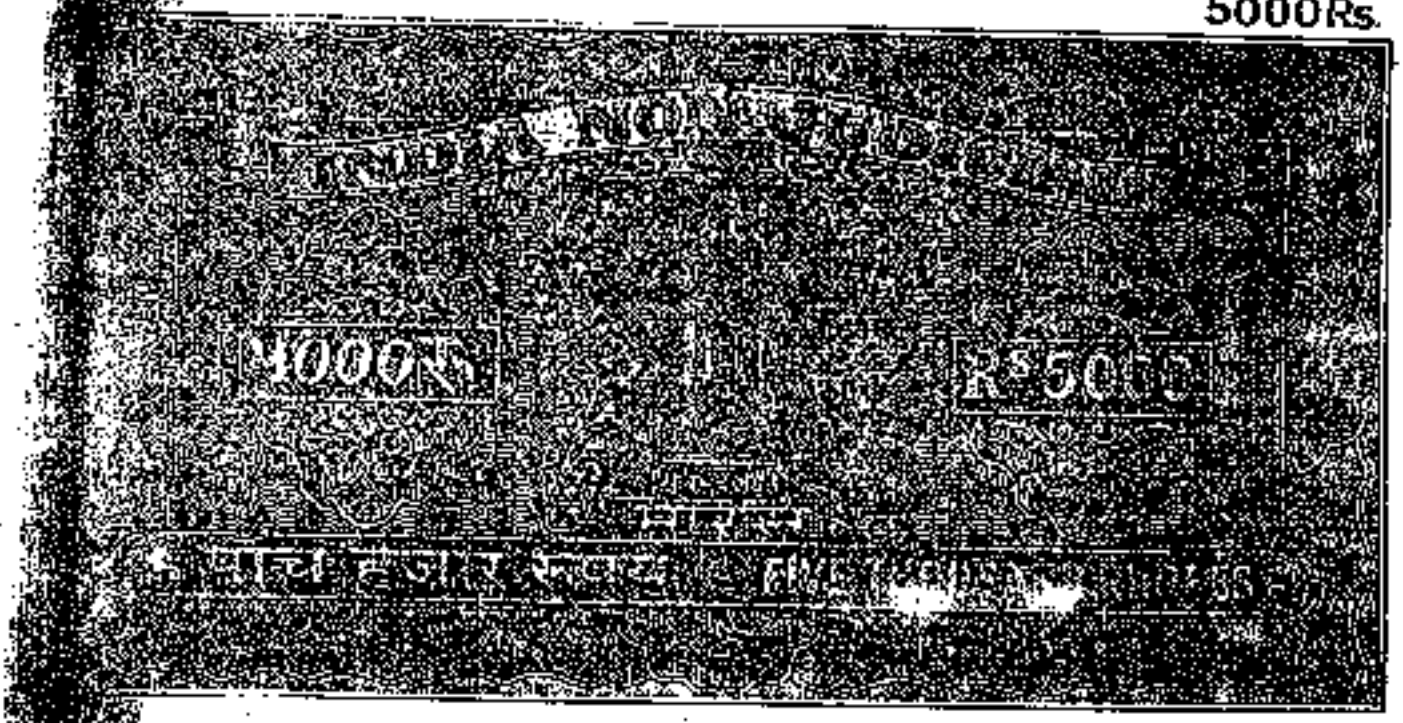

behalf appoint to enter into and have free access to the said officers for the purpose of examining and inspecting the said books of accounts, plans and records, and to make

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CHARTERED ATTORNEYS

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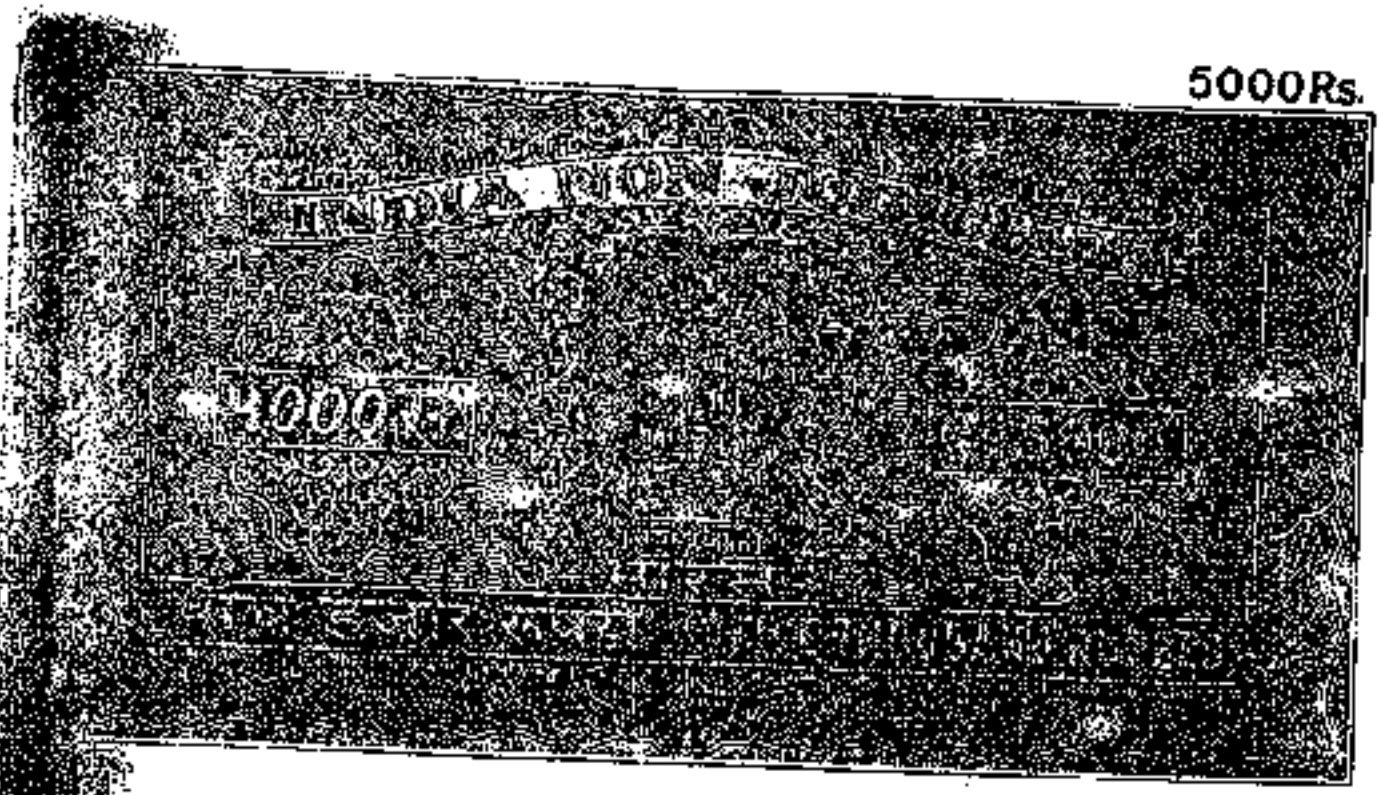

copies thereof and make extracts therefrom.

To maintain plans, etc.

11. The lessee/ lessees shall at all times during the said term maintain at the mine office correct intelligible up-to-date and complete

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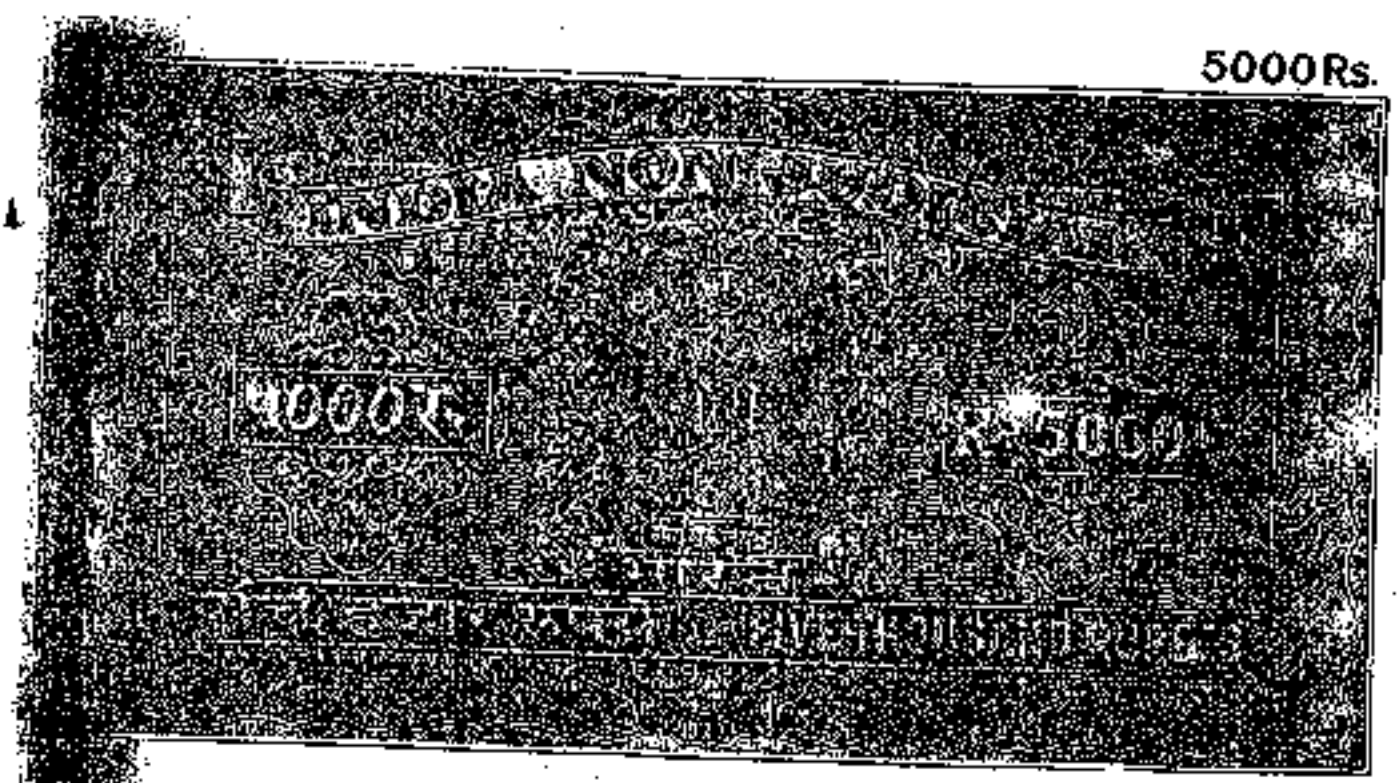

plans and sections of the mines in the said lands. They shall show all the operations, and workings and all the trenches, pits and drillings made by him/ them in the course of operations carried on by him/ them under the lease, faults and other disturbances

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encountered and geological data and all such plans and sections shall be amended and filled up by and from actual surveys to be made for that purpose at the end of twelve months or any period specified from time to time and the lessee/lessees shall

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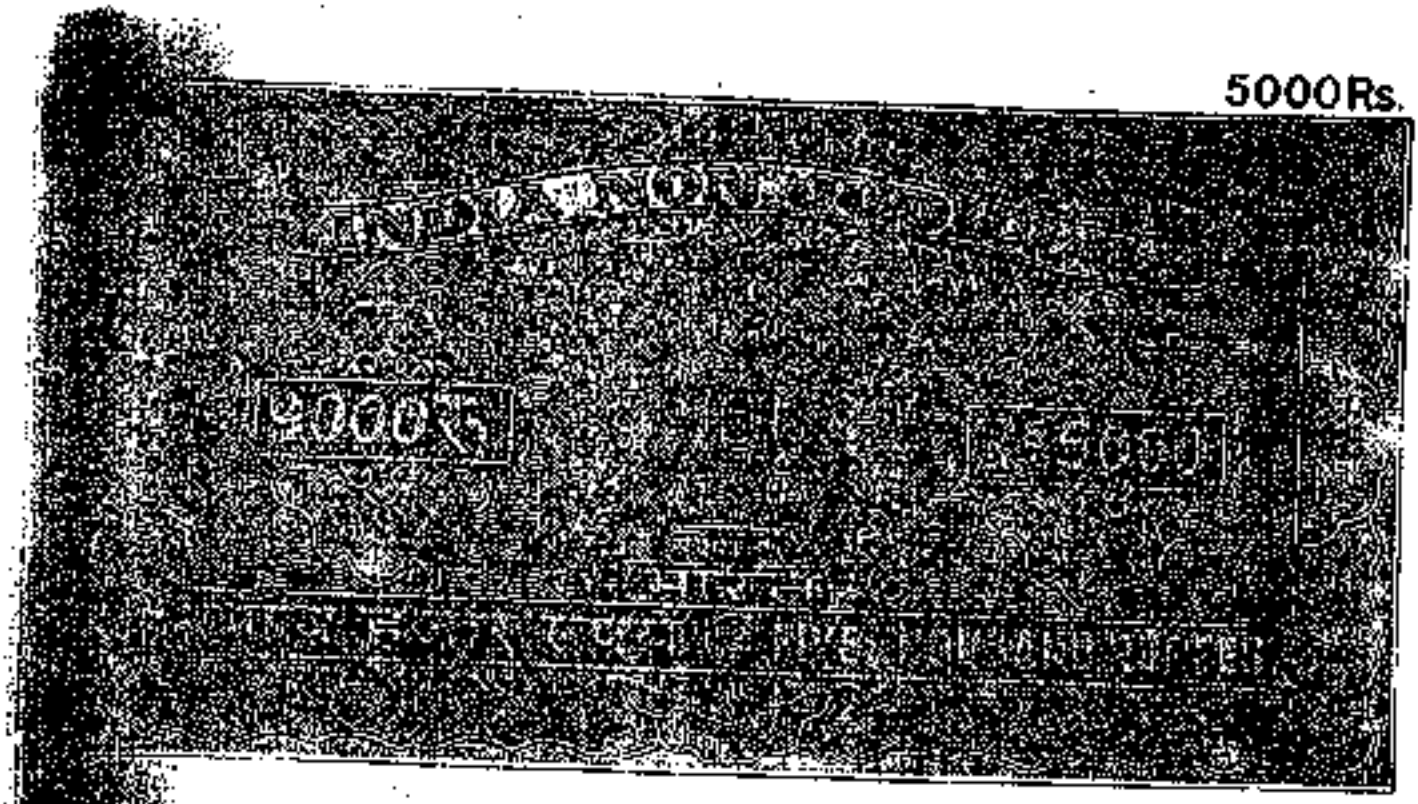

furnish free of charge to the Central and State Governments true and correct copies of such plans and sections whenever required. Accurate records of all trenches, pits and drillings shall show:-

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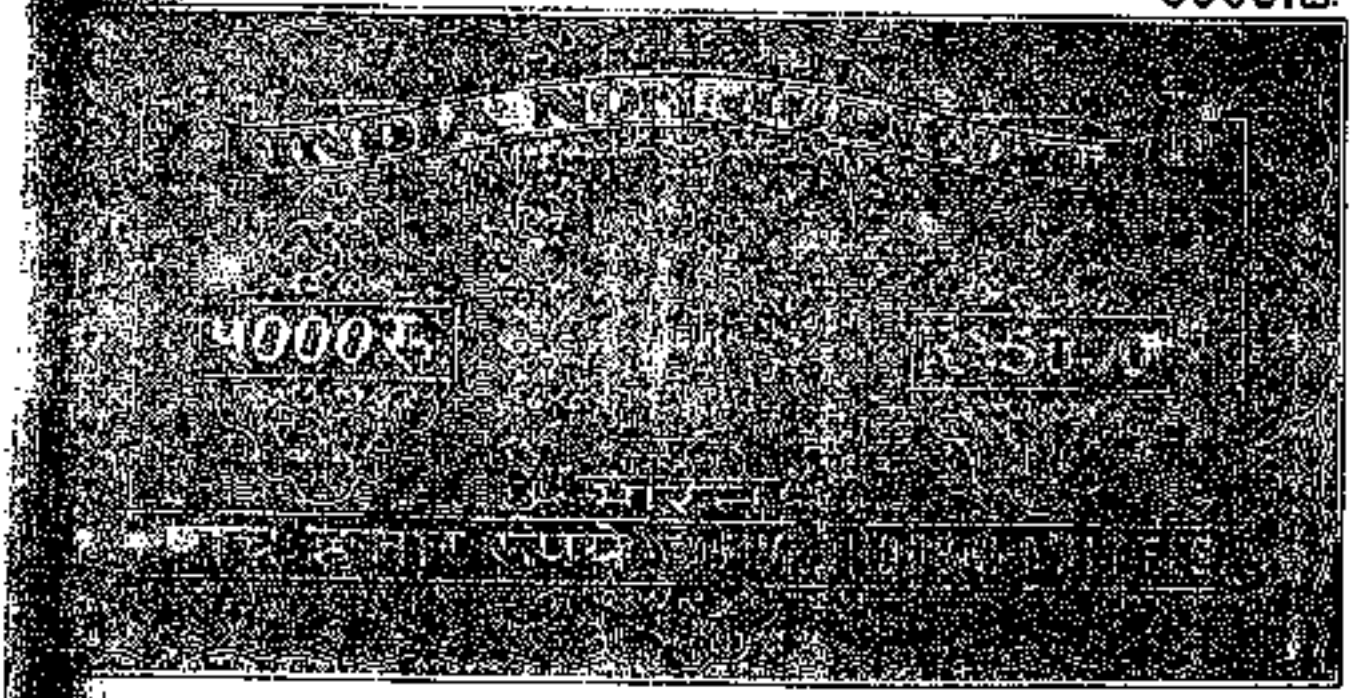

a) The subsoil and strata through which they pass.

b) Any mineral encountered.

c) Any other matter of interest and all data required by the Central and State Governments, from time to time.

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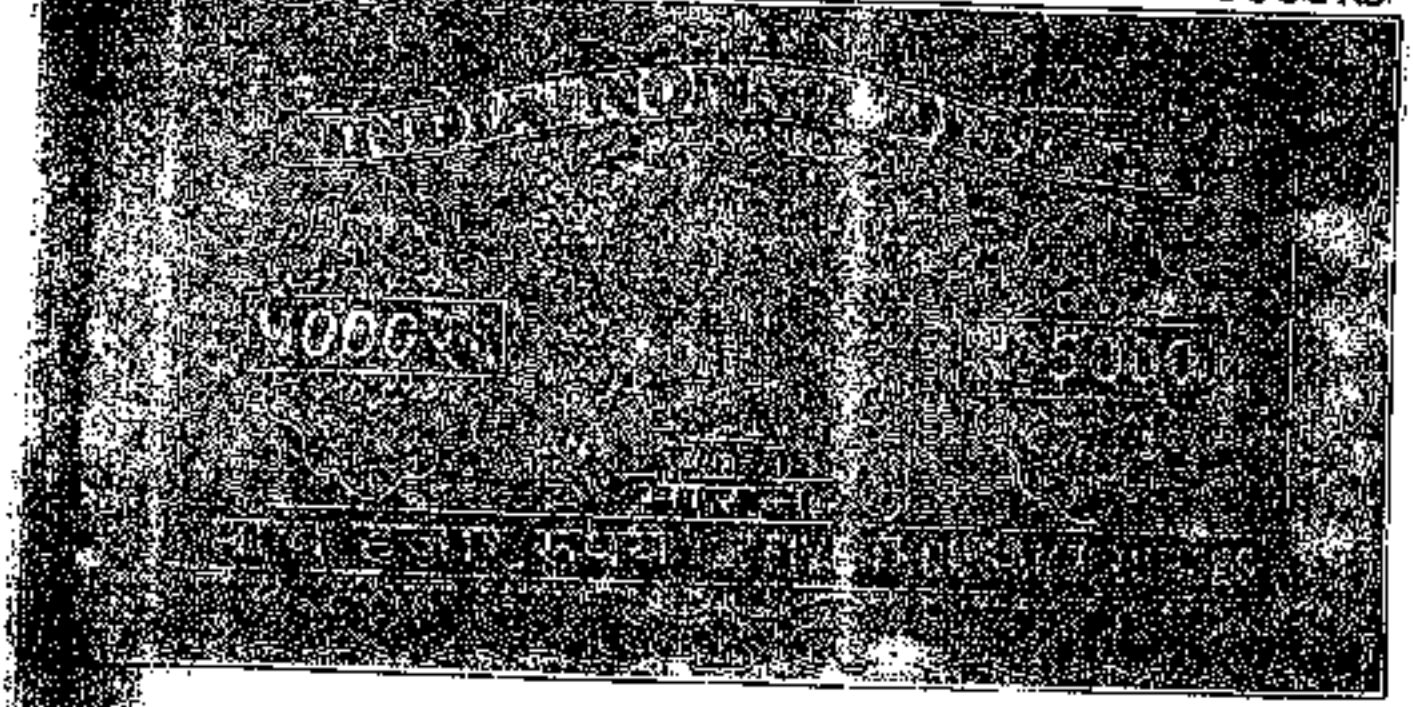

The lessee/lessees shall allow any officer of the Central or the State Government, authorised in this behalf by the Central Government, to inspect the same at all reasonable times. He/they shall also supply when asked for by the State

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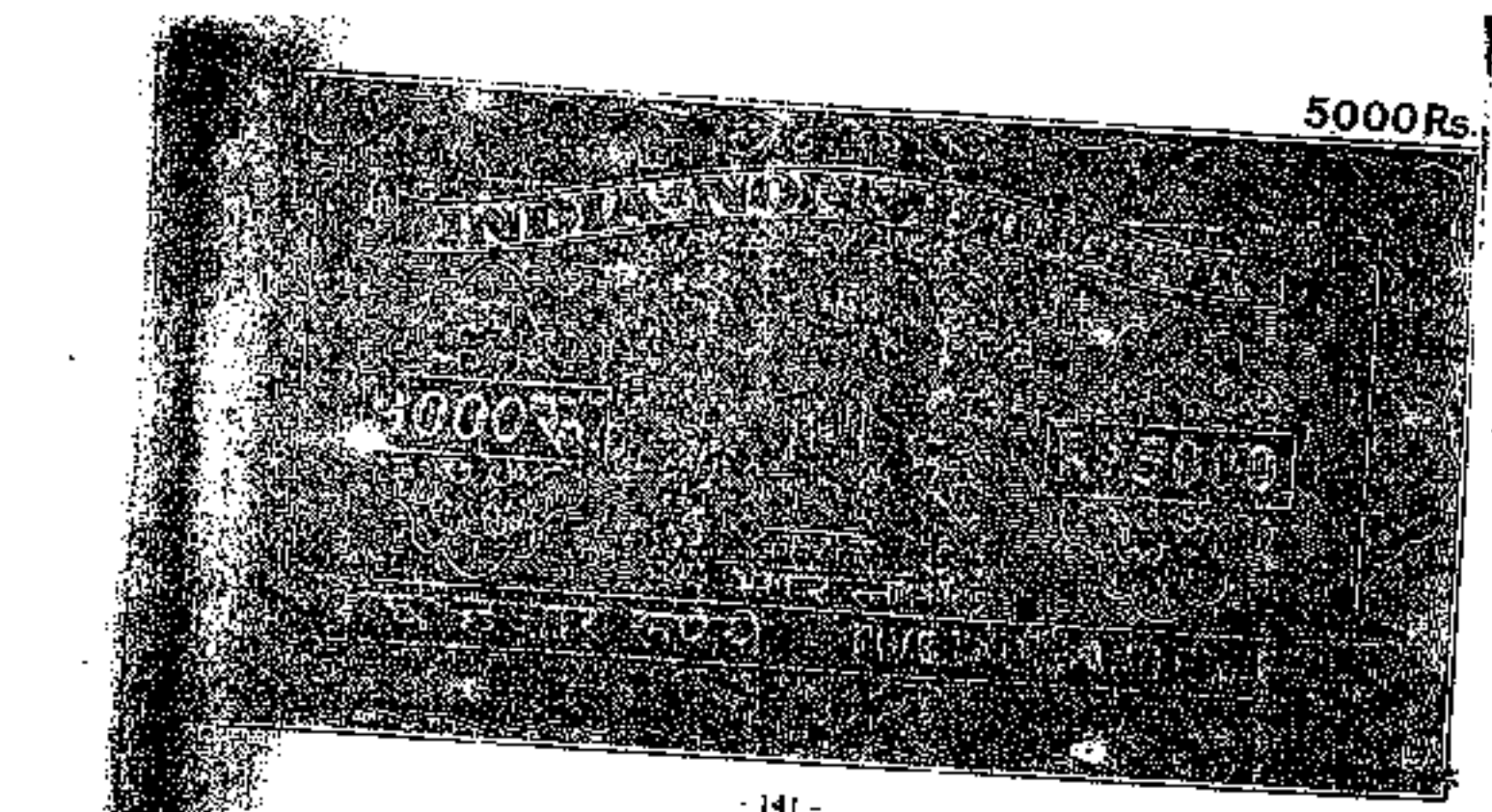

Government/the Coal Controller/the Director-General, Geological Survey of India the Controller General, Indian Bureau of Mines, a composite plan of the area showing thickness, dip, inclination, etc. of all

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the seams as also the quantity of reserves quality-wise.

11A. The lessee shall pay a wage not less than the minimum wage prescribed by the Central or State Government from time to time.

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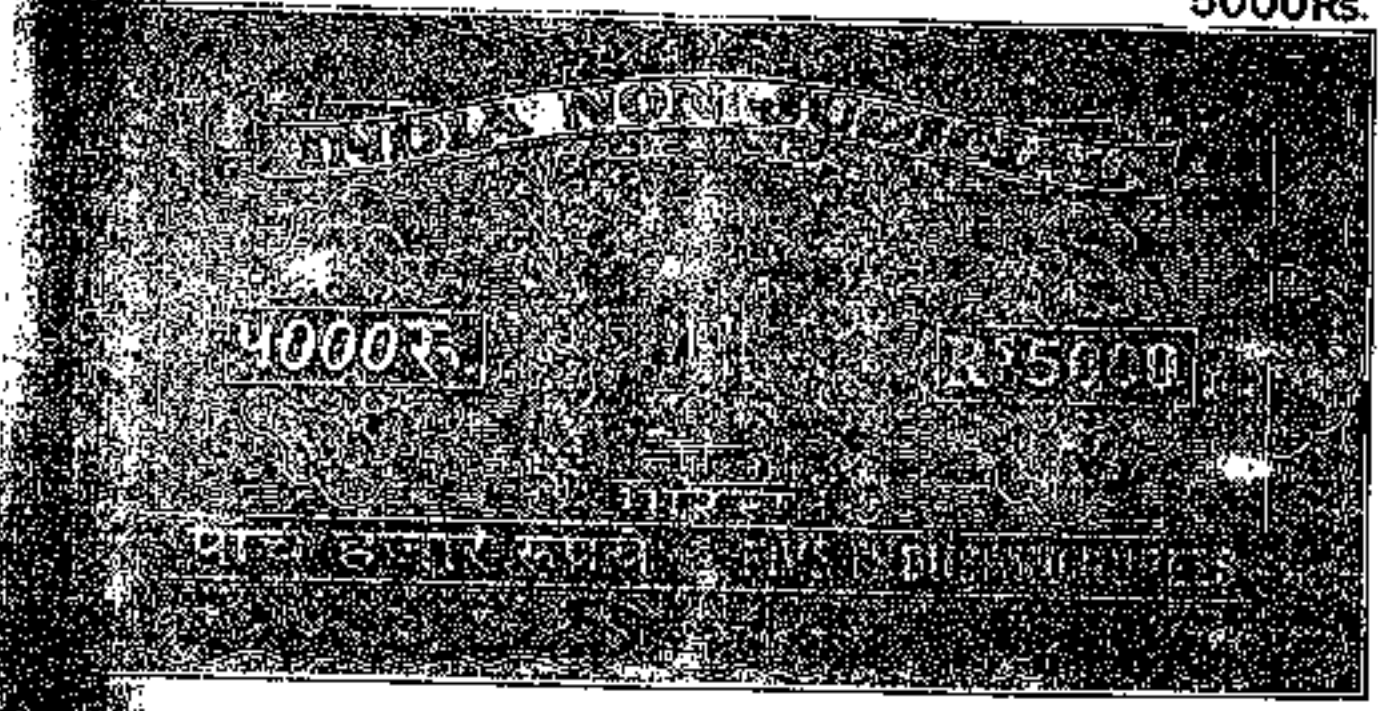

11B. The lessee shall comply with provisions of the Mines Act, 1952 and the rules made thereunder.

11C. The lessee shall take measures for the protection of environment like planting of

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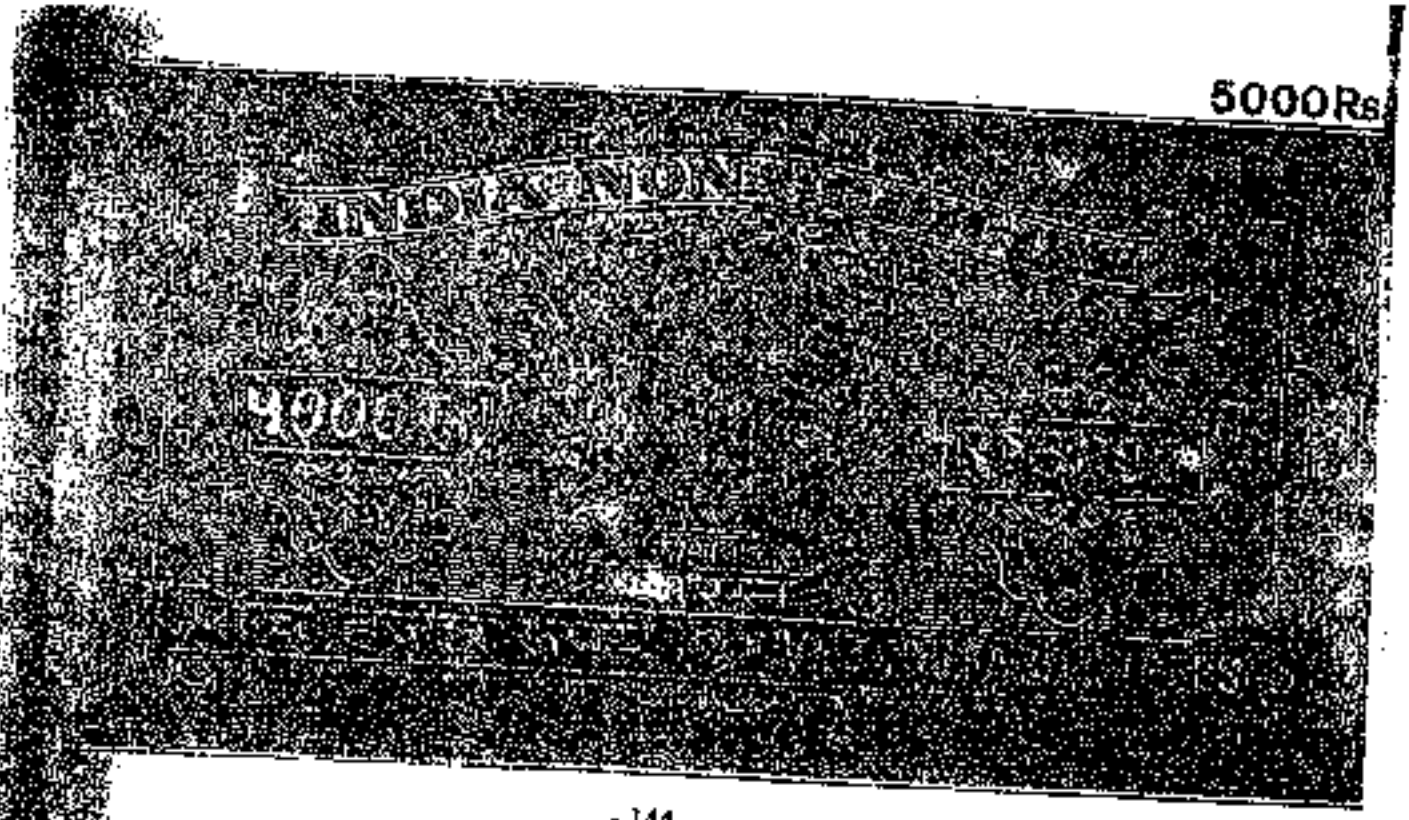

trees, reclamation of land, use of pollution control devices; and such other measures as may be prescribed by the Central or State Government, from time to time, at his own expense.

Cont....

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11D. The lessee shall pay compensation to the occupier of the land on the date and in the manner laid down in these rules.

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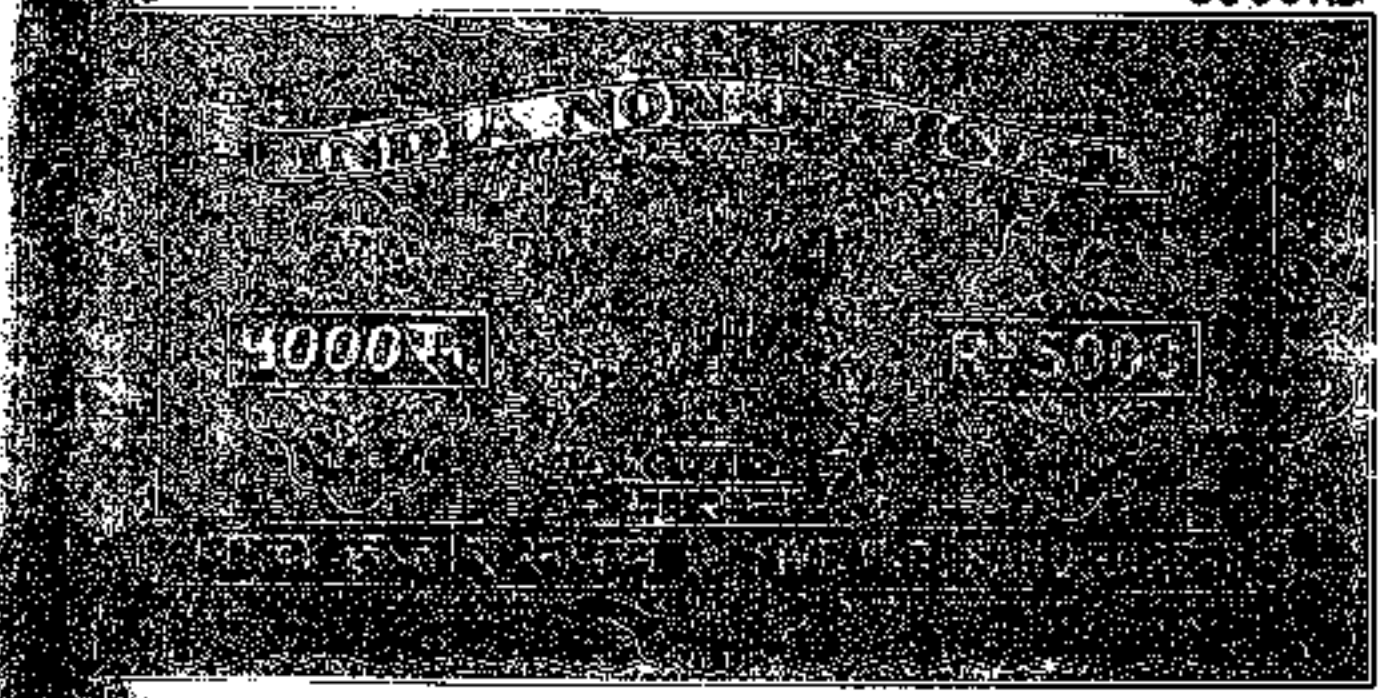

11E. The lessee shall, in the matter of employment, give preference to the tribals and to the persons who become displaced because of the

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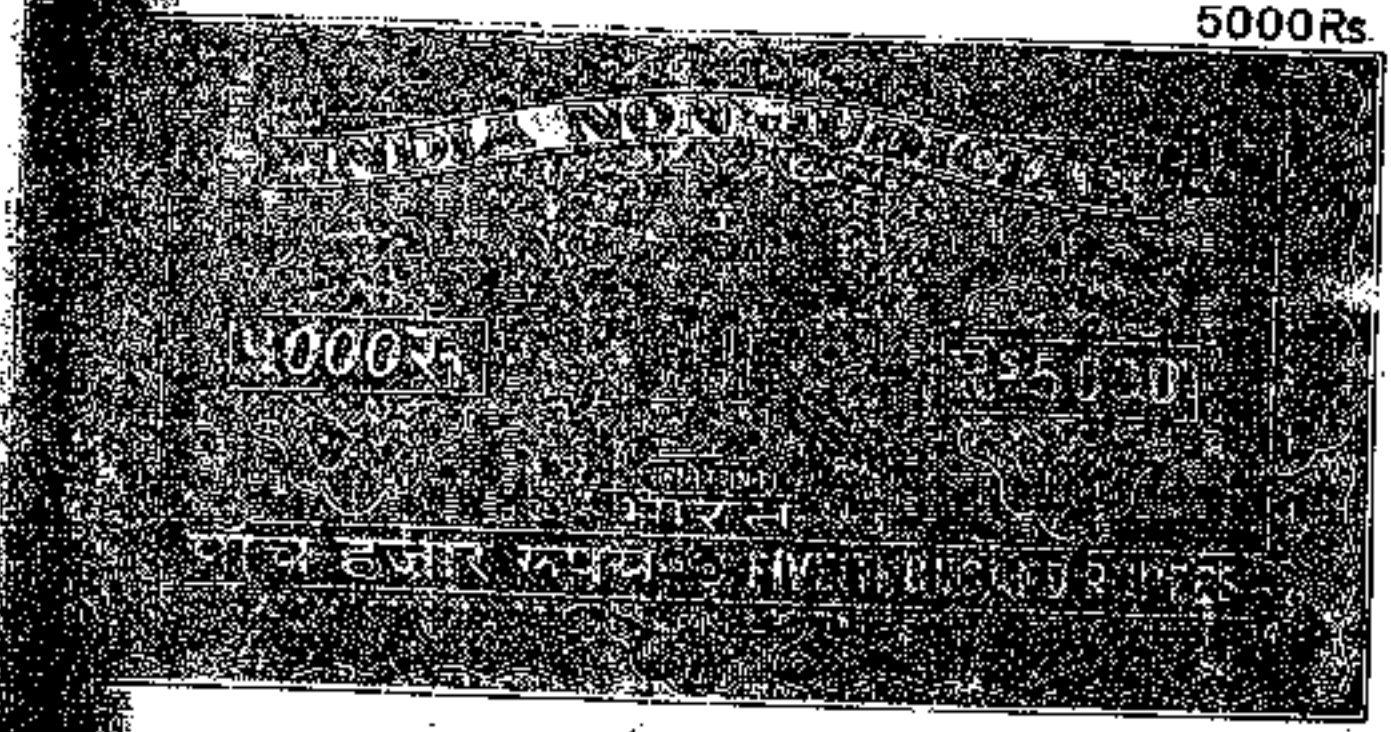

taking up of mining operations.

Act 67 of 1957

12. The lessee/lessees shall be bound by such rules as may be issued from time to time by the Government of India under section 18 of the Mines

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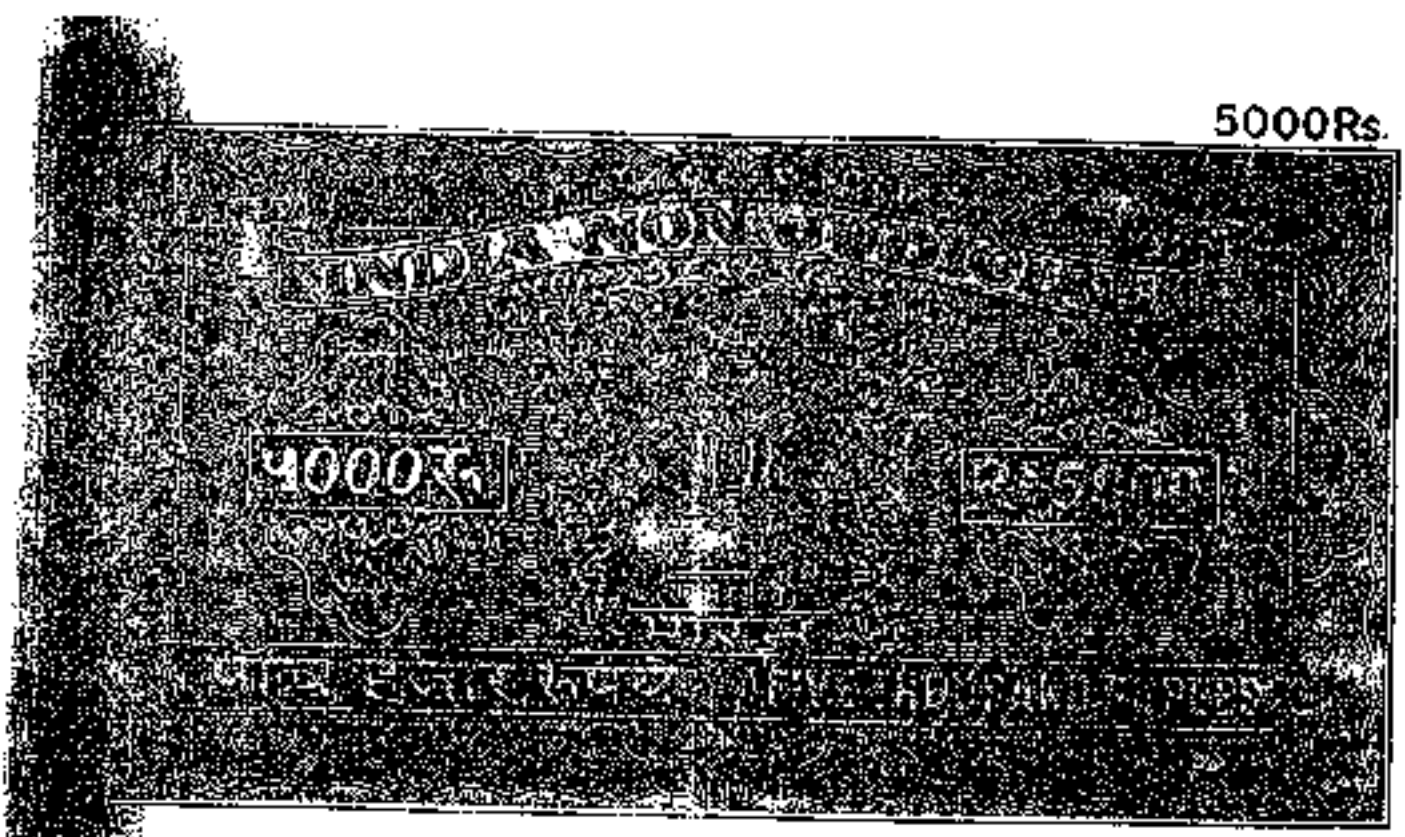

and Minerals (Regulation and Development) Act, 1957 (Act 67 of 1957) and shall not carry on mining or other operations under the said lease in any way other than as prescribed under these rules.

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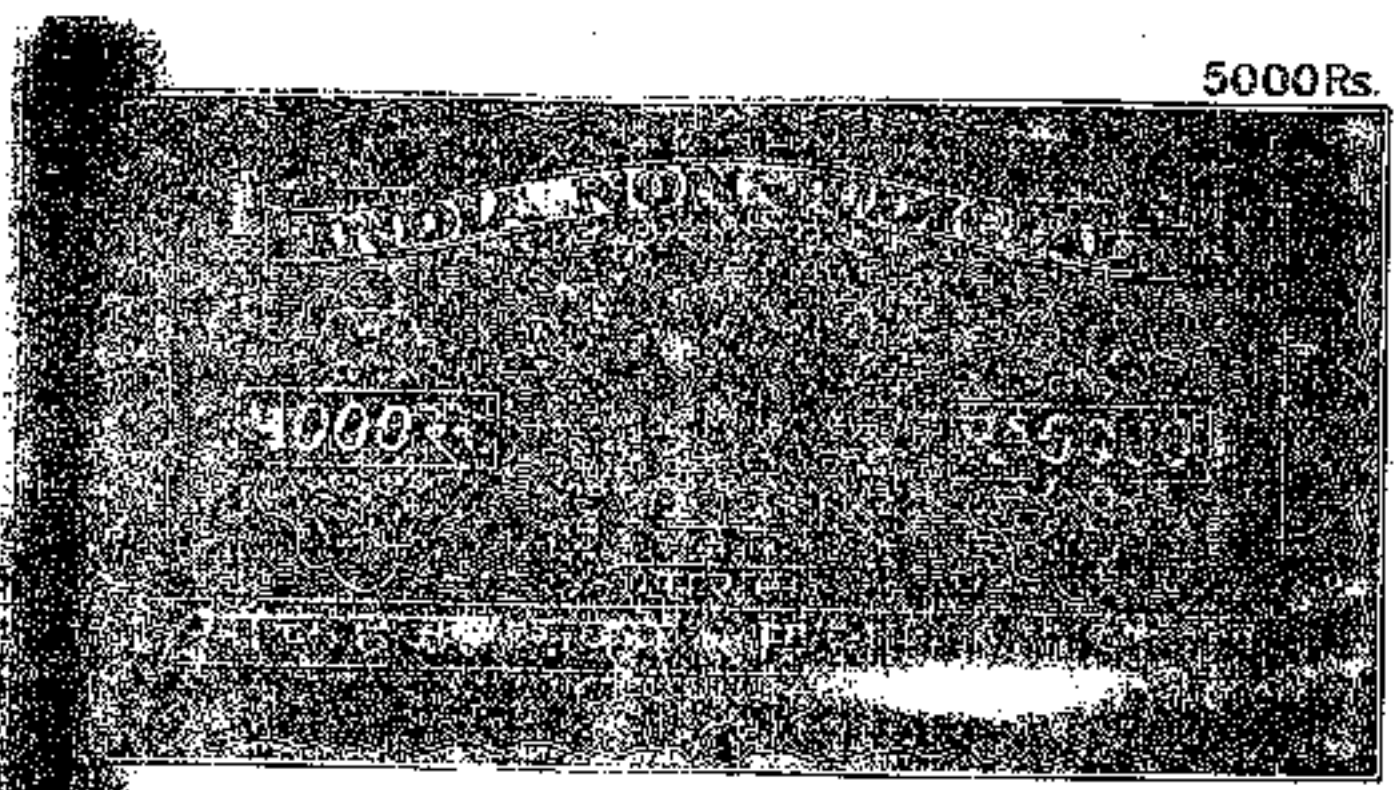

To provide weighing machine

13 Unless specifically exempted by the State Government the lessee/lessees shall provide and at all times keep at or near the pit head or each of the pit heads at which the said minerals shall be brought to bank a properly constructed and efficient weighing

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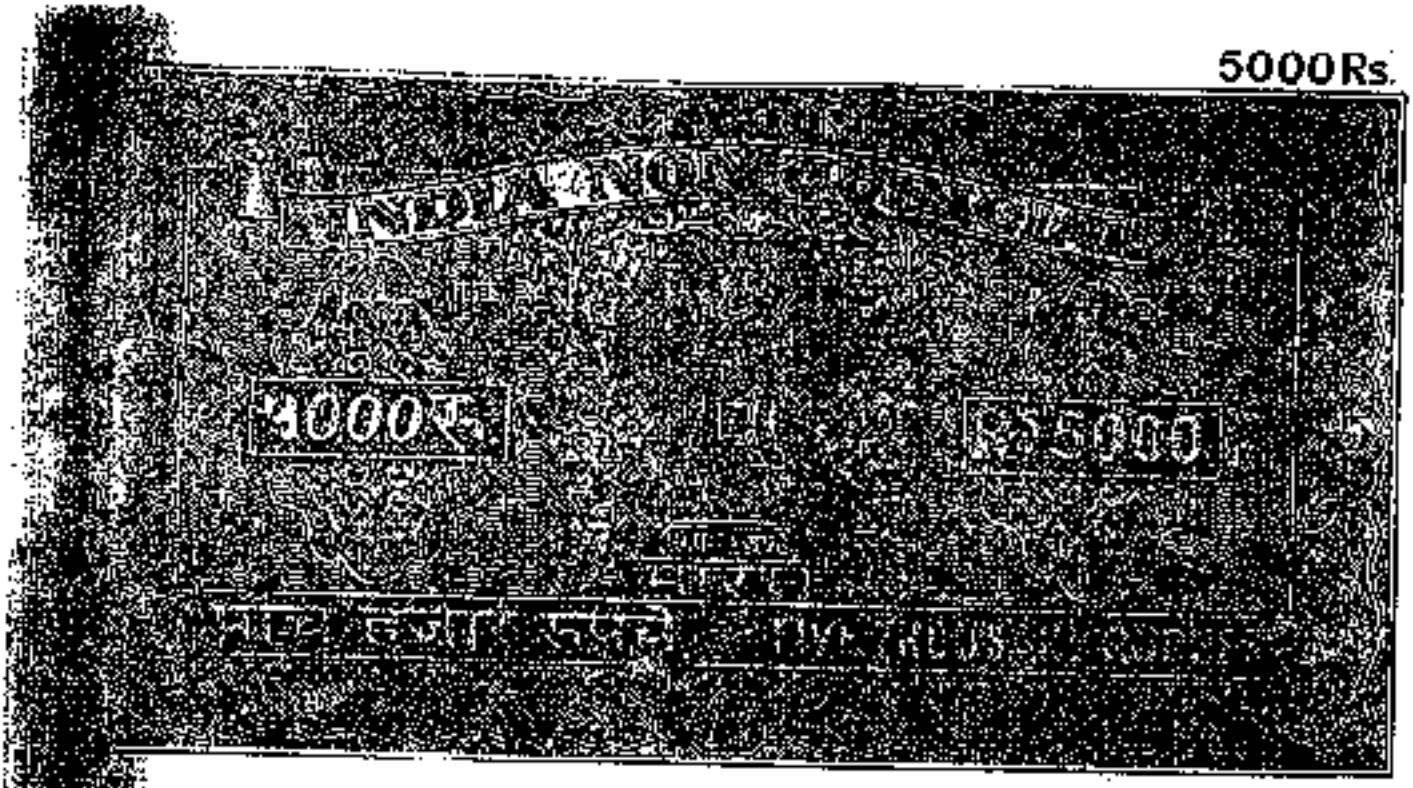

machine and shall weigh or cause to be weighed thereon all the said minerals, from time to time, brought to bank, sold, exported and converted and also the converted products and shall at the close of each day cause the total weights,

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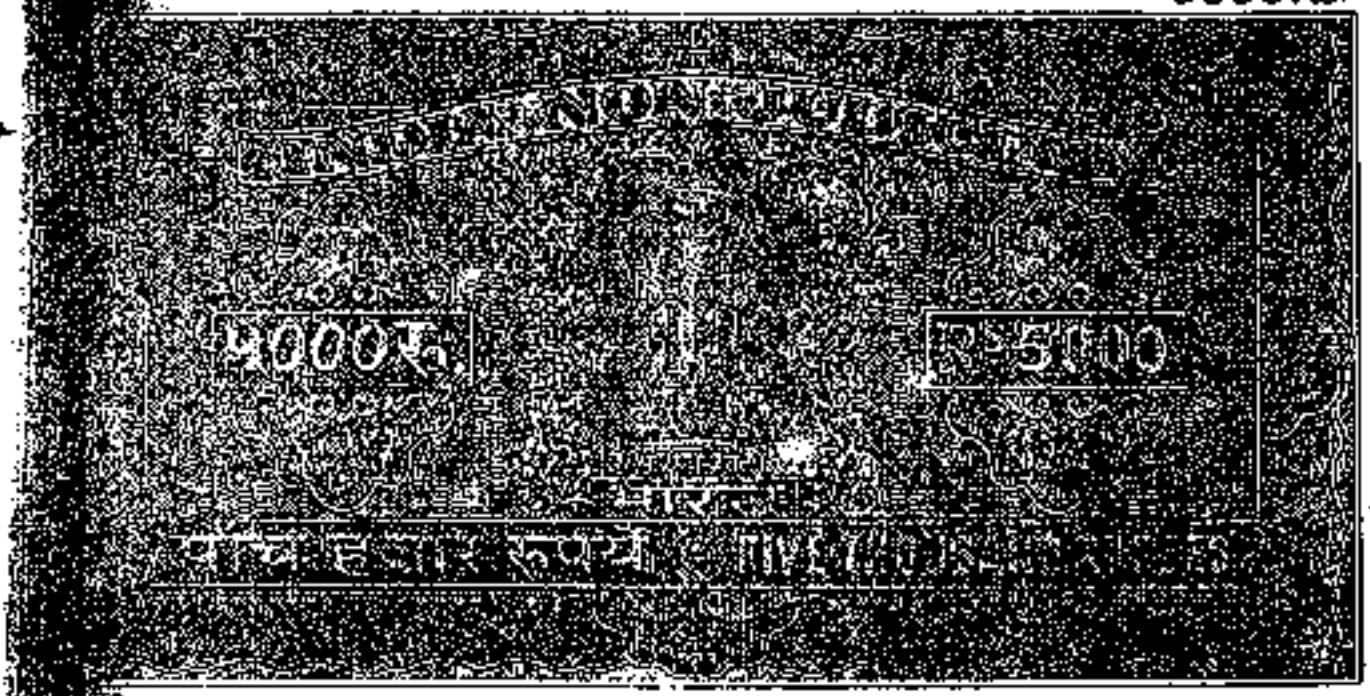

ascertained by such means of the said minerals, ores products raised, sold, exported and converted during the previous twenty four hours to be entered in the aforesaid books of accounts. The lessee/lessees shall permit the State Government at all

Cont....

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times during the said term to employ any person or persons to be present at the weighing of the said minerals as aforesaid and to keep accounts thereof and to check the accounts kept by the lessee/lessees. The lessee/lessees shall give 7(seven)

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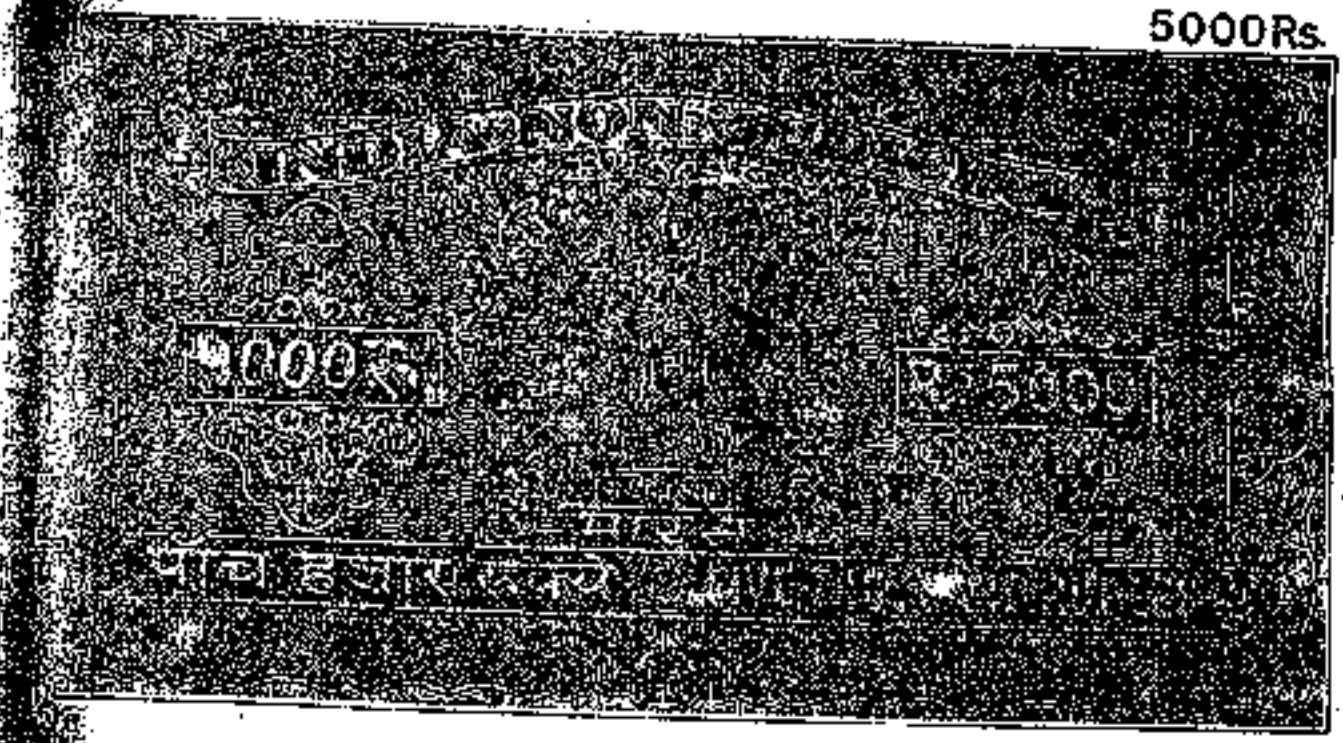

days previous notice in writing to the Deputy Commissioner/Collector of every such measuring or weighing in order that he or some officer on his behalf may be present thereat.

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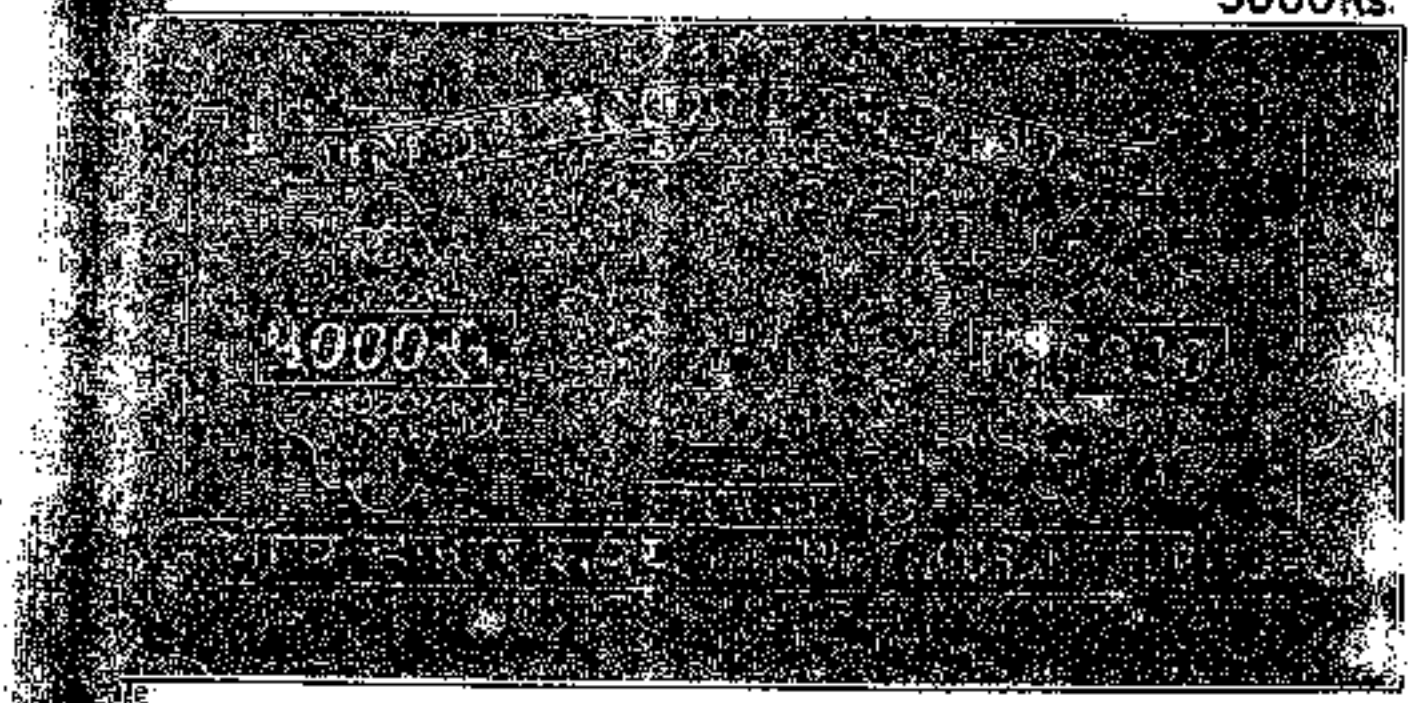

To allow test of weighing machine

14. The lessee/lessees shall allow any person or persons appointed in that behalf by the State Government at any time or times during the said term to examine and test every weighing machine to be provided and kept as aforesaid and the weights

Cont....

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used therewith in order to ascertain whether the same respectively are correct and in good repair and order and if upon any such examination or testing any such weighing machine or weights shall be found incorrect or out of repair" or order the State

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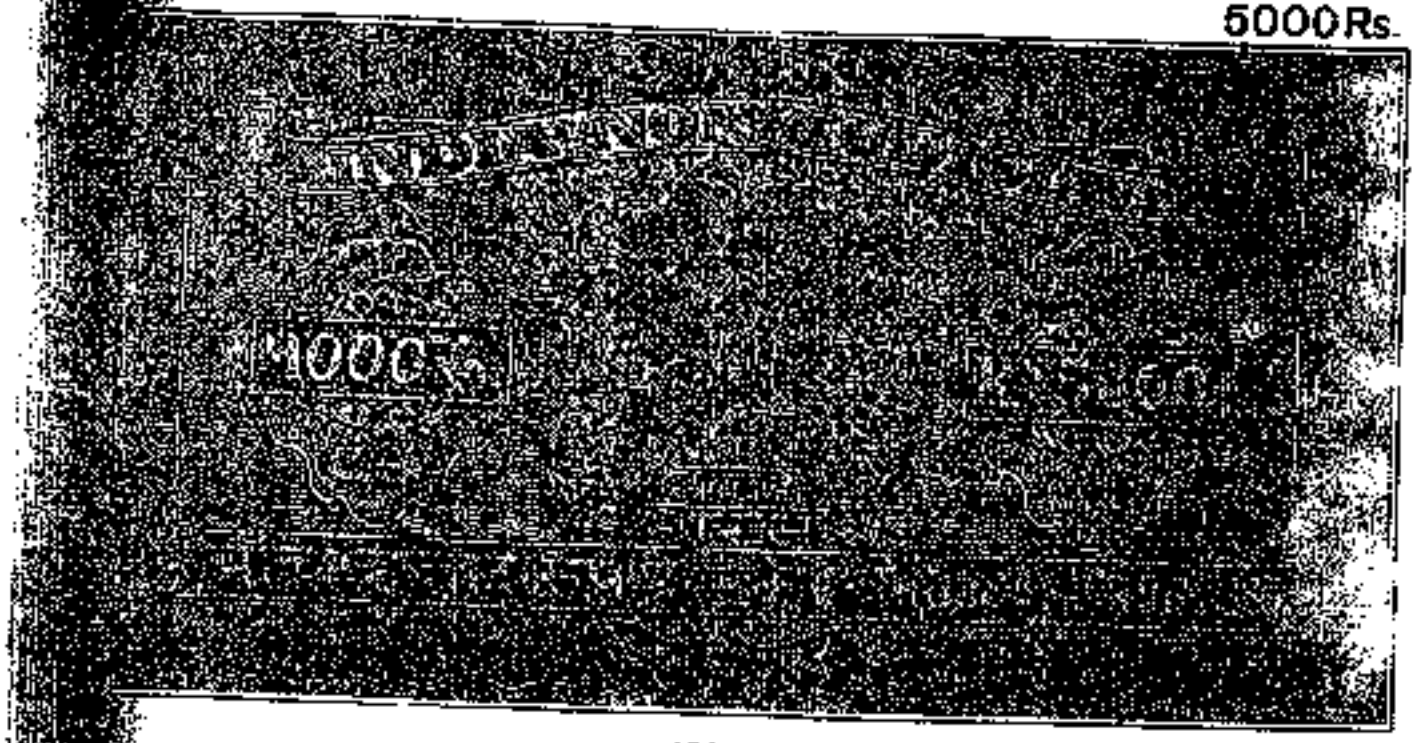

Government may require that the same be adjusted, repaired and put in order by and at the expense of the lessee/lessees and if such requisition be not complied with within fourteen days after the same shall have been made, the State Government may

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cause such weighing machine or weights to be adjusted, repaired, and put in order and the expense of so doing shall be paid by the lessee/lessees to the State Government on demand and if upon any such examination or testing as

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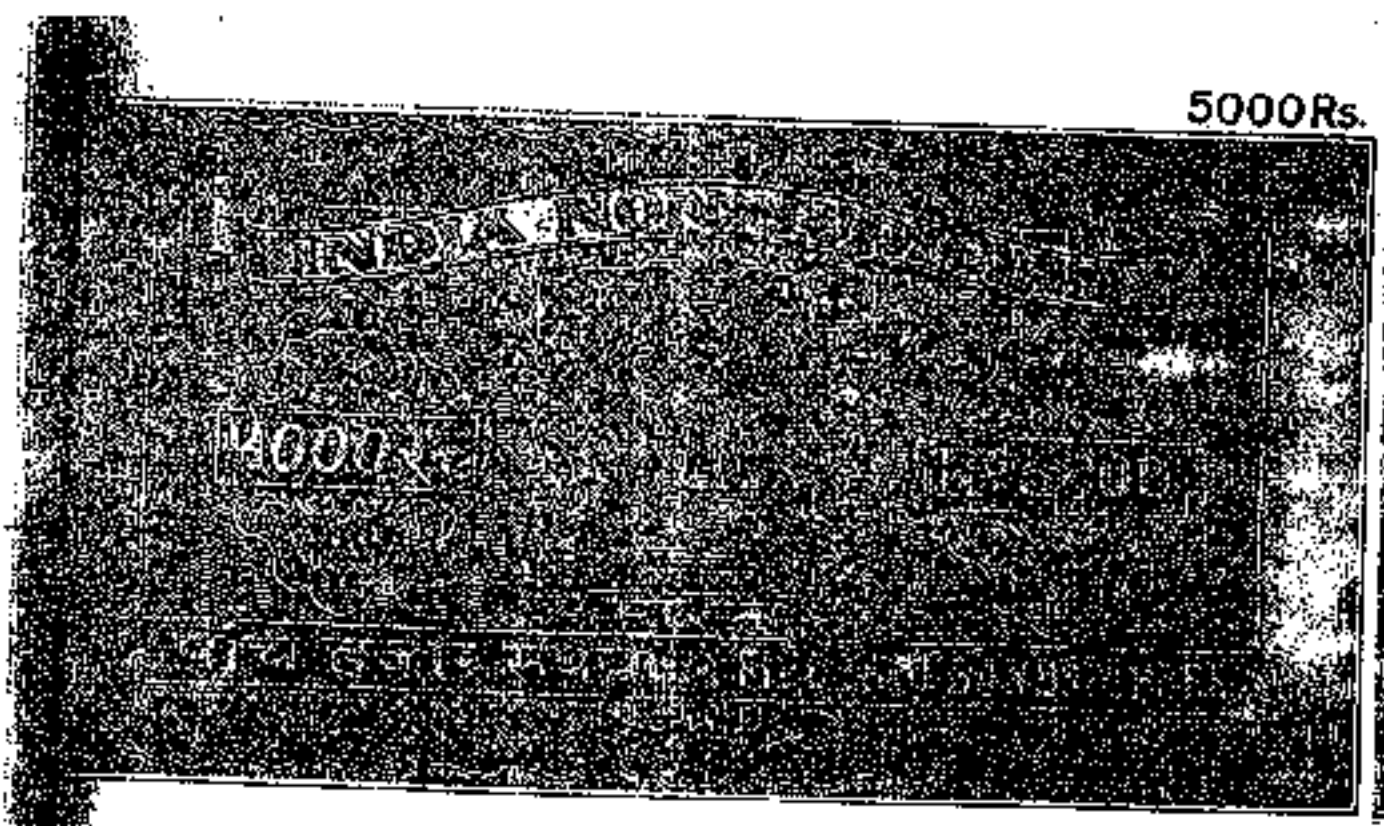

aforesaid any error shall be discovered in any weighing machine or weights to the prejudice of the State Government such error shall be regarded as having existed for three calendar months previous to the discovery thereof or from the last

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occasion of so examining and testing the same weighing machine and weights in case such occasion shall be within such period of three months and the said rent and royalty shall be paid and accounted for accordingly.

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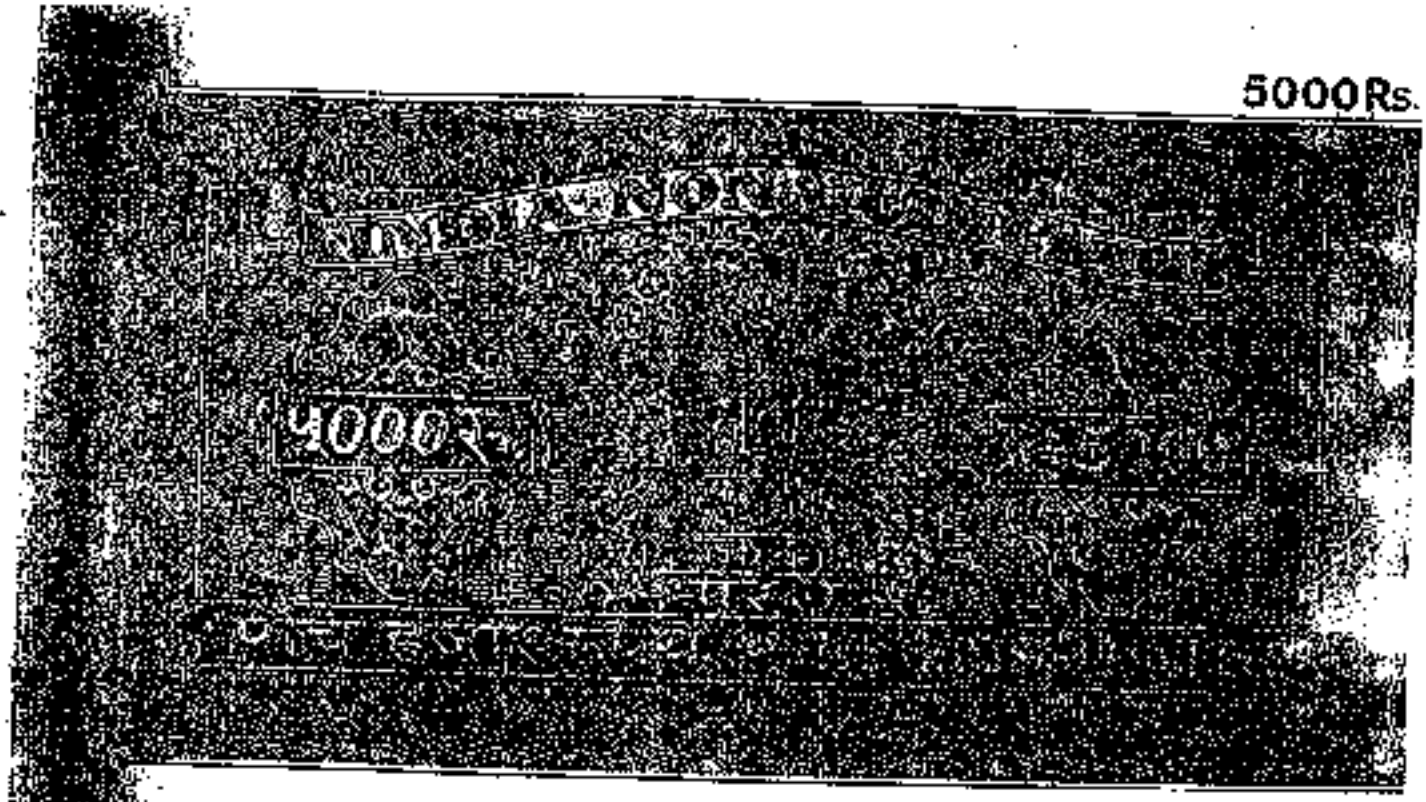

To pay compensation for injury of third parties

15. The lessee/lessees shall make and pay reasonable satisfactionand compensation for all damage, injury or disturbance or person or property which may be done by or on the part of lessee/ lessees in exercise of

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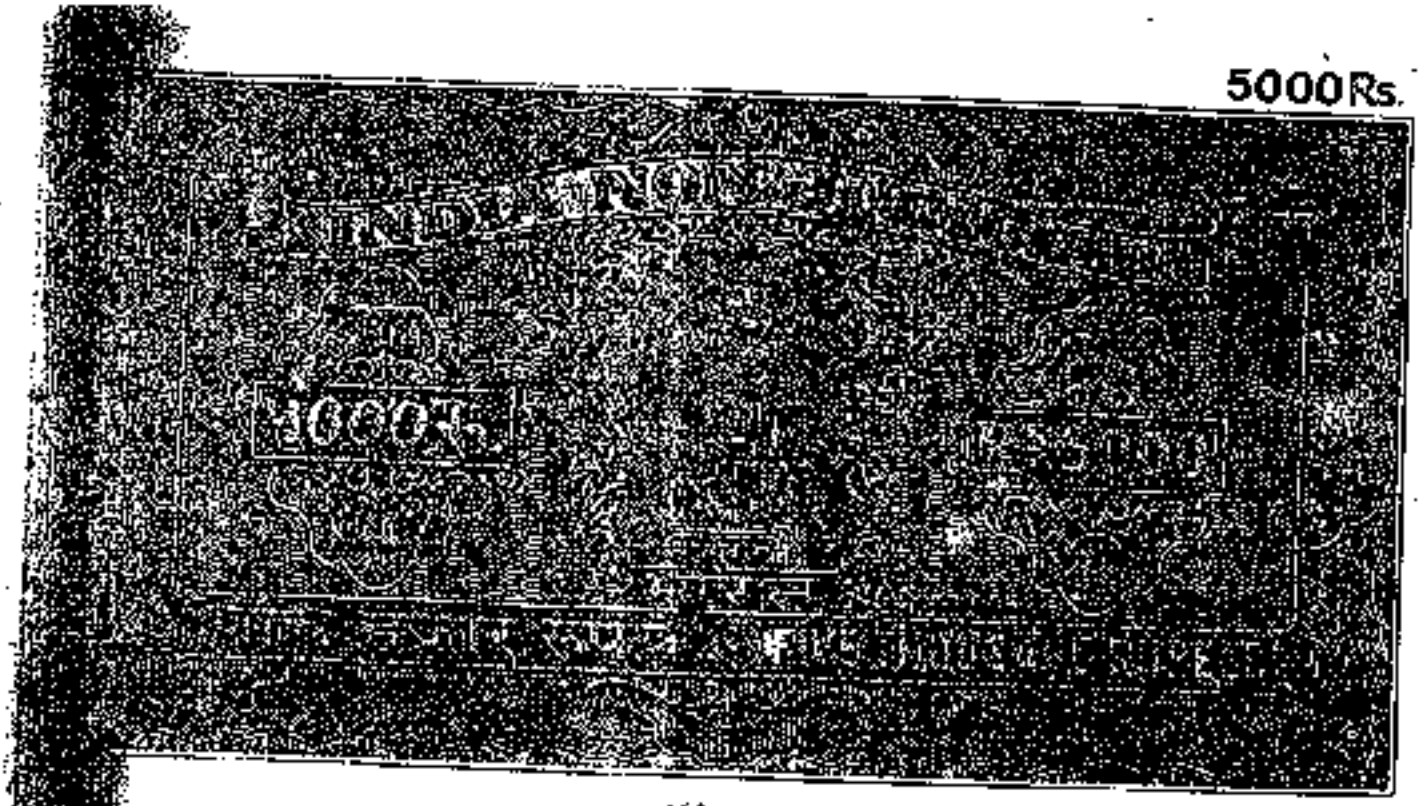

the liberties and power granted by these presents and shall at all times save harmless and keep indemnified the State Government from and against all suits, claims and demands which may be brought or made by any person or persons in respect of

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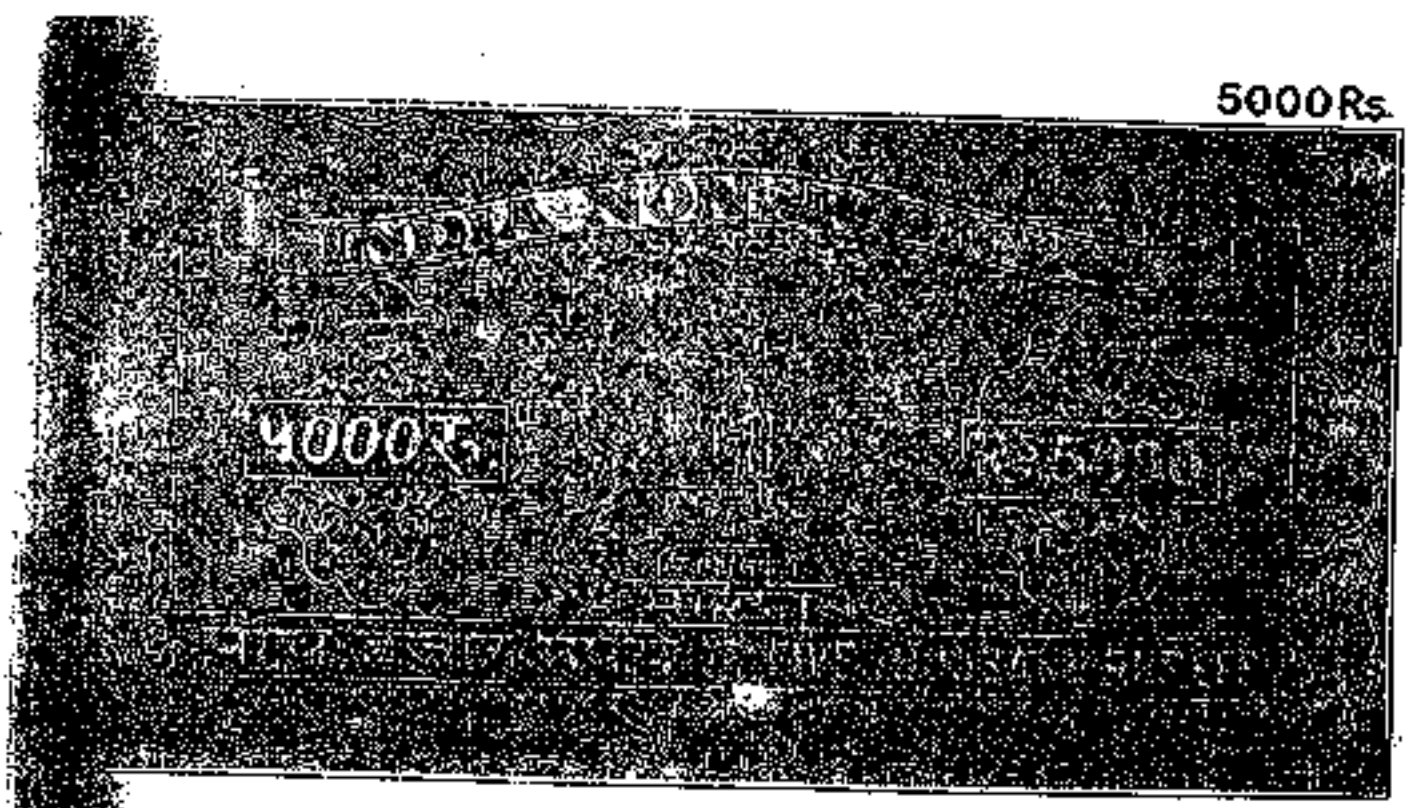

any such damage, injury or disturbance.

Not to obstruct working of other minerals.

16. The lessee/lessees will exercise the liberties and powers hereby granted in such a manner as to offer no unnecessary or reasonably avoidable

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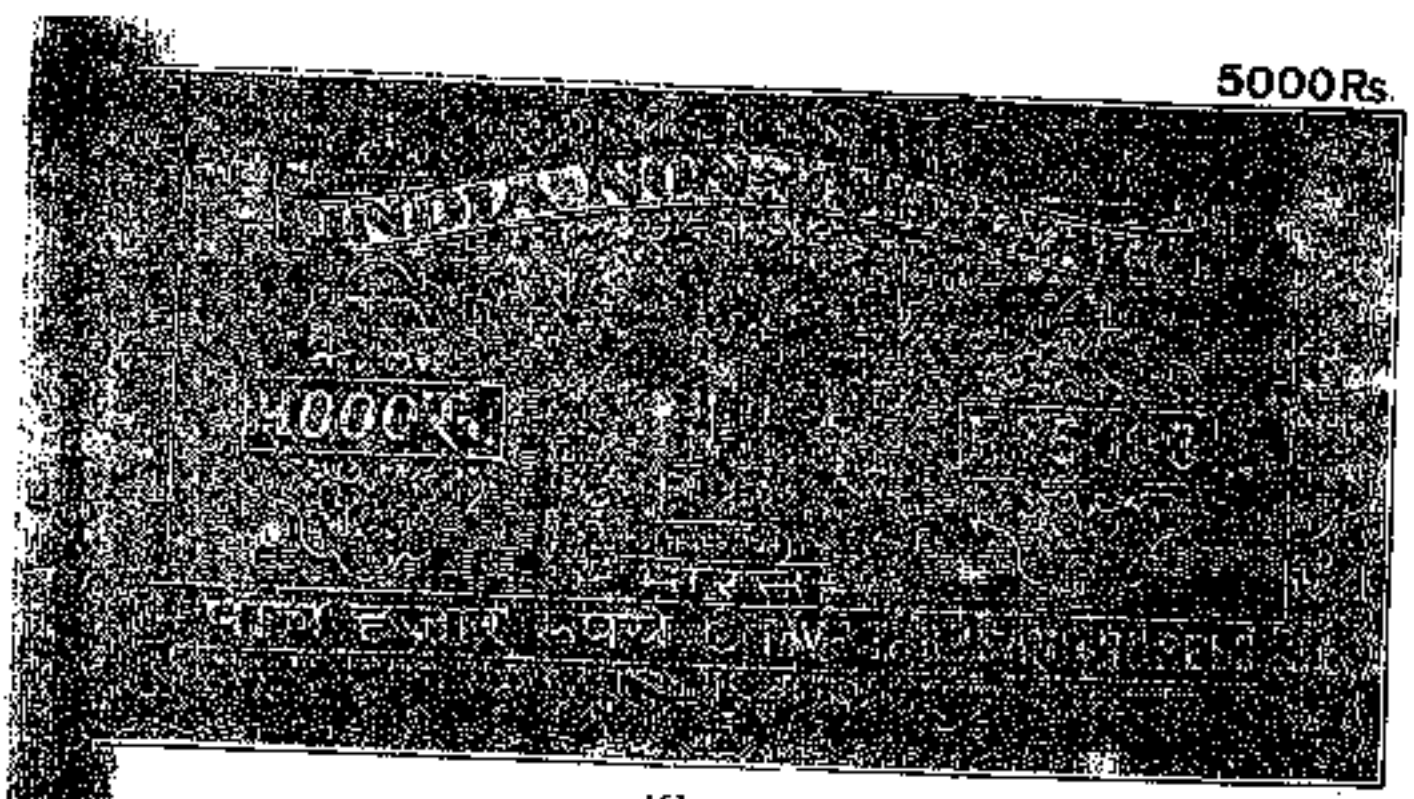

obstruction or interruption to the development and working within the said lands of any minerals not included in this lease and shall at all times afford to the Central and State Government and to the holders of prospecting licences or mining leases

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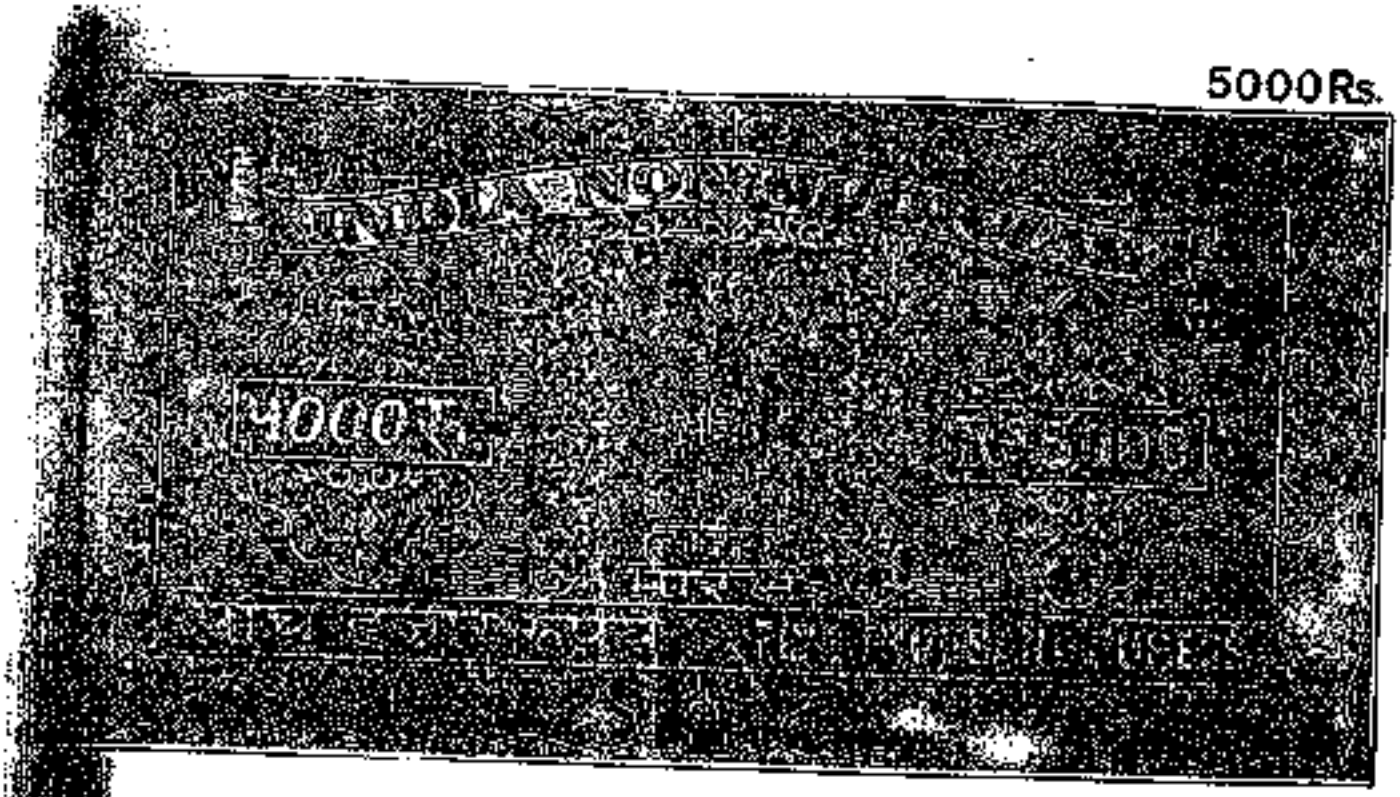

in respect of any such minerals or any minerals within any land adjacent to the said lands as the case may be reasonable means of access and safe and convenient passage upon and across the said lands to such minerals for the purpose of

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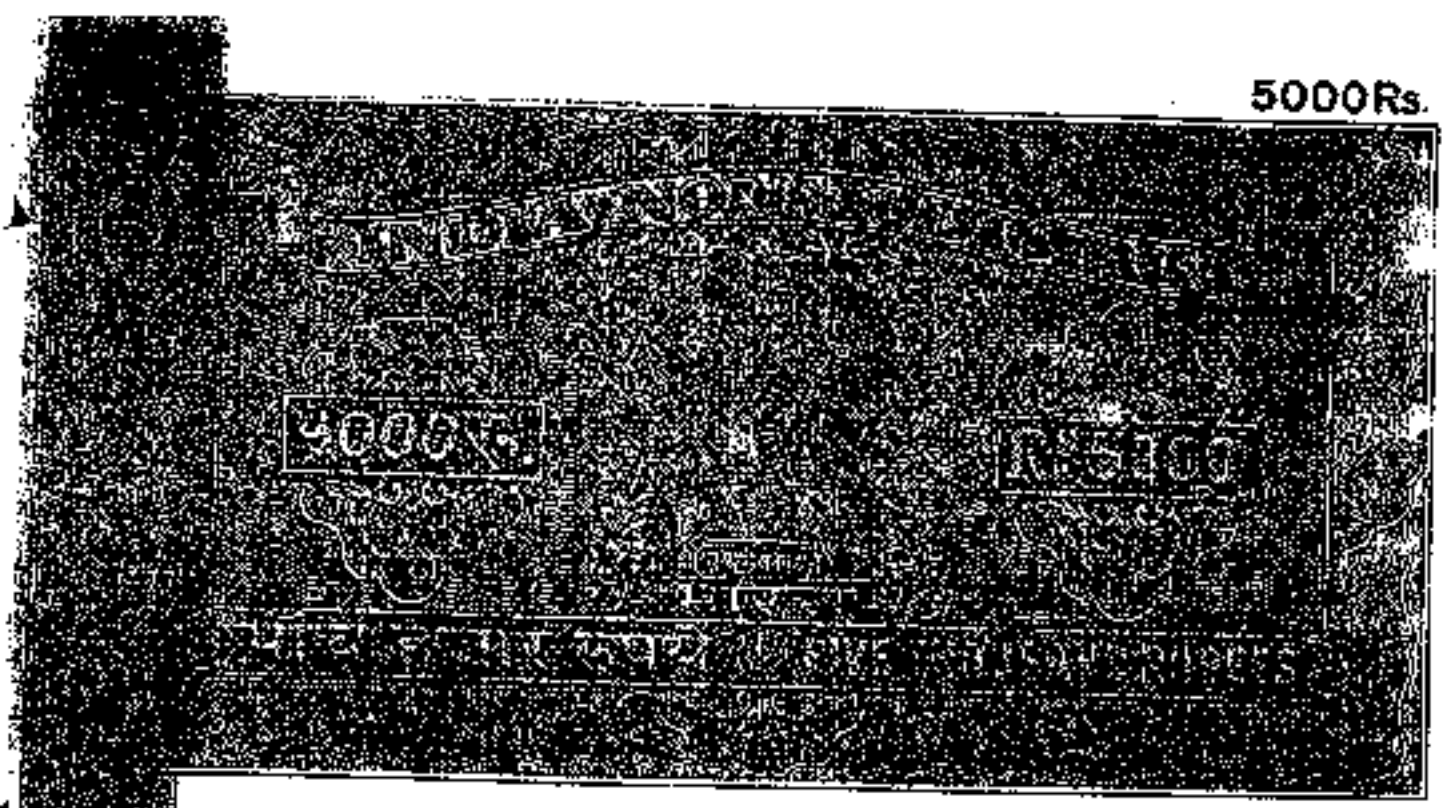

getting working, developing and carrying away the same provided that the lessee/lessees shall receive reasonable compensation for any damage or injury which he/they may sustain by reason or in consequence of the use of such passage by such

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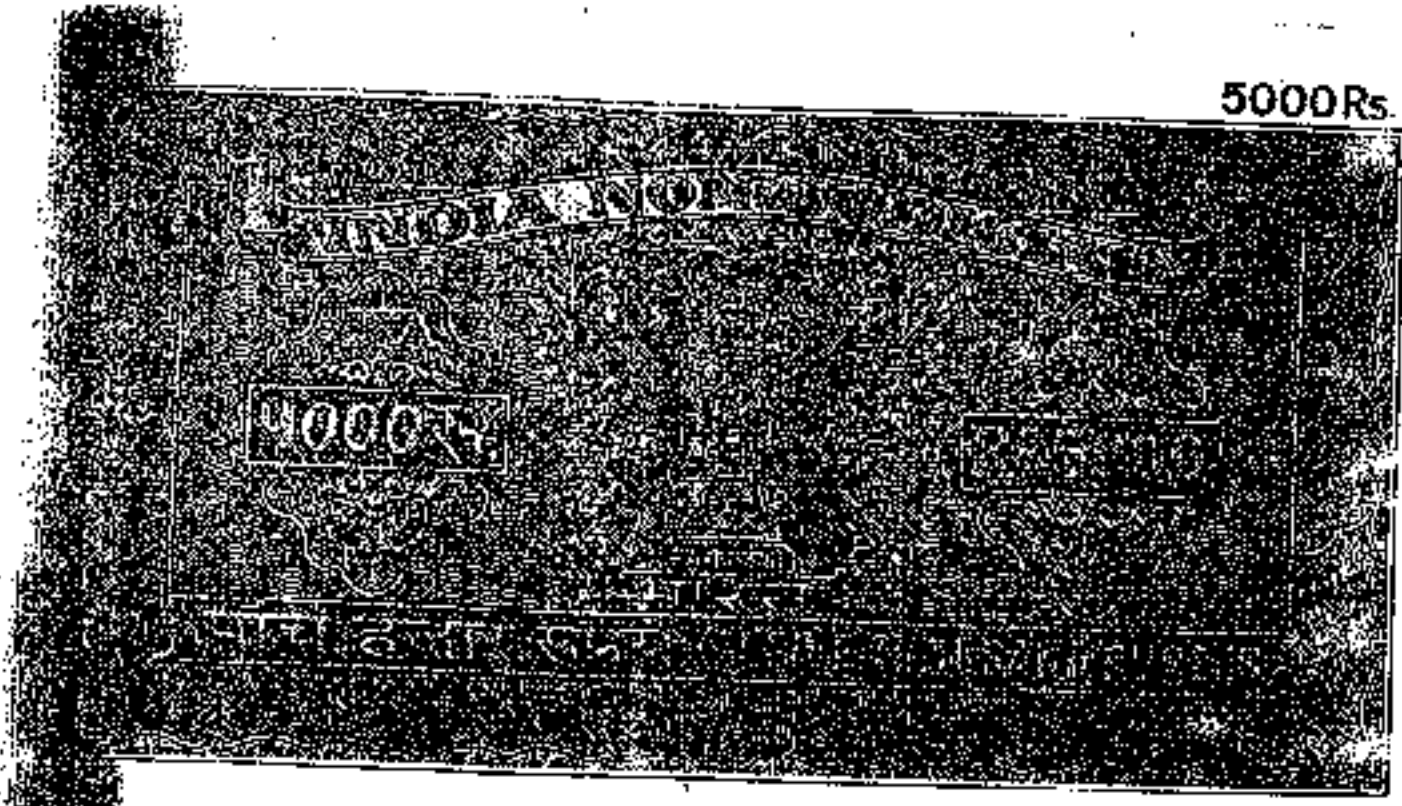

lessees or holders of prospecting licences.

Transfer of lease

17. (1) The lessee/ lessees shall not, without the previous consent in writing of the State Government, in the first schedule to the Act,

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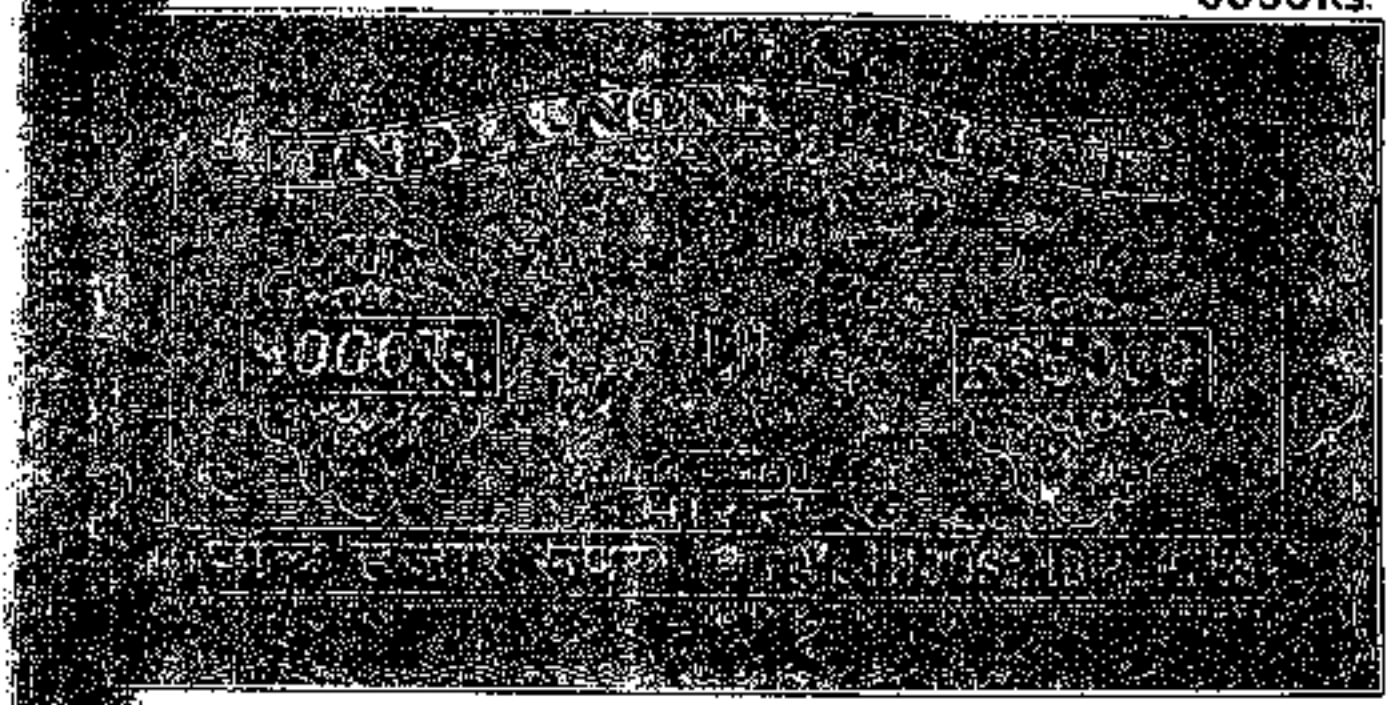

without the previous approval of the Central Government and in the case of mining lease in respect of any mineral specified.

u) assign, sublet, mortgage, or in any other manner, transfer the mining

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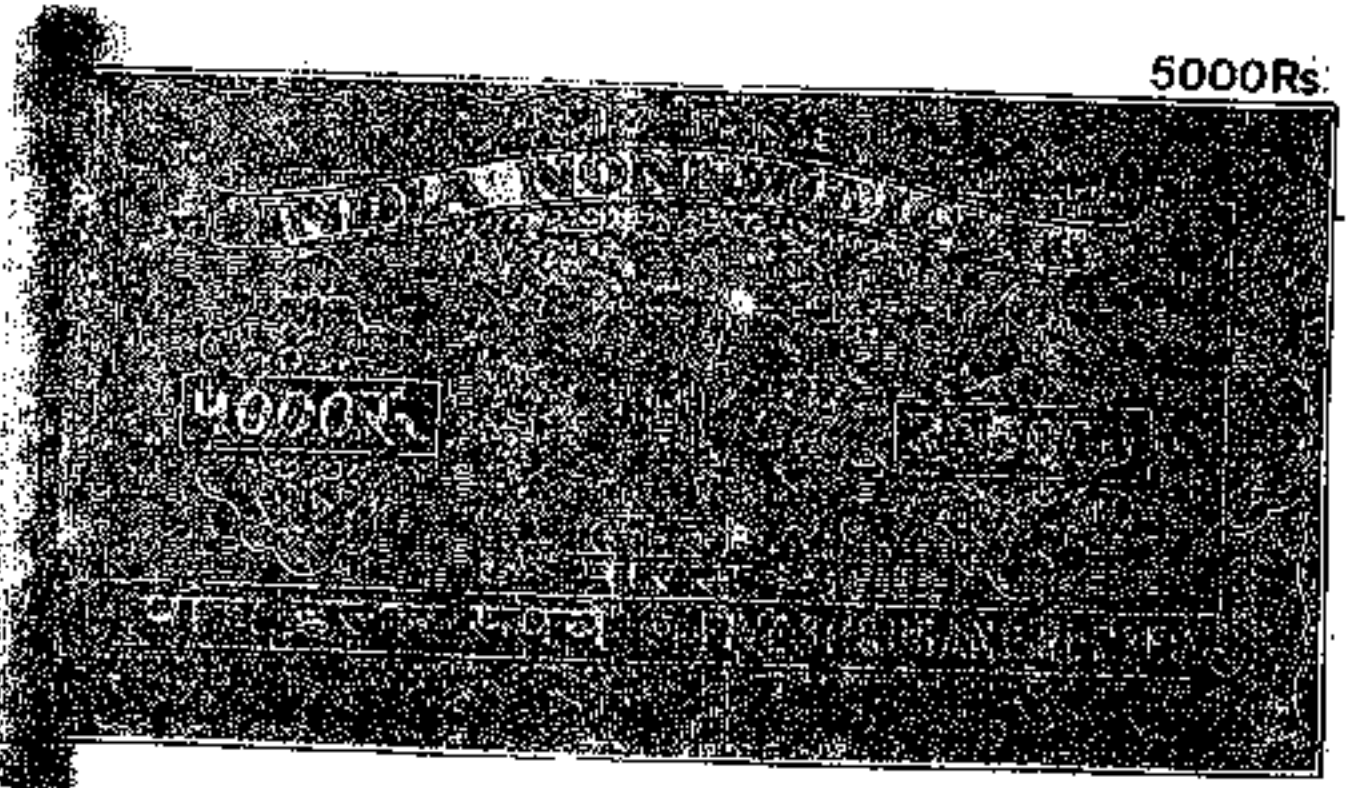

lease, or any right, title or interest therein, or

b) enter into or make any arrangement, contract or understanding whereby the lessee/lessees will or may be directly or indirectly financed to a

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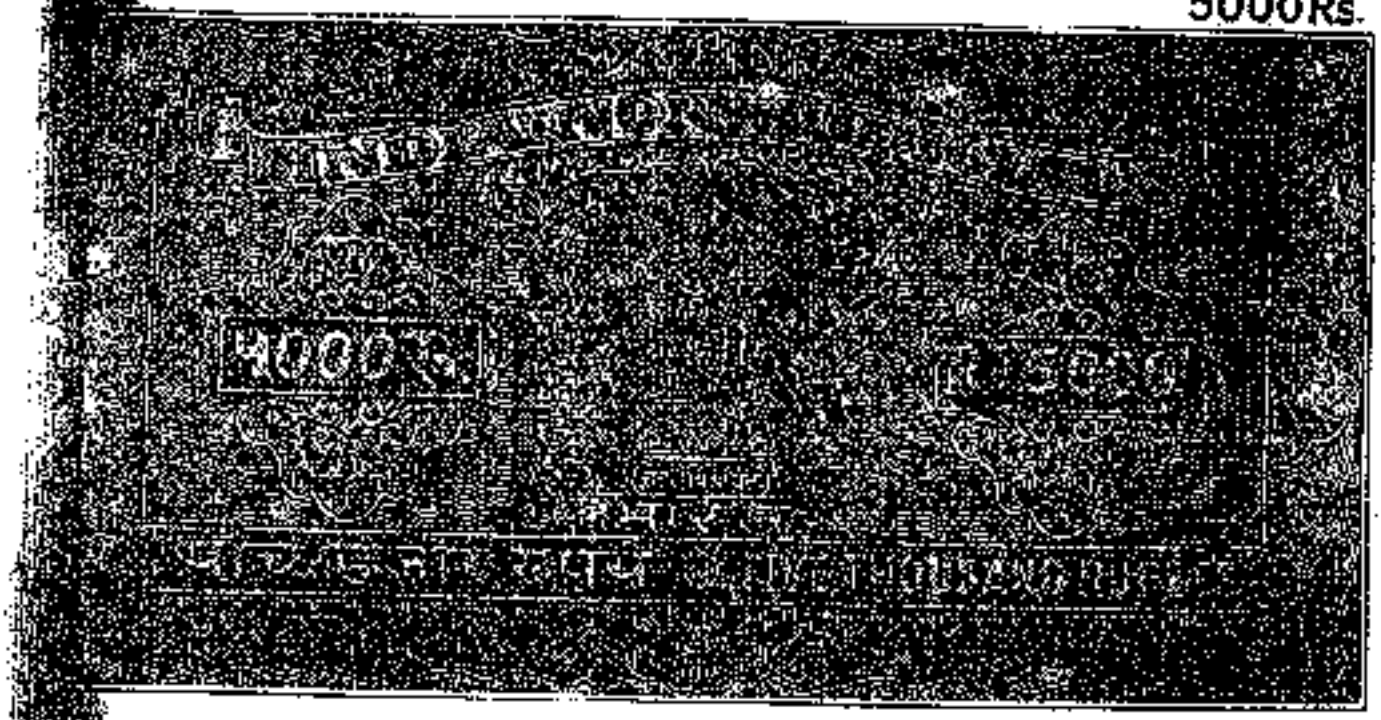

substantial extent by, or under which the lessee's operations or undertakings will or may be substantially controlled by, any person or body of persons other than the lessee/lessees :

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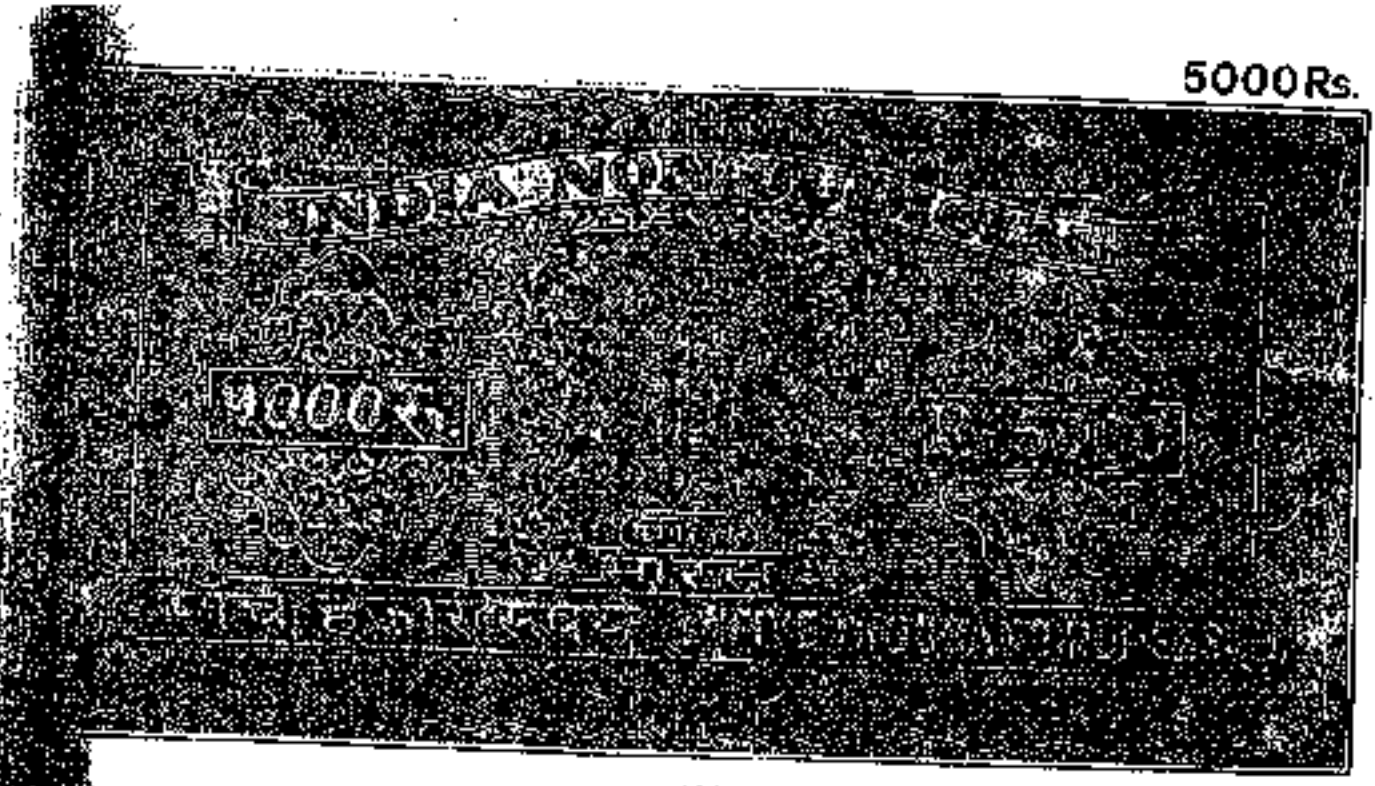

Provided that the State Government shall not give its written consent unless -

a) the lessee has furnished an affidavit along with his application for transfer of the

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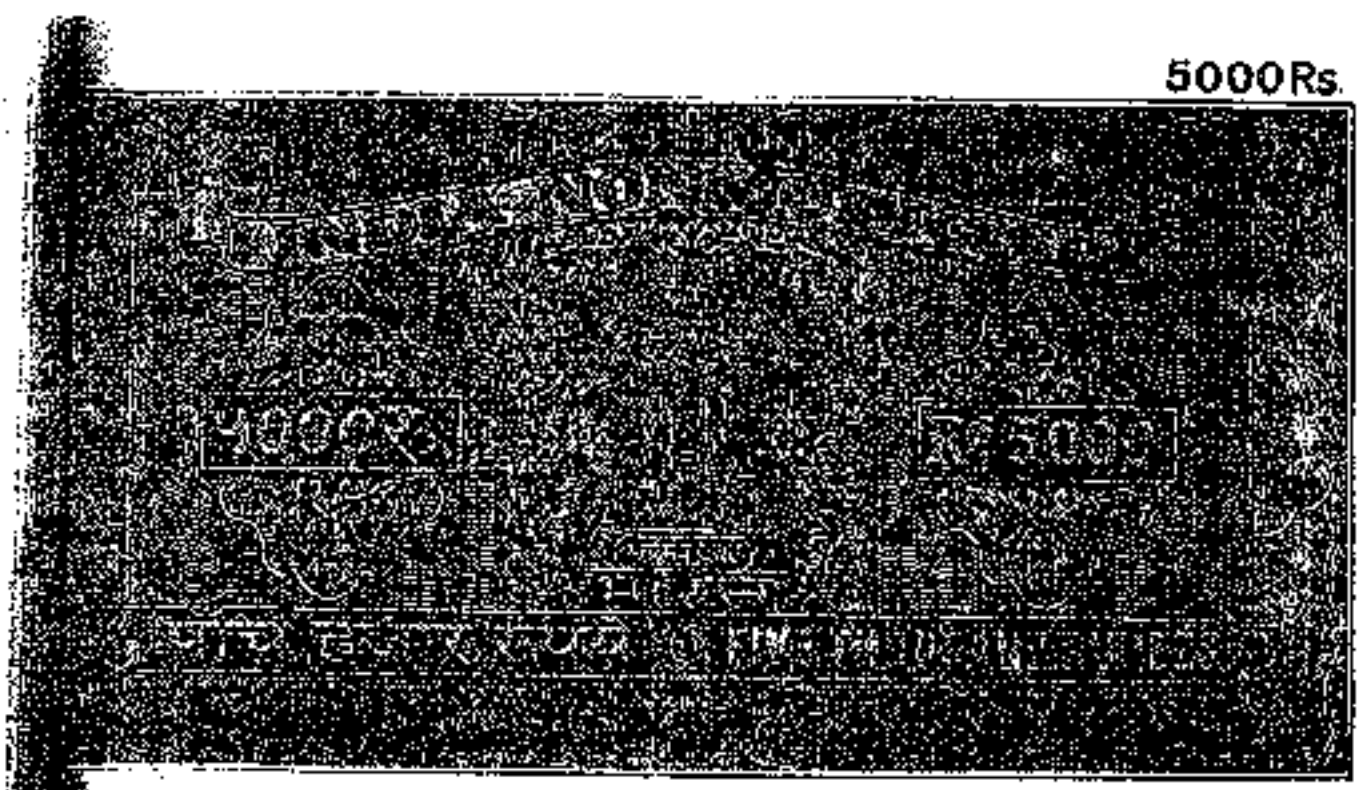

mining lease specifying therein the amount that he has already taken or proposes to take as consideration from the transferee;...

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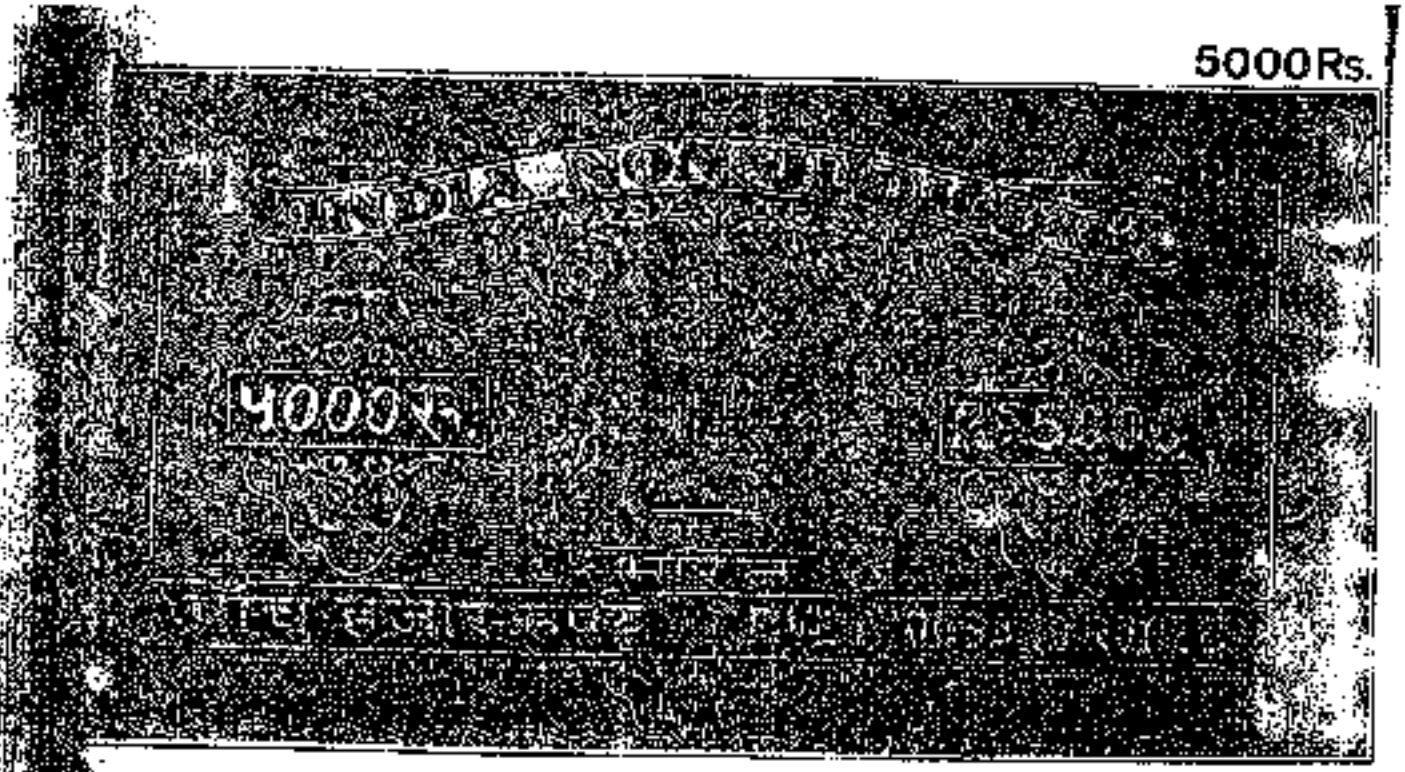

b) the transfer of the mining lease is to be made to a person or body directly undertaking mining operations.

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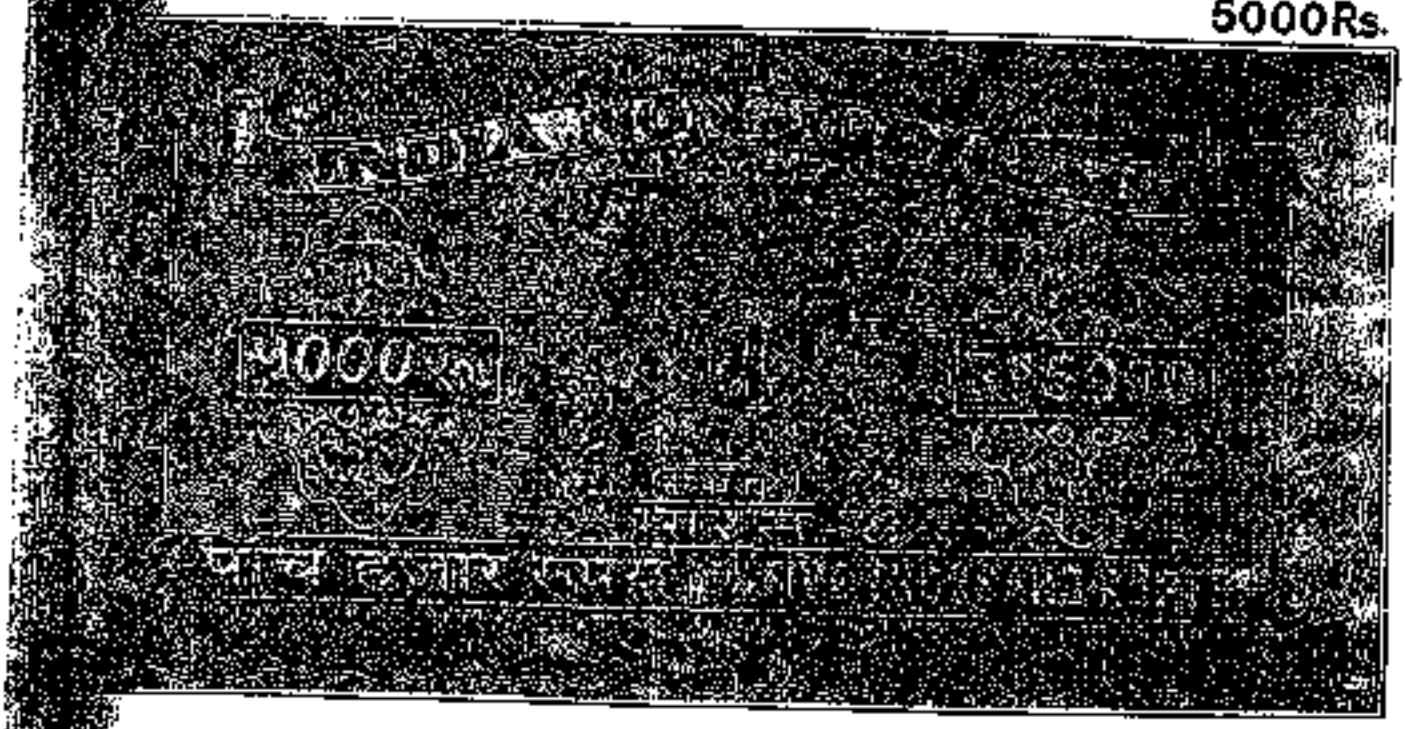

Provided further that when the mortgage is an Institution or a Bank or a Corporation specified in Schedule V, it shall not be necessary for the lessee/lessees to obtain any such consent of the State Government.

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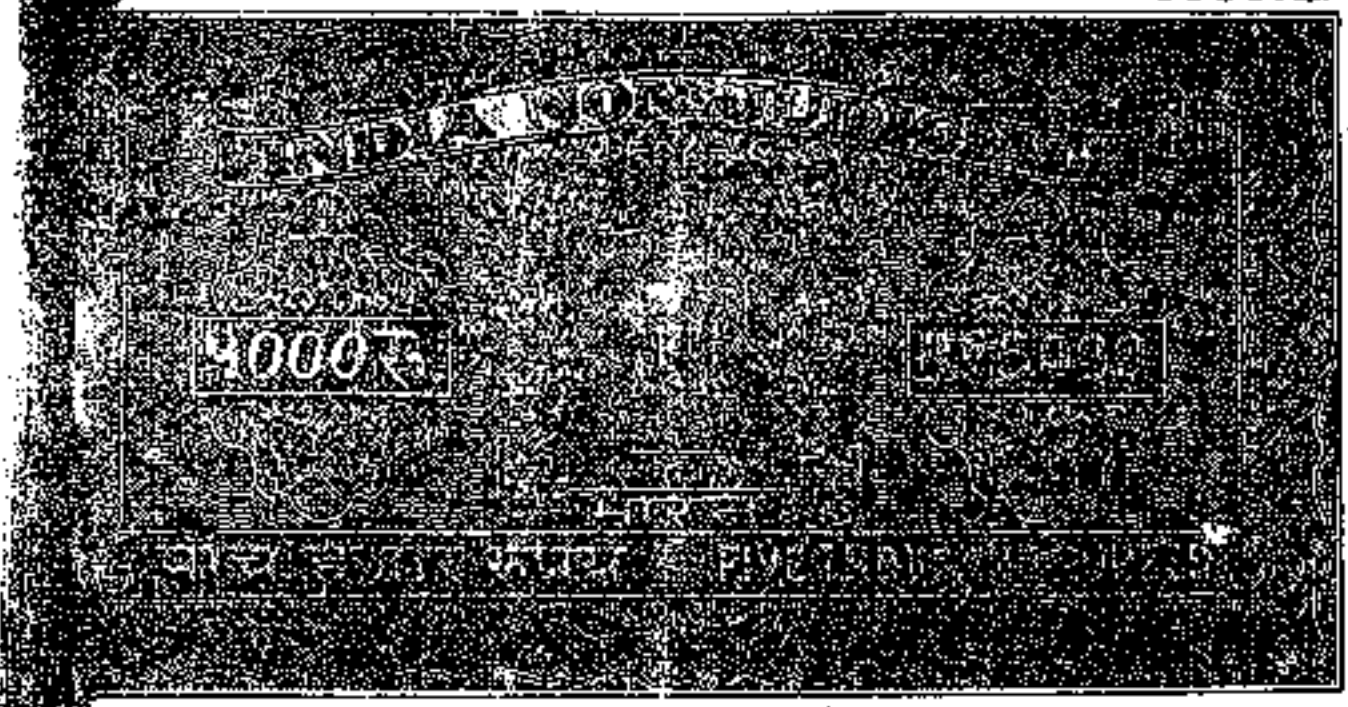

(1A.) The State Government shall not give its consent to transfer of mining lease unless the transferee has accepted all the conditions and liabilities which the transferor was

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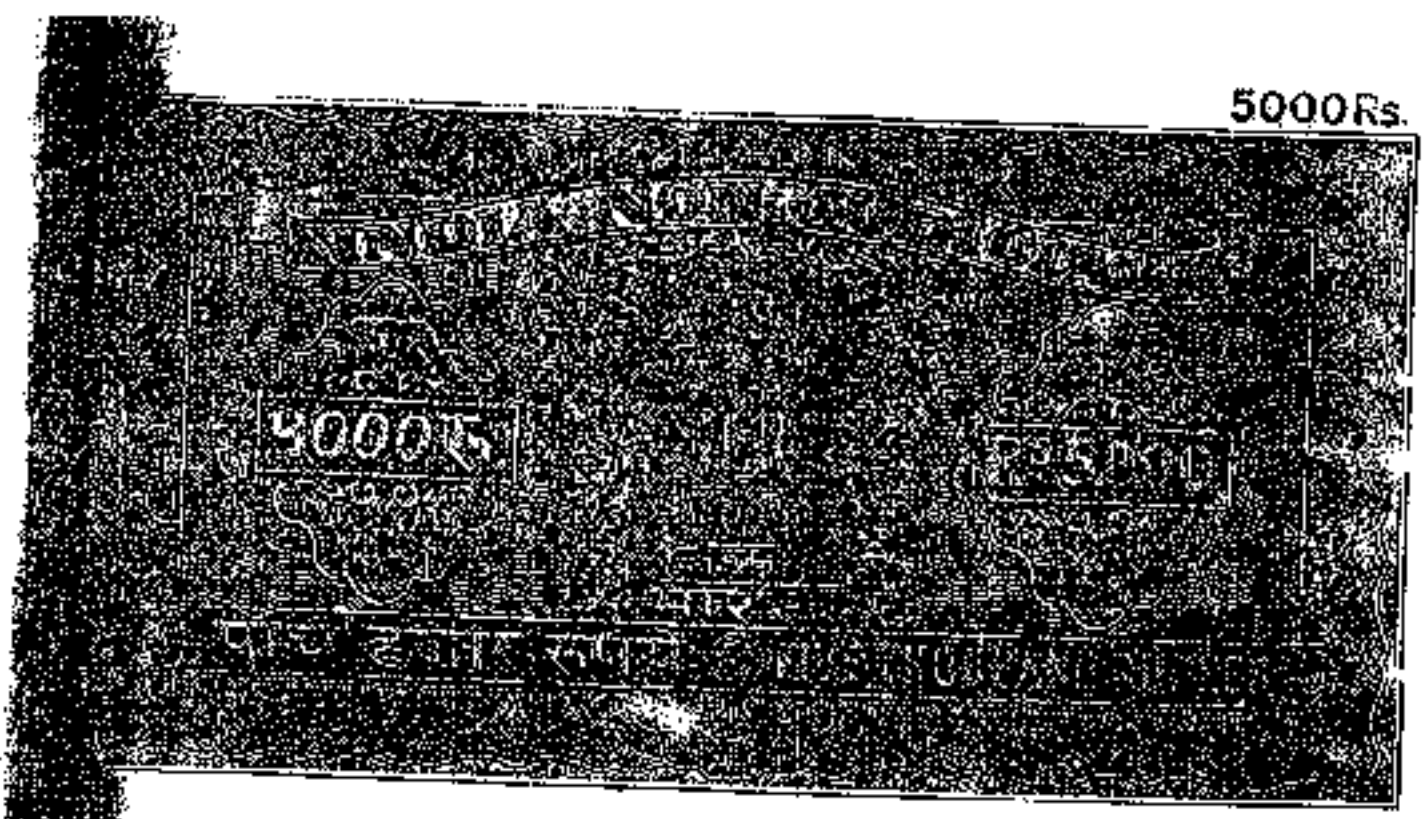

having in respect of such mining lease.

(2) Without prejudice to the above provisions, the lessee/lessees may, subject to the conditions specified in the proviso to

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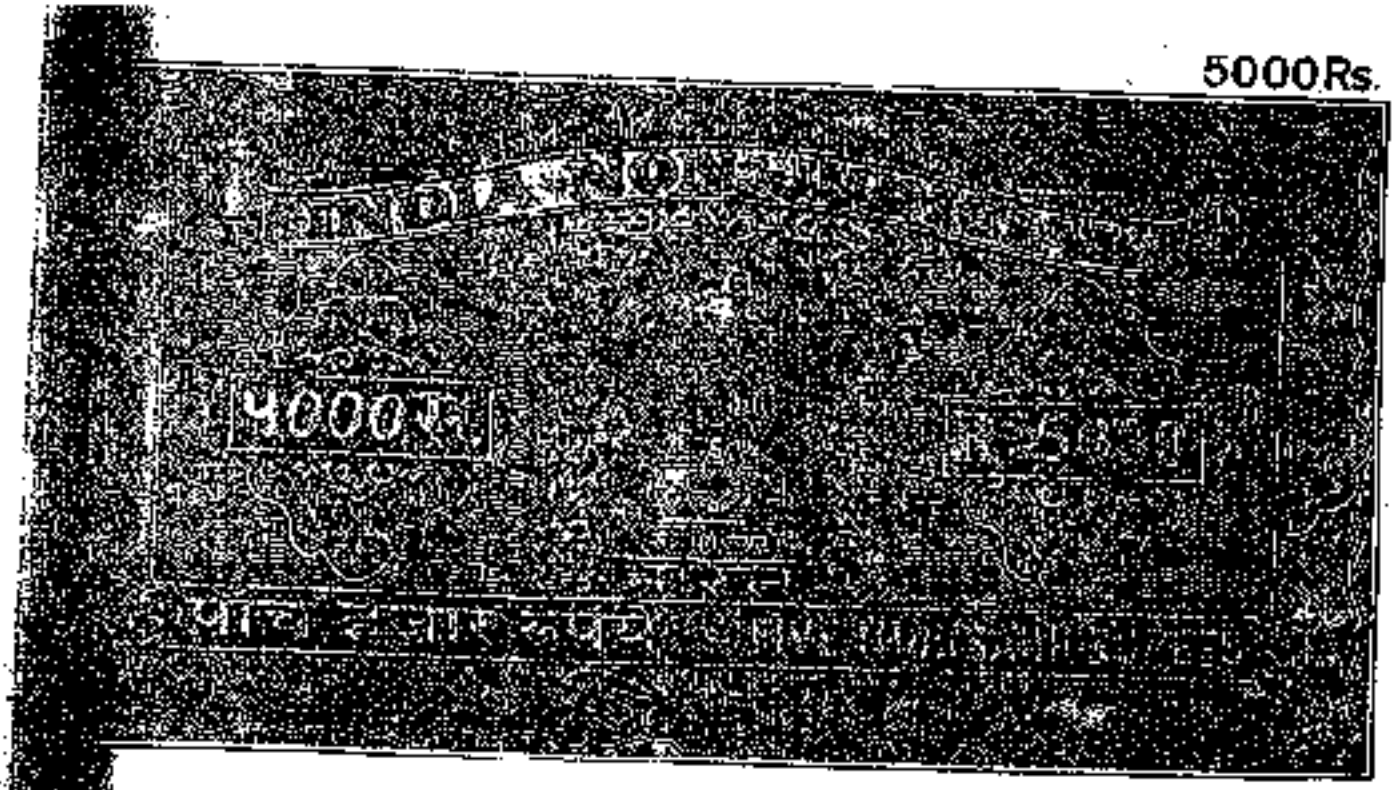

Rule 35 of said Rules, transfer this lease or any right, title or interest therein, to a person who has filed an affidavit stating that he has filed up-to-date income tax returns, paid income tax assessed on

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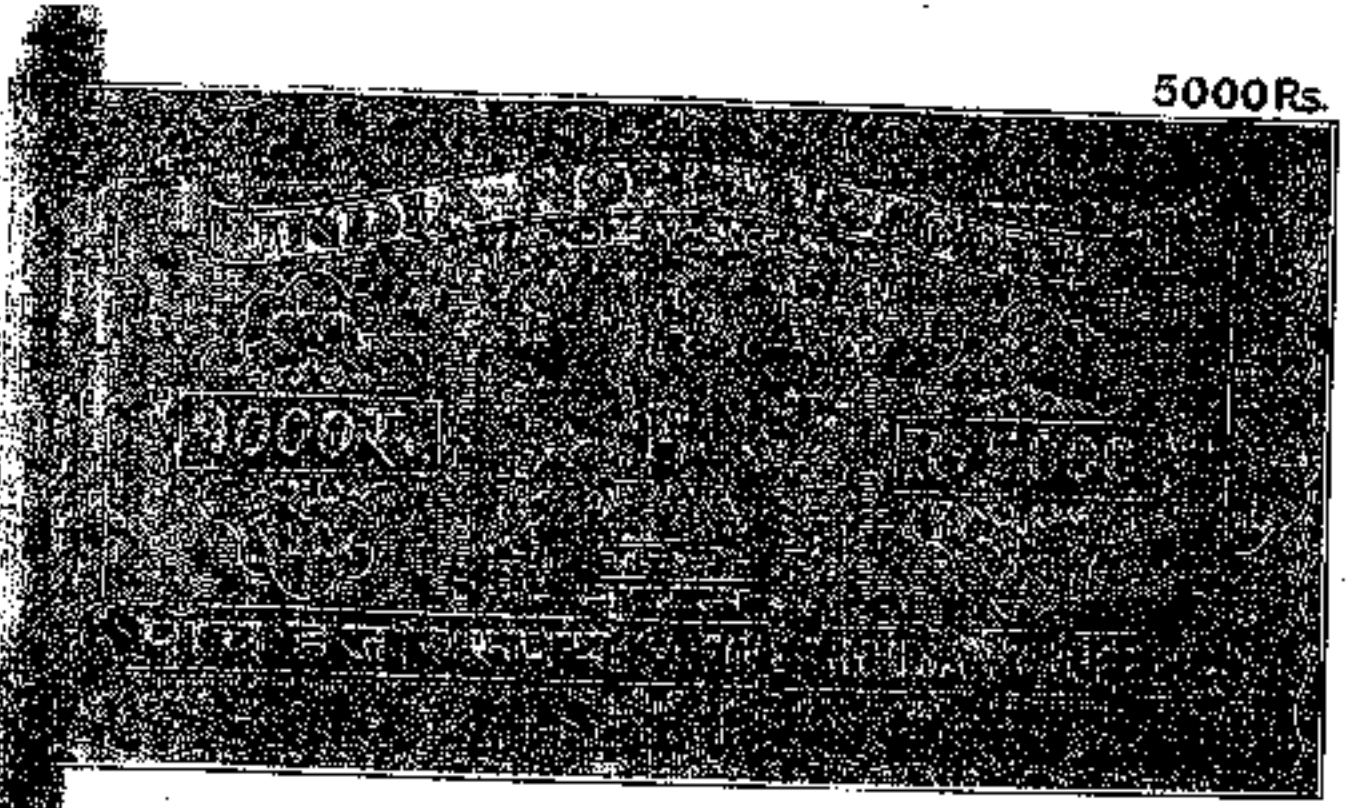

him and paid the income tax on the basis of self assessment as provided in the Income Tax Act, 1961 (43 of 1961), on payment of five hundred rupees to the State Government:

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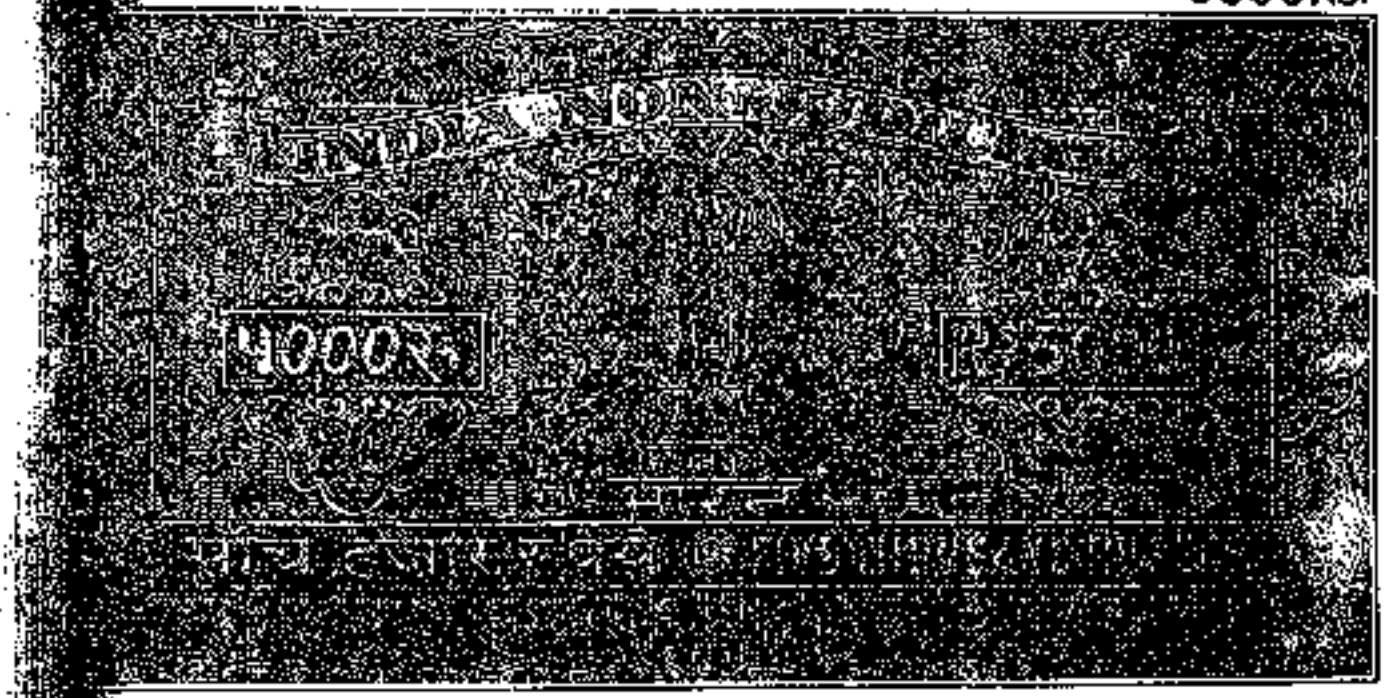

Provided that the lessee/lessees shall make available to the transferee the original or certified copies of all plans of abandoned workings in the area and in a belt 65 metres wide surrounding it.

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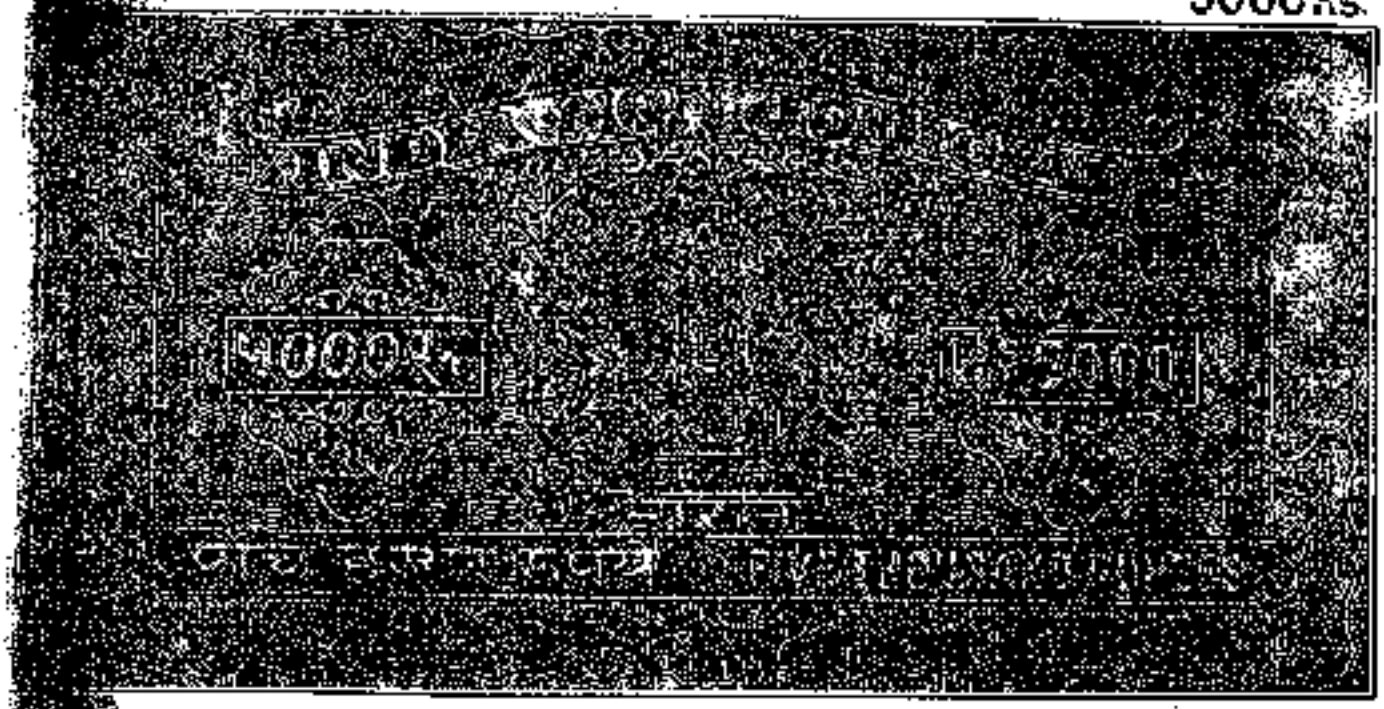

Provided further that, where the mortgagee is an Institution or a Bank or a Corporation specified in Schedule V, it shall not be necessary for any such Institution or Bank or Corporation to meet with the

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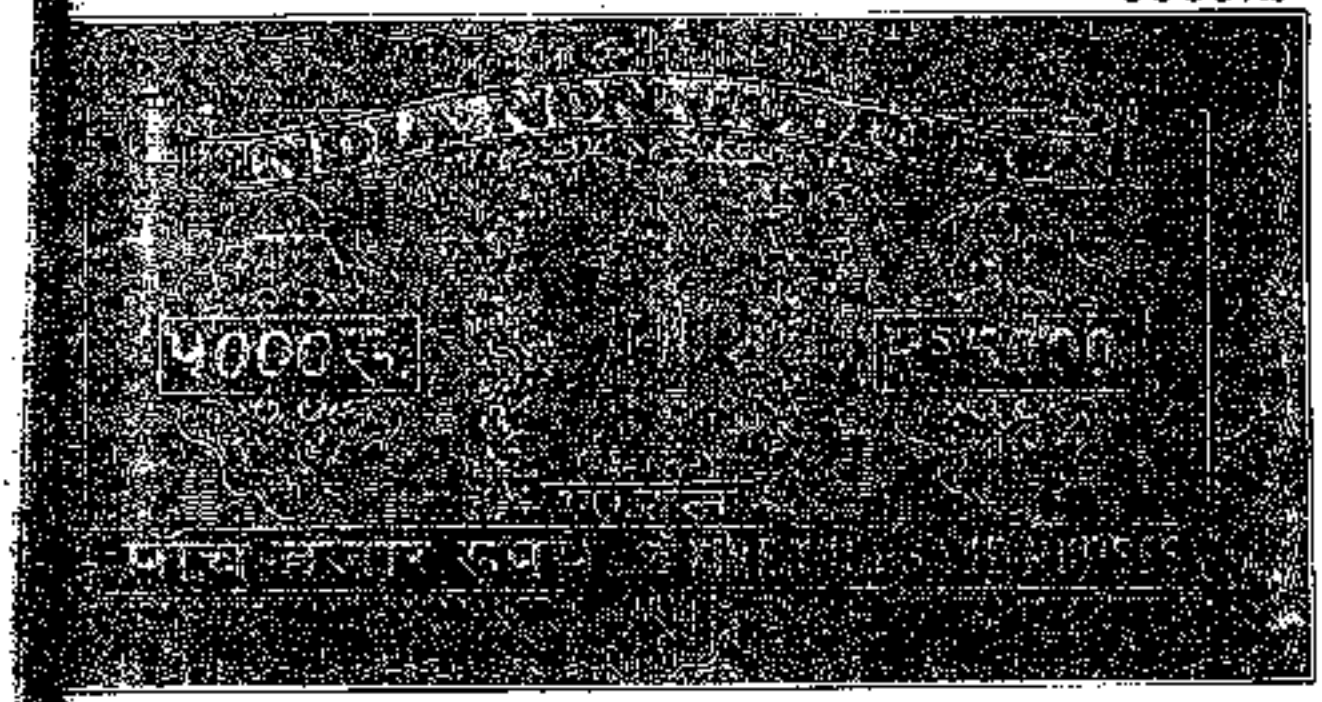

requirement relating to income tax and the said valid clearance certificate.

(3) The State Government, may, by order in writing, determine the lease at any time if the

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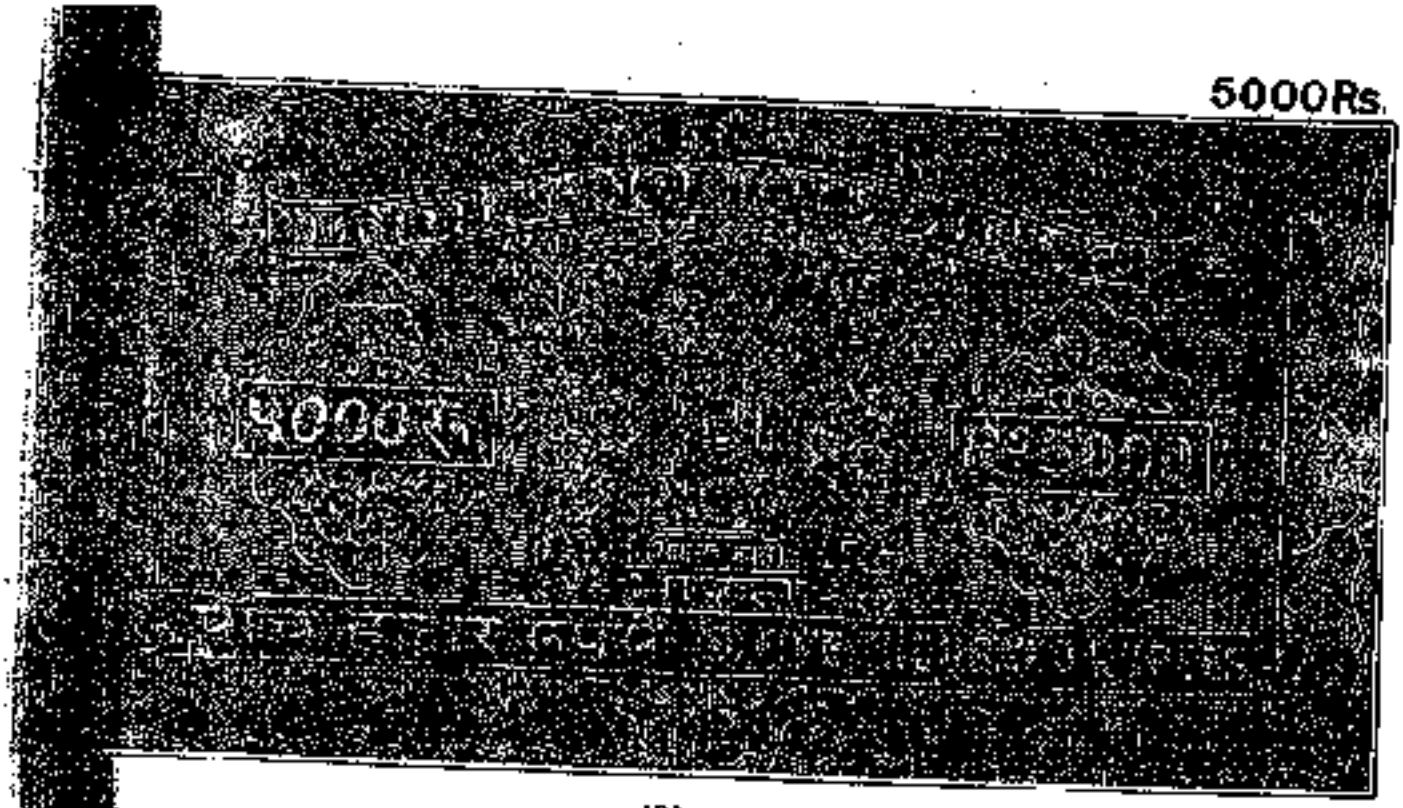

lessee/ lessees has/have in the opinion of the State Government, committed a breach of any of the above provisions or has/have transferred the lease or any right, title or interest therein

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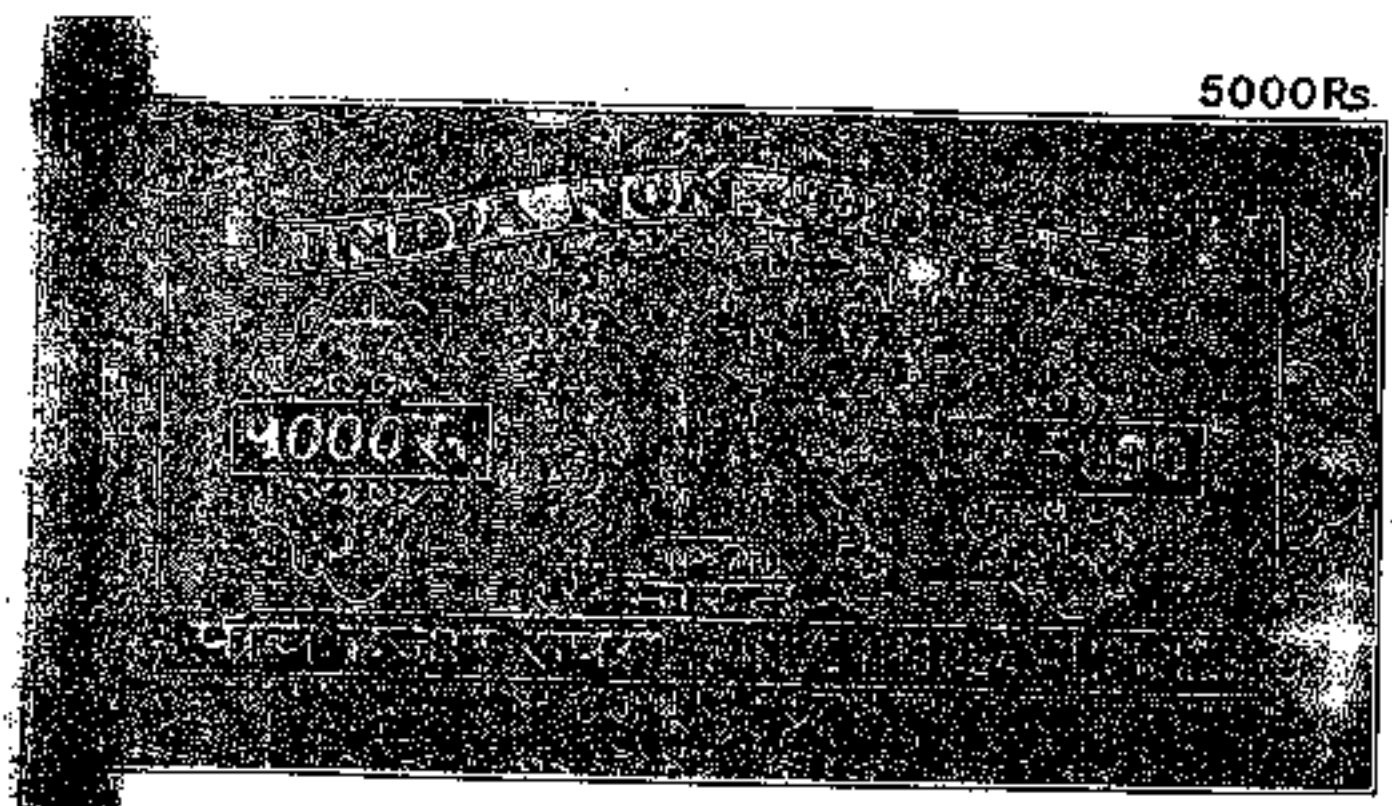

otherwise than in accordance

with Clause (2):

Provided that no such order shall be

made without giving the

lessee/lessees a reasonable

opportunity of stating his/their case.

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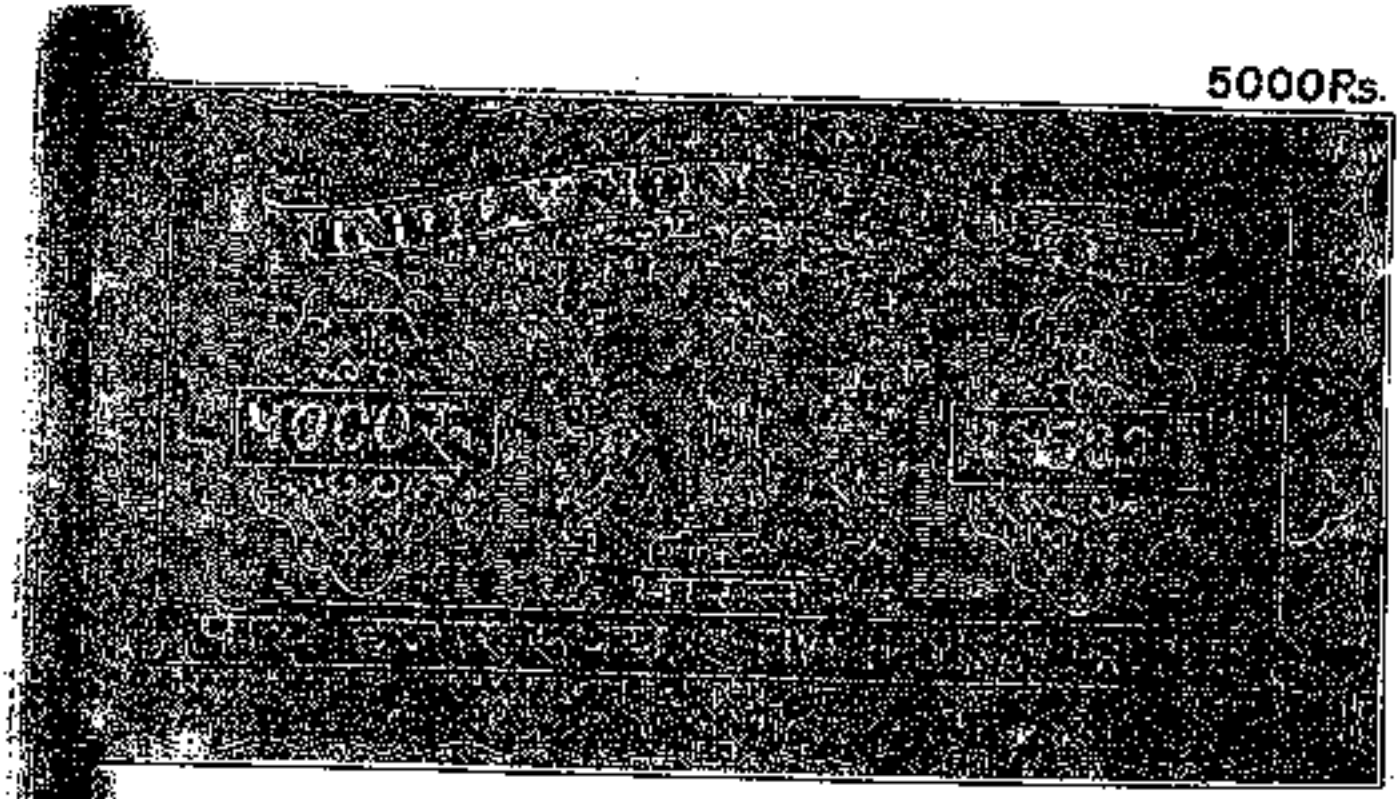

Not to be financed or controlled by a Trust, Corporation, Firm or person.

18. The lease shall not be controlled and the lessee/lessees shall not allow themselves to be controlled by any Trust, Syndicate, Corporation Firm or person except with the written consent of the Central

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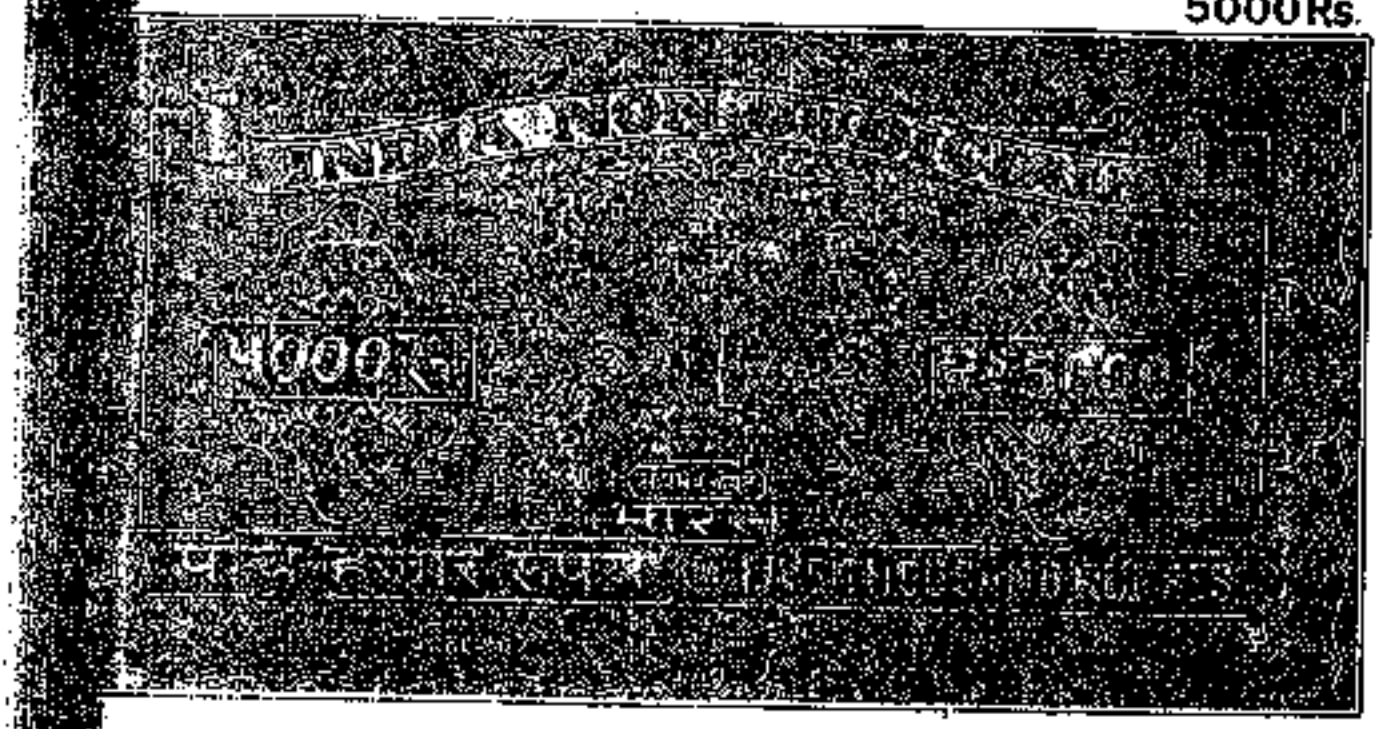

Government. The lessee/lessees shall not enter into or make any arrangement compact or understanding whereby the lessee/lessees will or may be directly or indirectly financed by or under which the lessee's/lessees'

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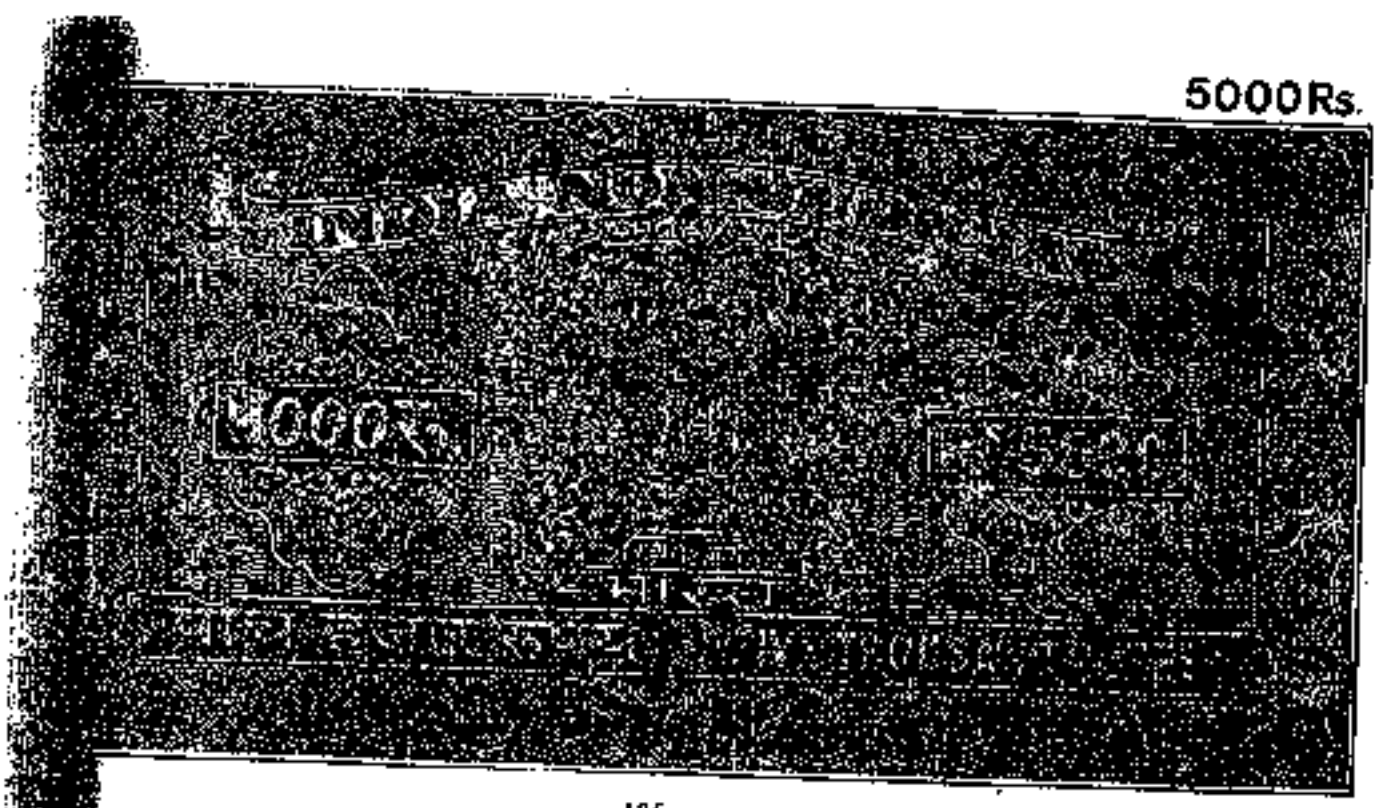

operations or undertakings will or may be carried on directly or indirectly by or for the benefit of or subject to the control of any Trust, Syndicate, Corporation, Firm or person unless with the written sanction given prior to such

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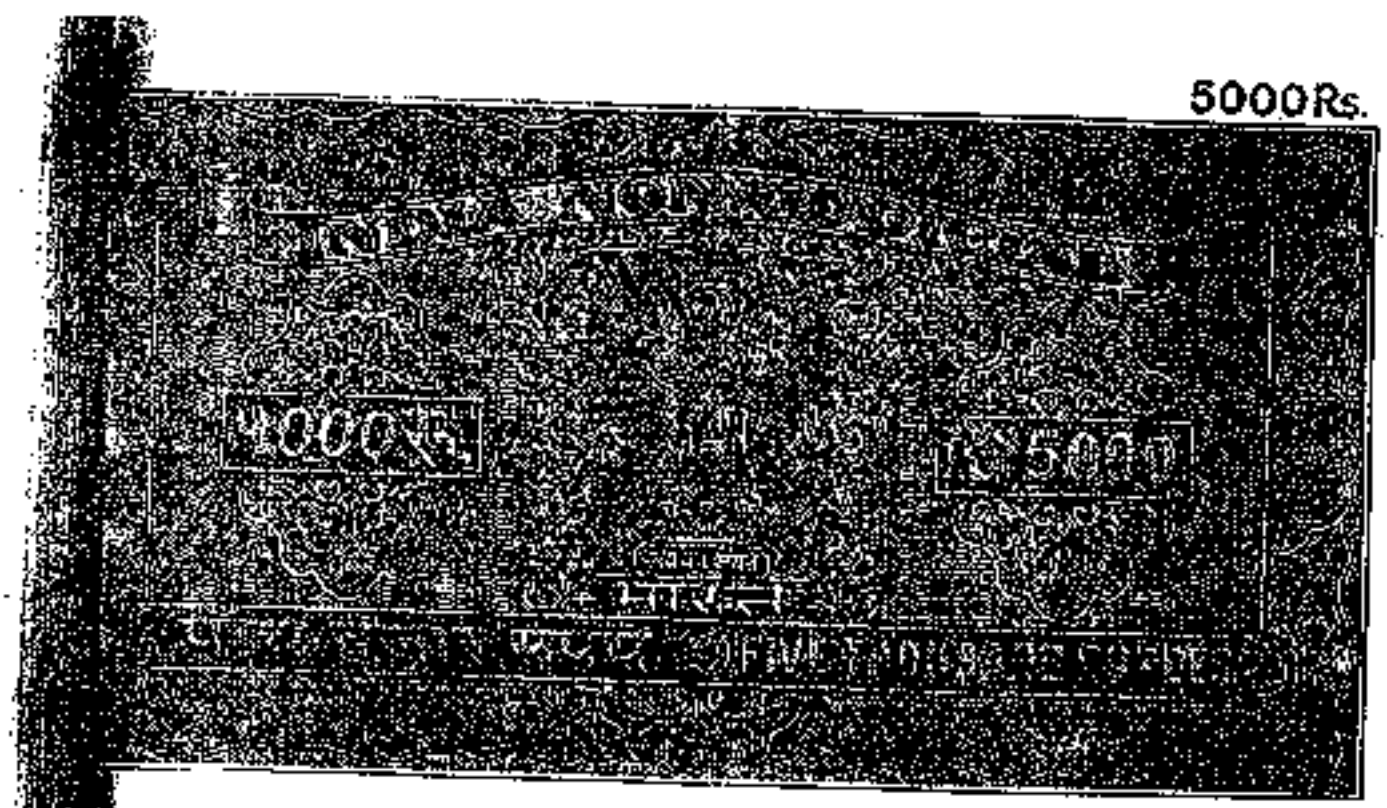

arrangement compact or understanding being entered into or made of the Central Government and any or every such arrangement compact or understanding as aforesaid (entered into or made with such sanction as aforesaid) shall only

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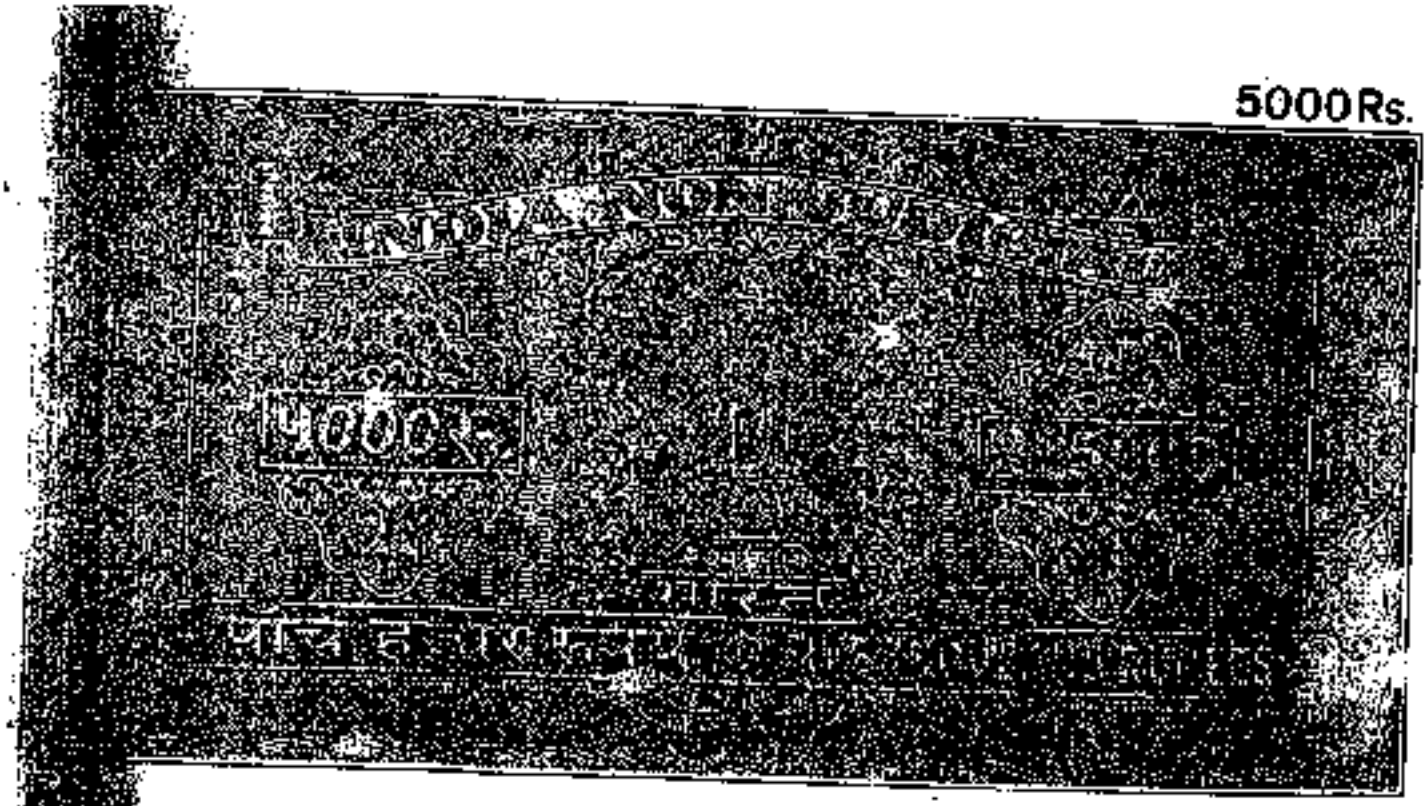

be entered into or made and shall always be subject to an express condition binding upon the other party or parties thereto that on the occasion of a state of emergency of which the President of India in his discretion shall be the sole judge it

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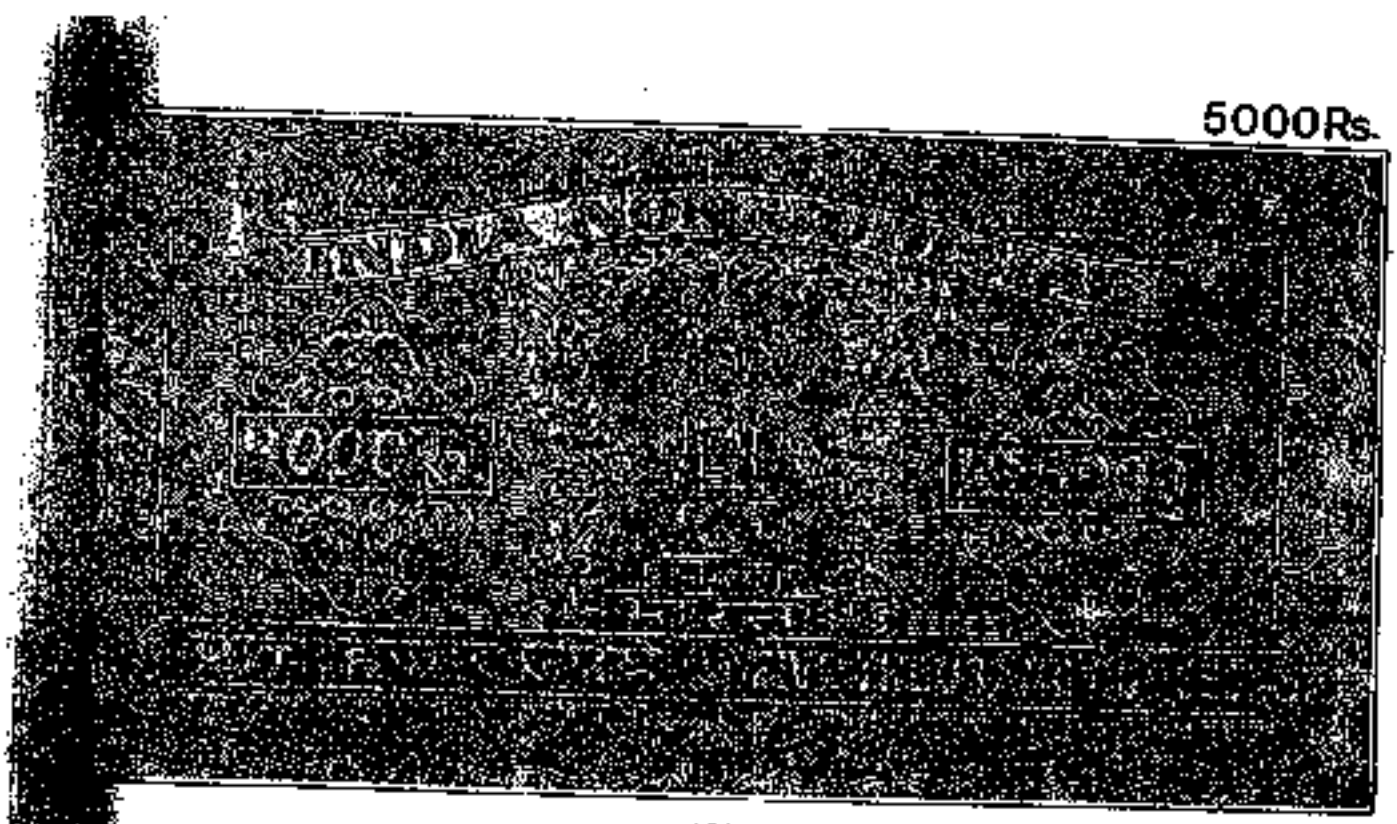

shall be terminable if so required in writing by the State Government and shall in the event of any such requisition being made be forthwith thereafter determined by the lessee/lessees accordingly.

Cont....

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Lessee shall deposit any additional amount necessary

19. Whenever the security deposit of (Rupees Two Thousand only) Rs.2,000.00/- or any part thereof, or any further sum hereafter deposited with the State Government in replenishment thereof shall be forfeited or applied by the

Cont....

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Central or State Government pursuant to the power in hereinafter declared in that behalf the lessee/lessees shall deposit with the State Government such further sum as may be sufficient with the unappropriated part thereof to bring

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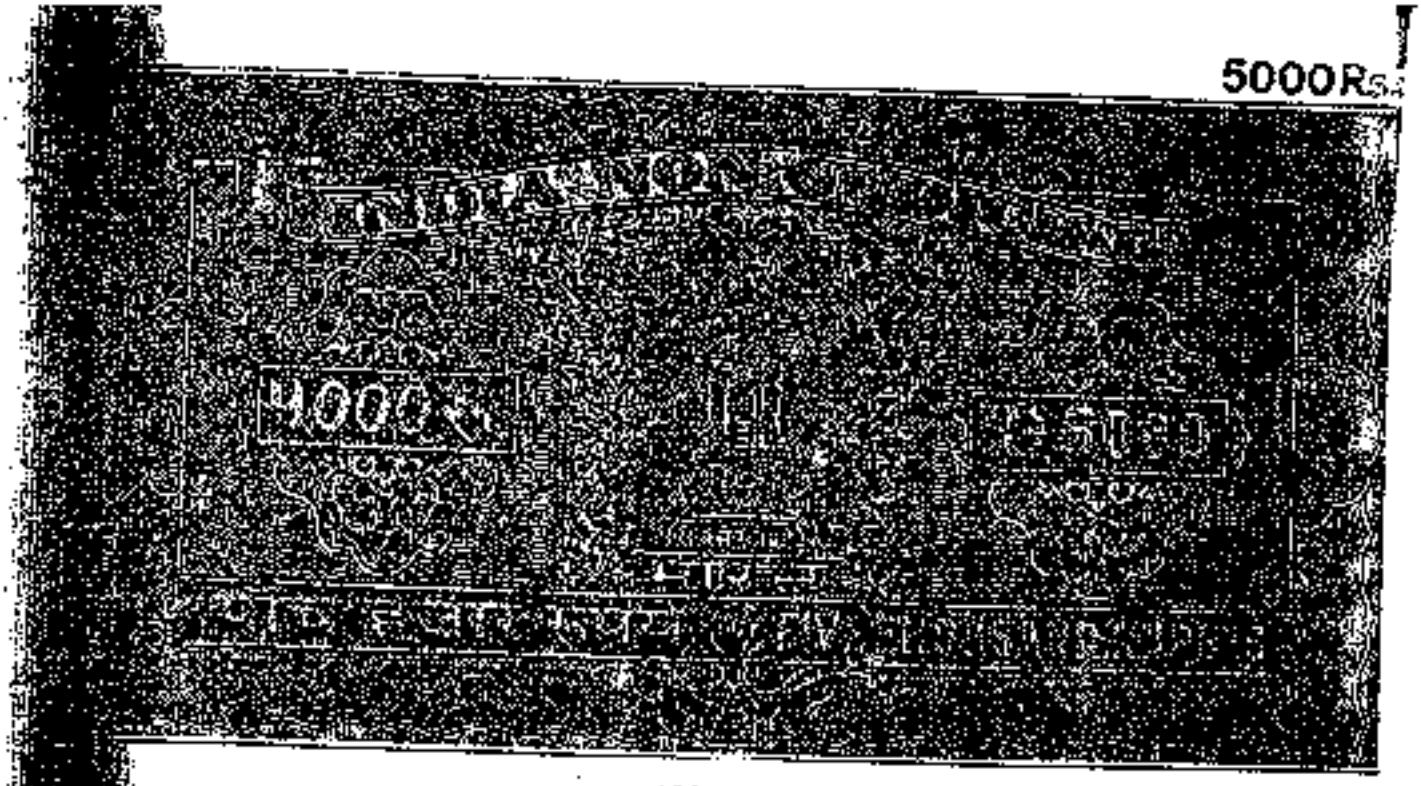

the amount in deposit with the State Government upto the sum of Rs.1,000.00. (Rupees one thousand only)

Delivery of workings in good order to State Government after determination of lease.

20. The lessee/lessees shall at the expiration or sooner determination of the said term or any renewal

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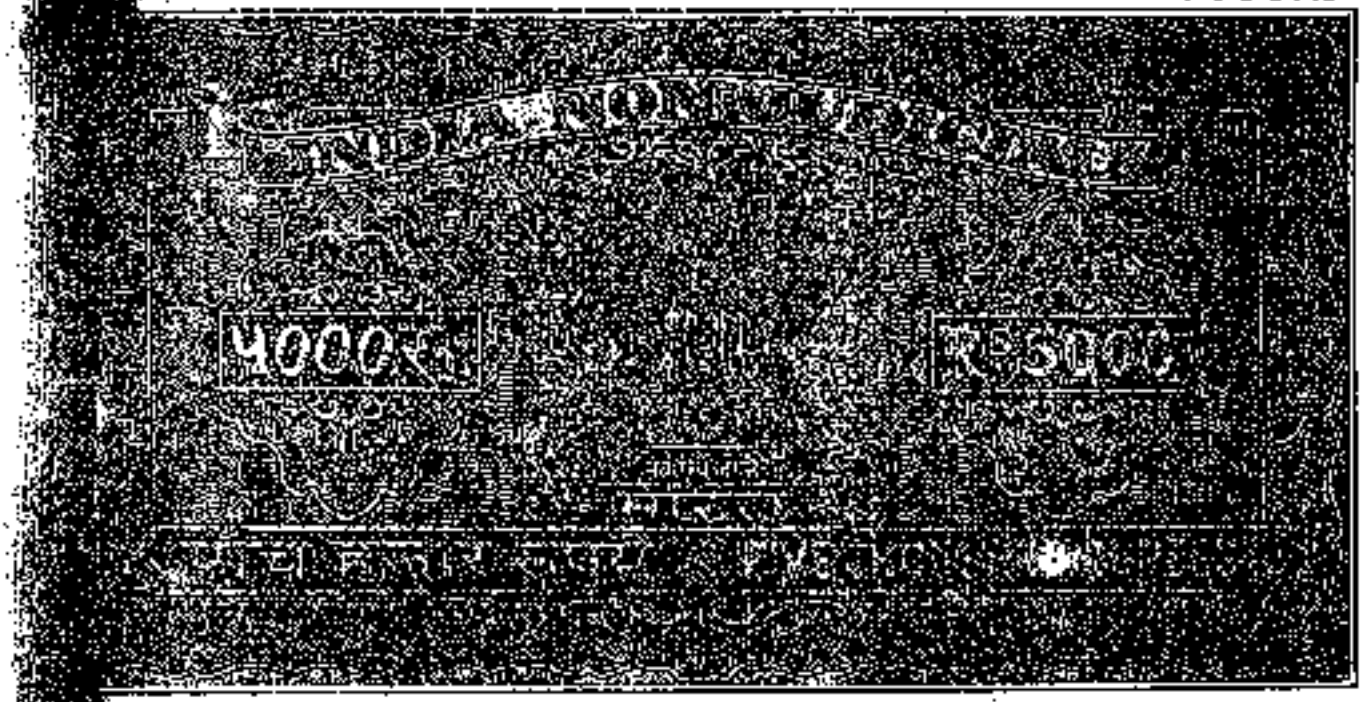

there of deliver upto the State Government all mines, pits, shafts, inclines, drifts, levels, water ways, airways and other works now existing or hereafter to be sunk or made on or under the said lands except such as have been abandoned

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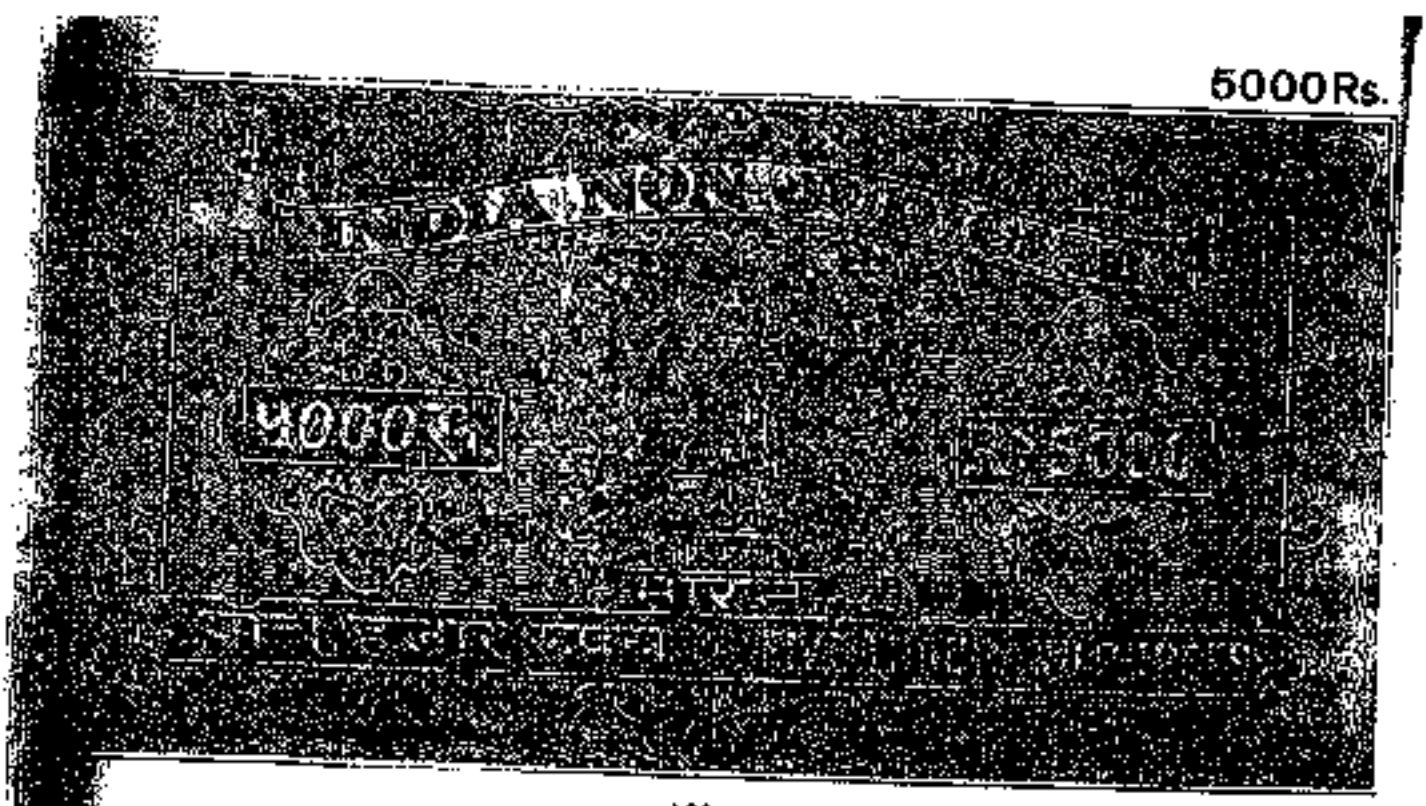

with the sanction of the State Government and in any ordinary and fair course of working all engines, machinery, plant, building, structures, other works and conveniences which at the commencement of the said term were

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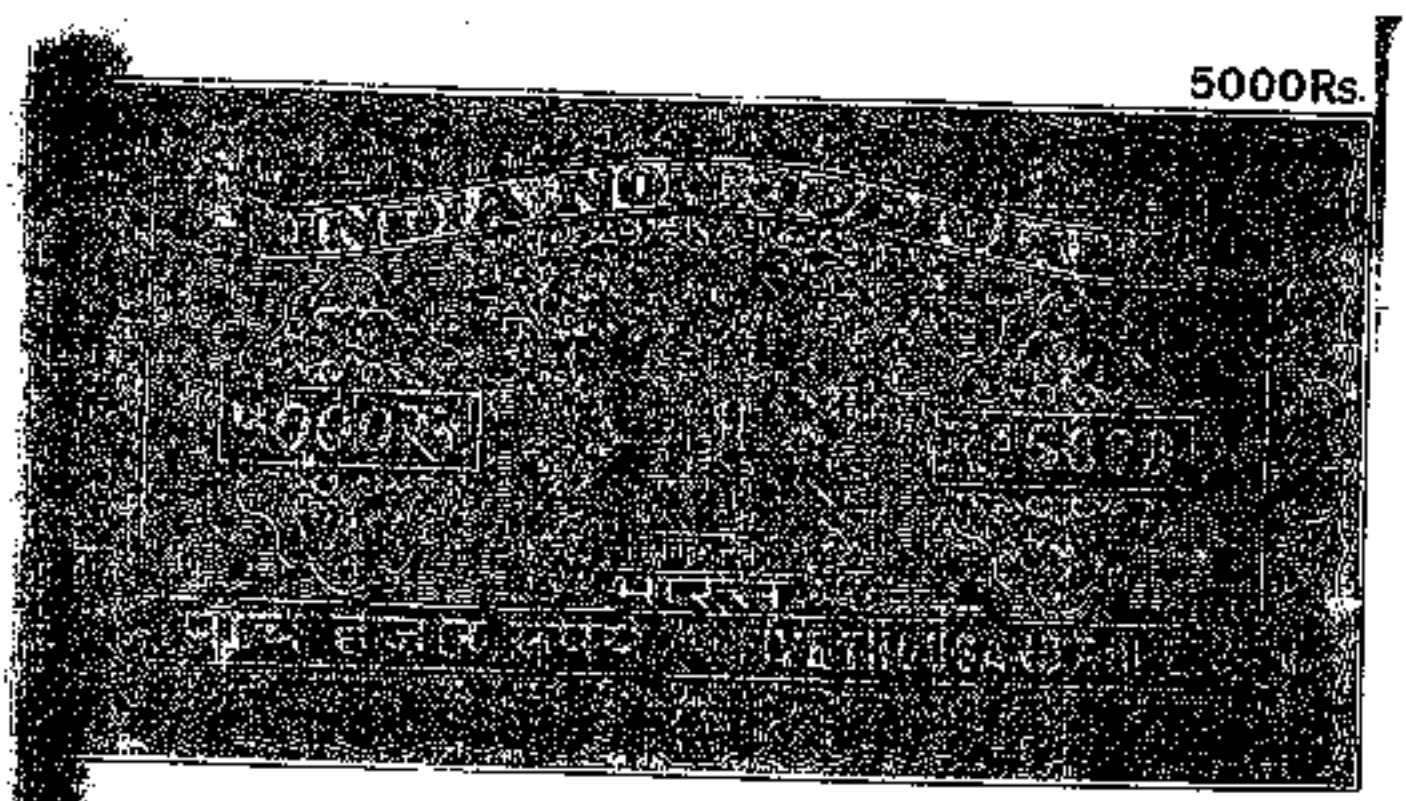

upon or under the said lands and all such machinery set up by the lessee/lessees below ground which cannot be removed without causing injury to the mines or works under the said lands (except such of the same as may with the sanction of the

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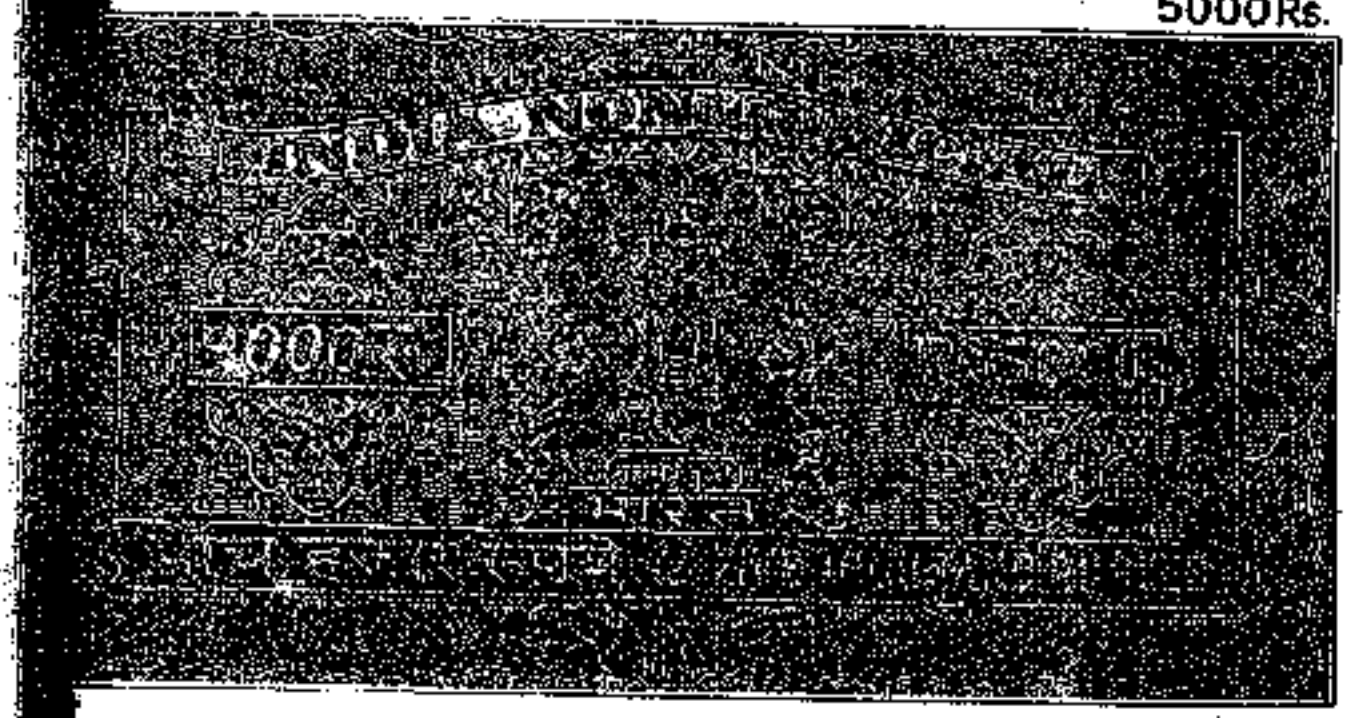

State Government have become disused) and all buildings and structures of bricks or stone erected by the lessee/lessees above ground level in good repair order and condition and fit in all respects for

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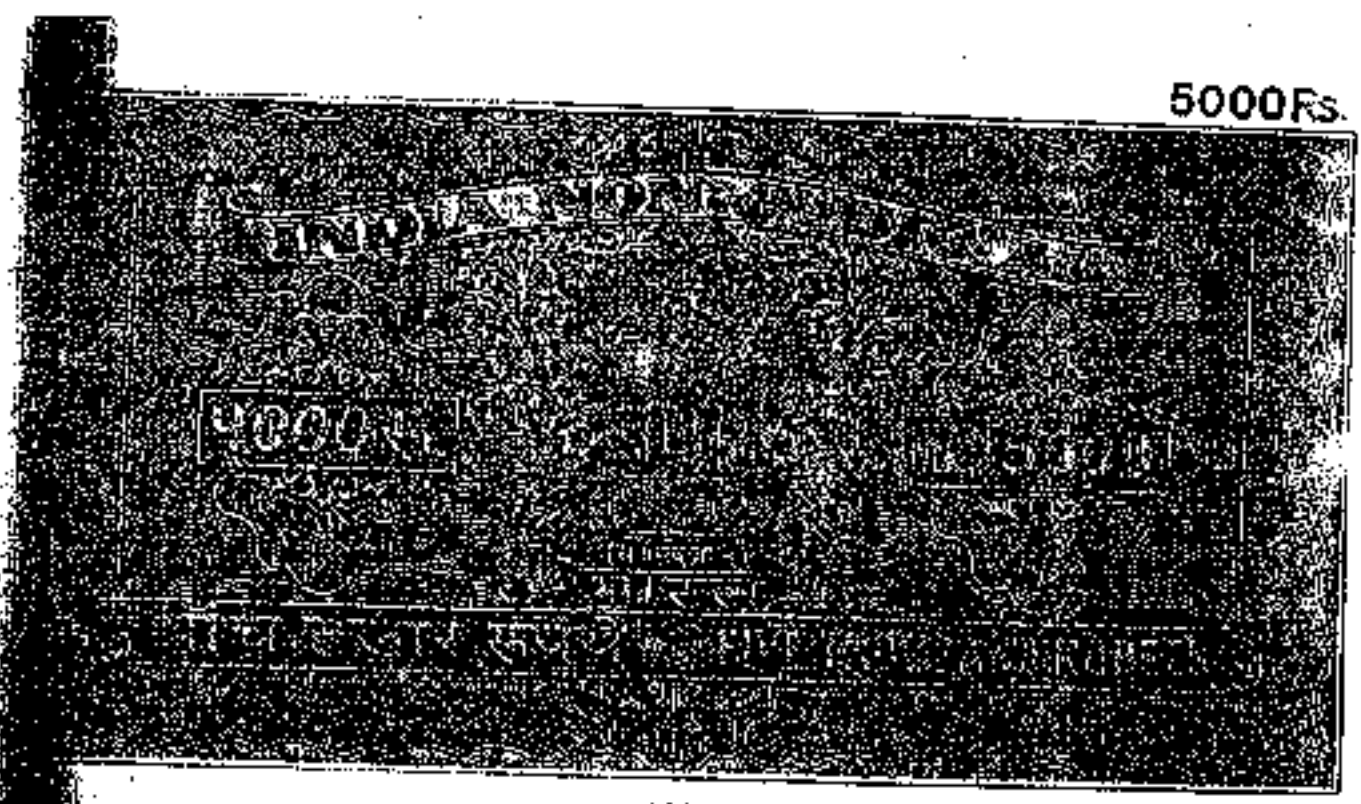

further working of the said mines and the said minerals.

Right of pre-emption

21. a) The State Government shall from time to time and all times during the said term have the right (to be exercised by notice in writing

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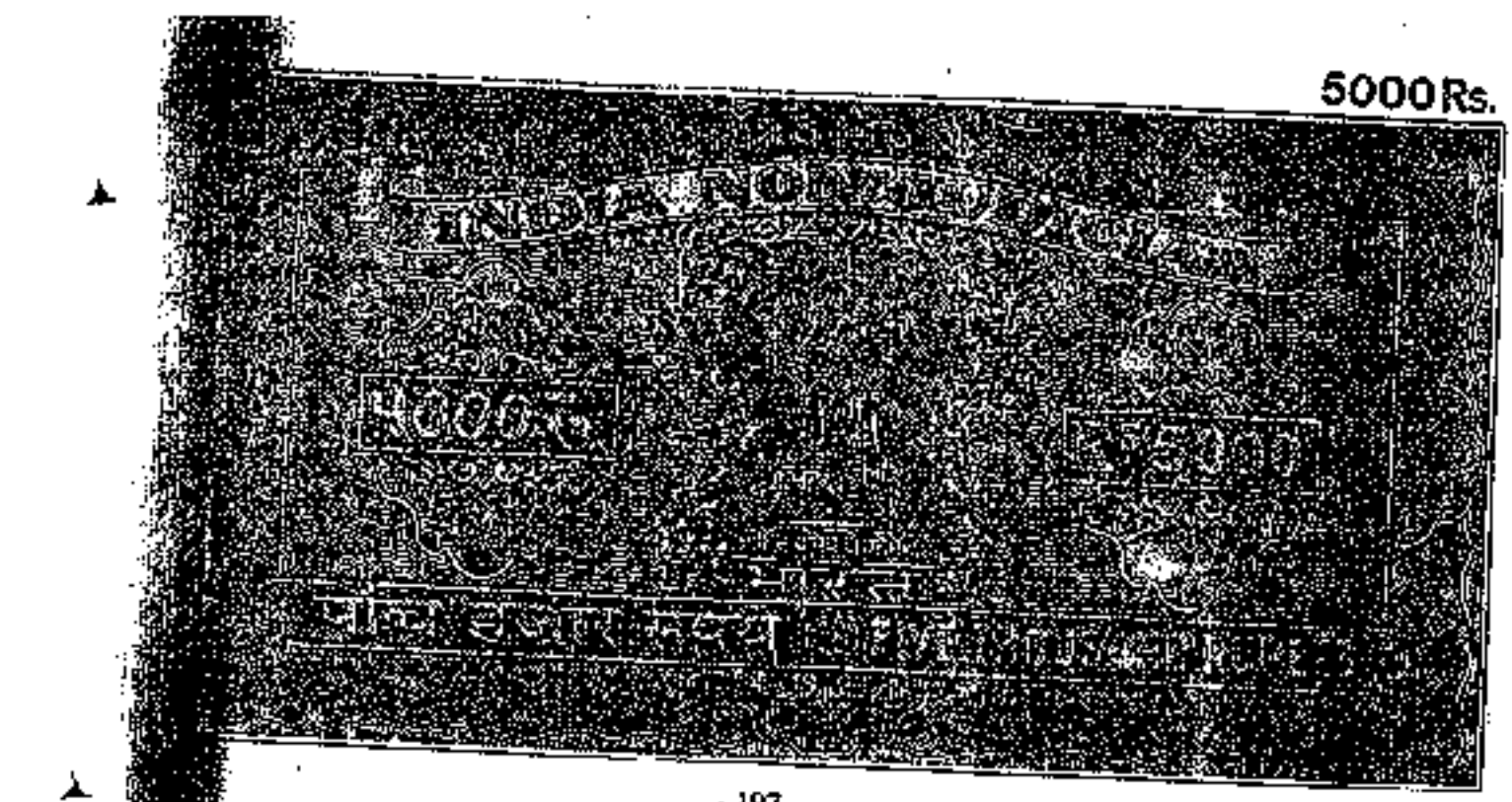

to the lessee/lessees) of pre-emption of the said minerals (and all products thereof) lying in or upon the said lands hereby demised or elsewhere under the control of the lessee/lessees and the lessee/lessees shall with all possible expedition

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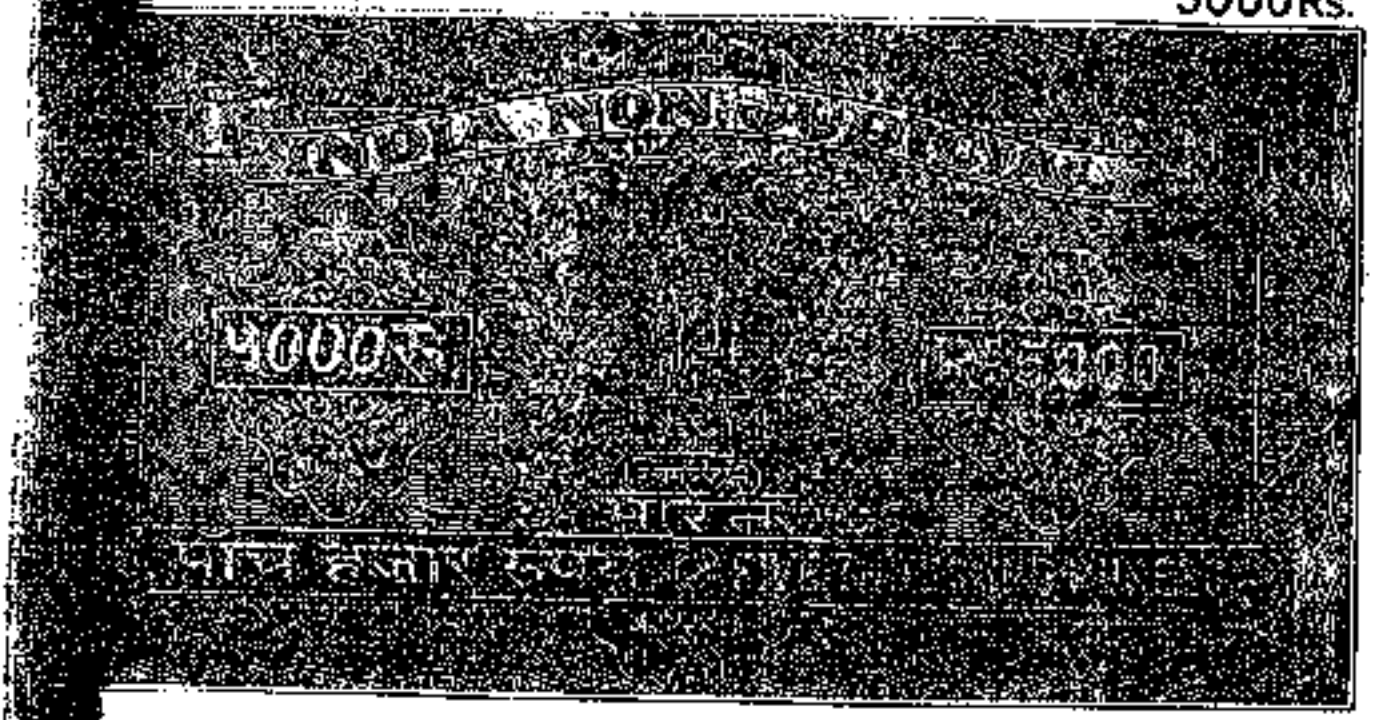

deliver all minerals or products or minerals purchased by the State Government under the power conferred by this provision in the quantities at the times in manner and at the place specified in the notice exercising the said right.

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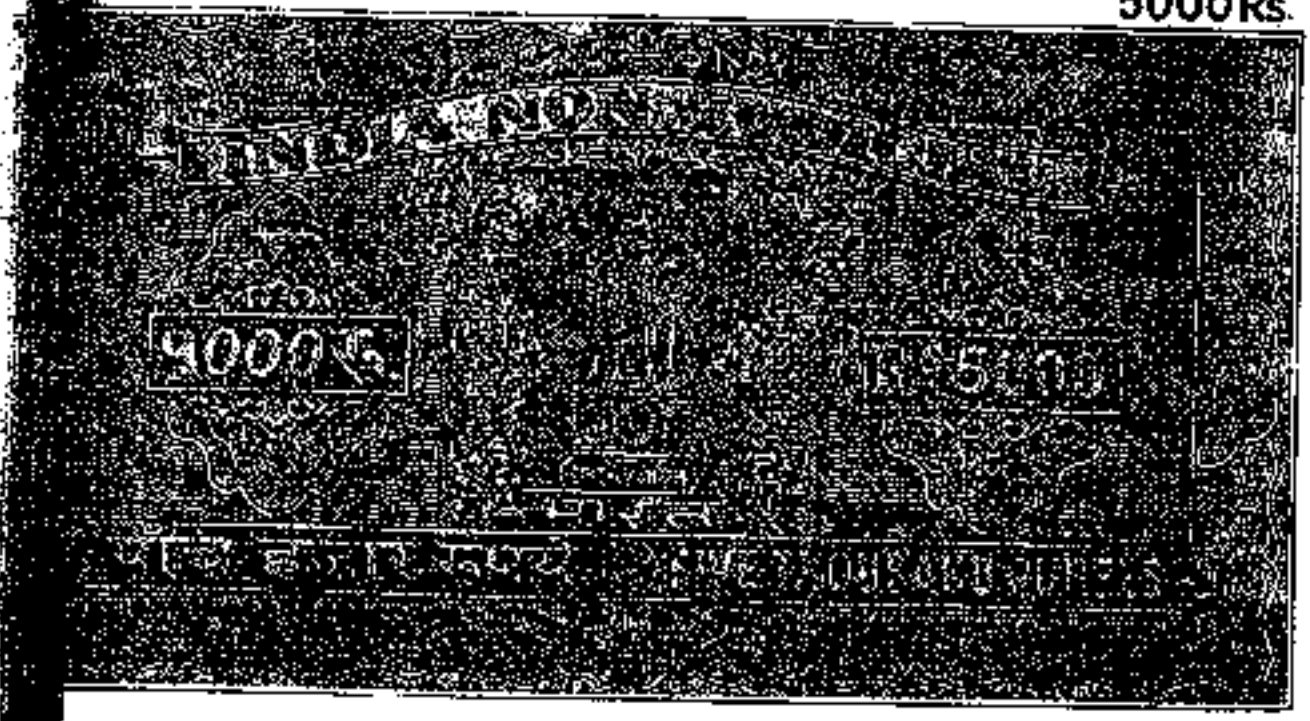

b) Should the right of pre-emption conferred by this present provision be exercised and a vessel chartered to carry the minerals or products thereof procured on behalf of the State Government or

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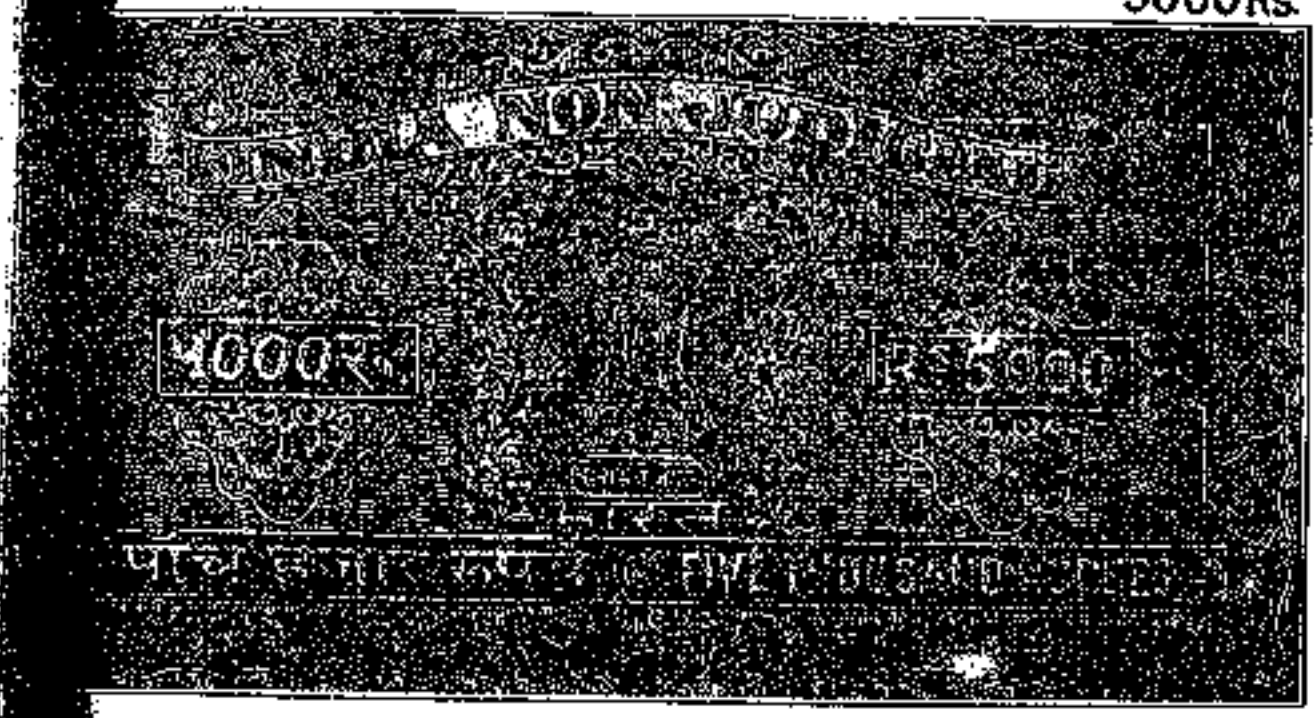

the Central Government be detained on demurrage at the port of loading the lessee/lessees shall pay the amount due for demurrage according to the terms of the charter party of such vessel unless the State Government shall be satisfied that

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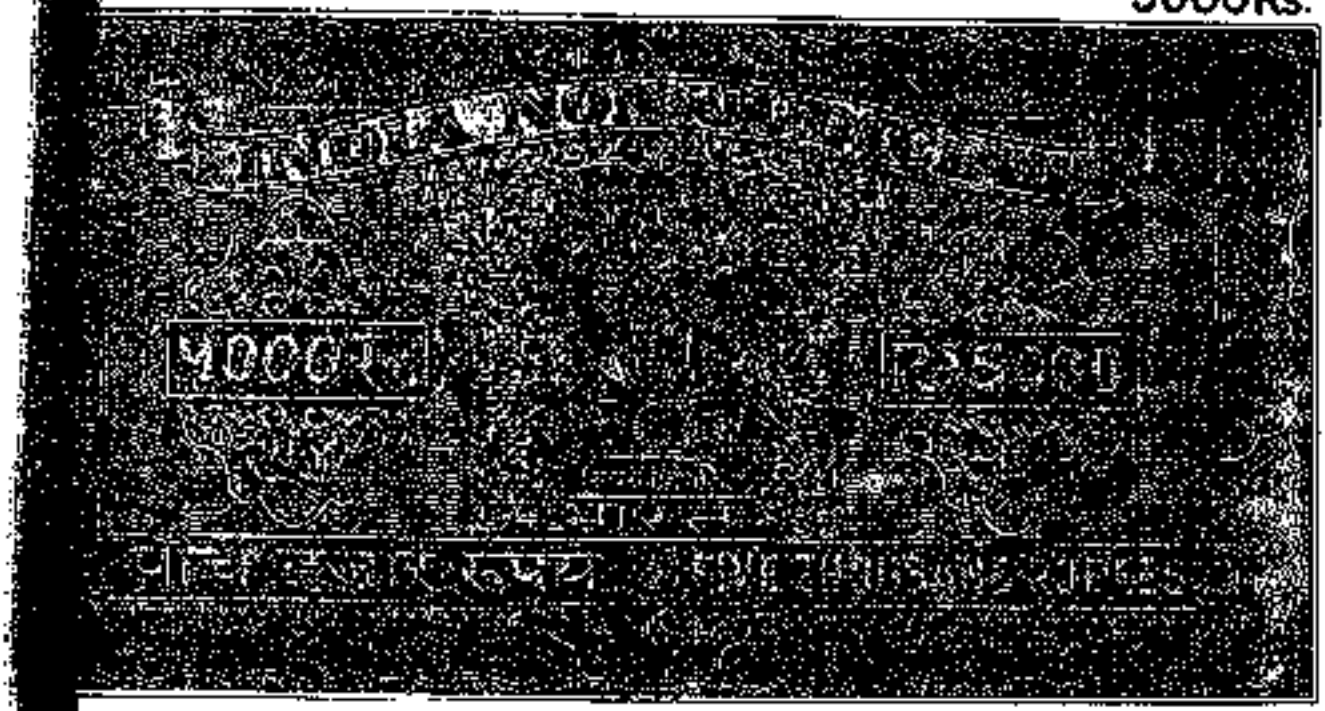

the delay is due to causes beyond the control of the lessee/lessees.

c) The price to be paid for all minerals or products of minerals taken in pre-emption by the State Government in exercise of the right

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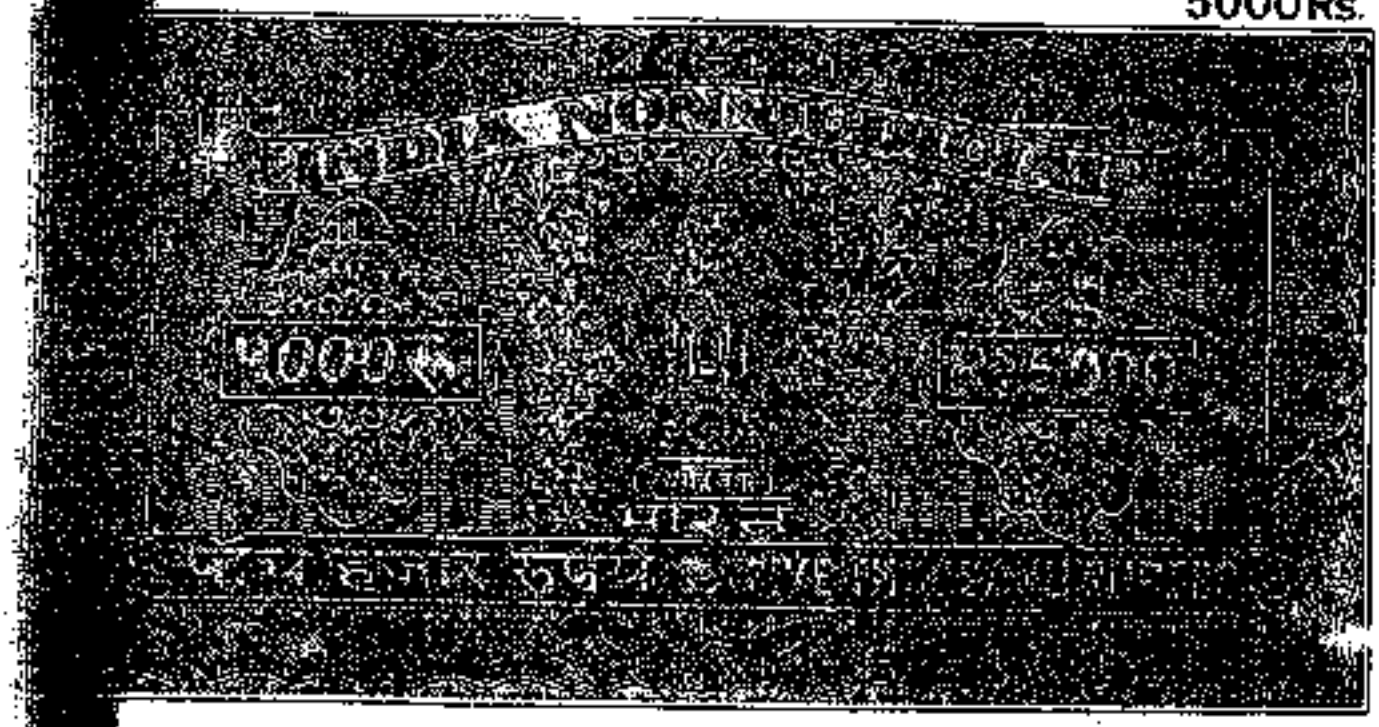

hereby conferred shall be the fair market price prevailing at the time of pre-emption PROVIDED THAT in order to assist in arriving at the said fair market price the lessee/lessees shall if so required furnish to the State Government for the

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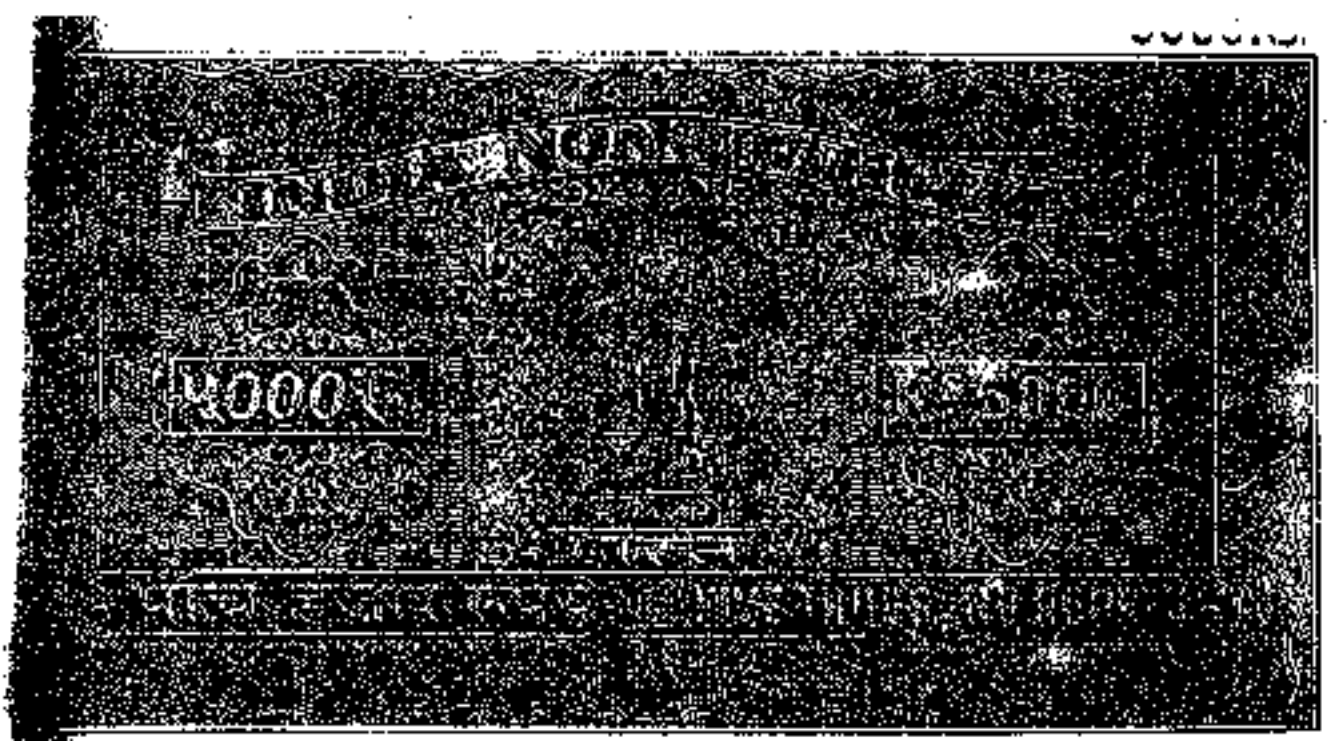

confidential information of the Government, particulars of the quantities, descriptions and prices of the said minerals or products thereof sold to other customers and of charters entered into for freight,for carriage of the same and shall

Cont....

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produce to such officer or officers as may be directed by the State Government original or authenticated copies of contracts and charter parties entered into for the sale or freightage of such minerals or products.

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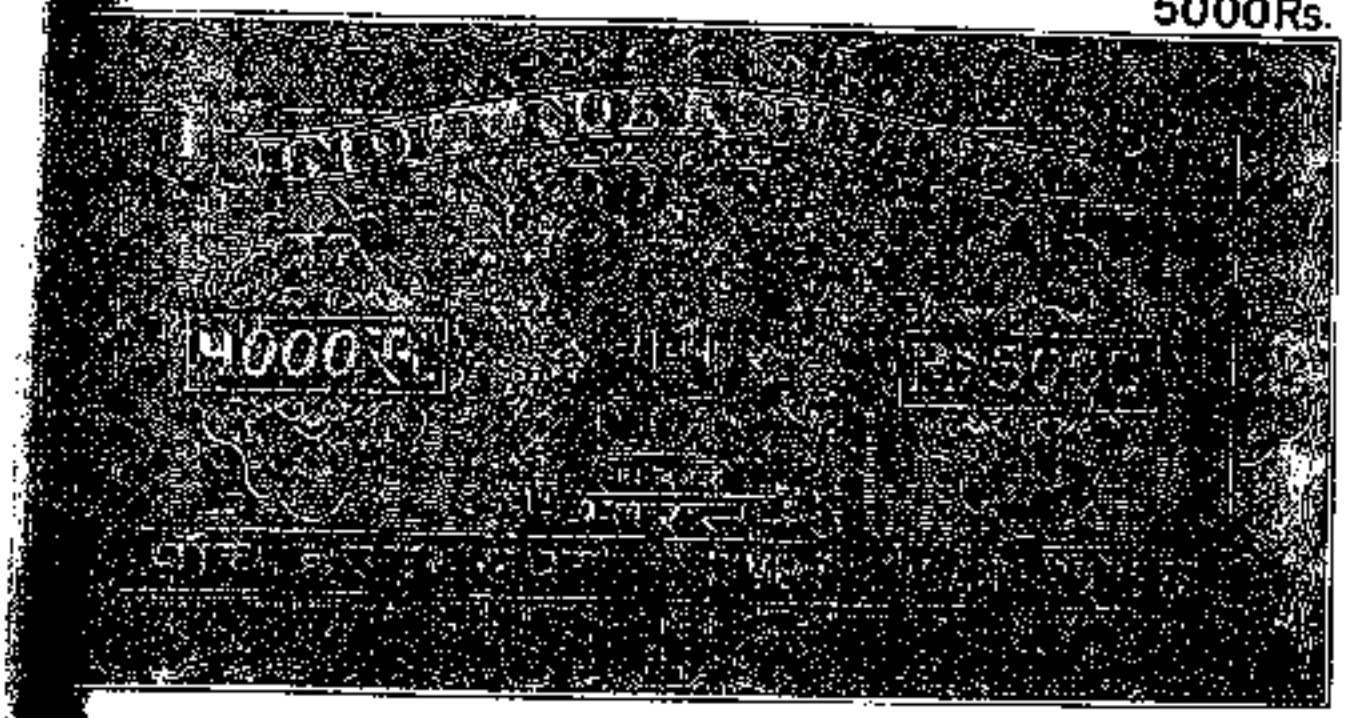

d) In the event of the existence of a state of war or emergency (of which existence the President of India shall be the sole judge and a notification to this effect in the Gazette of India shall be conclusive

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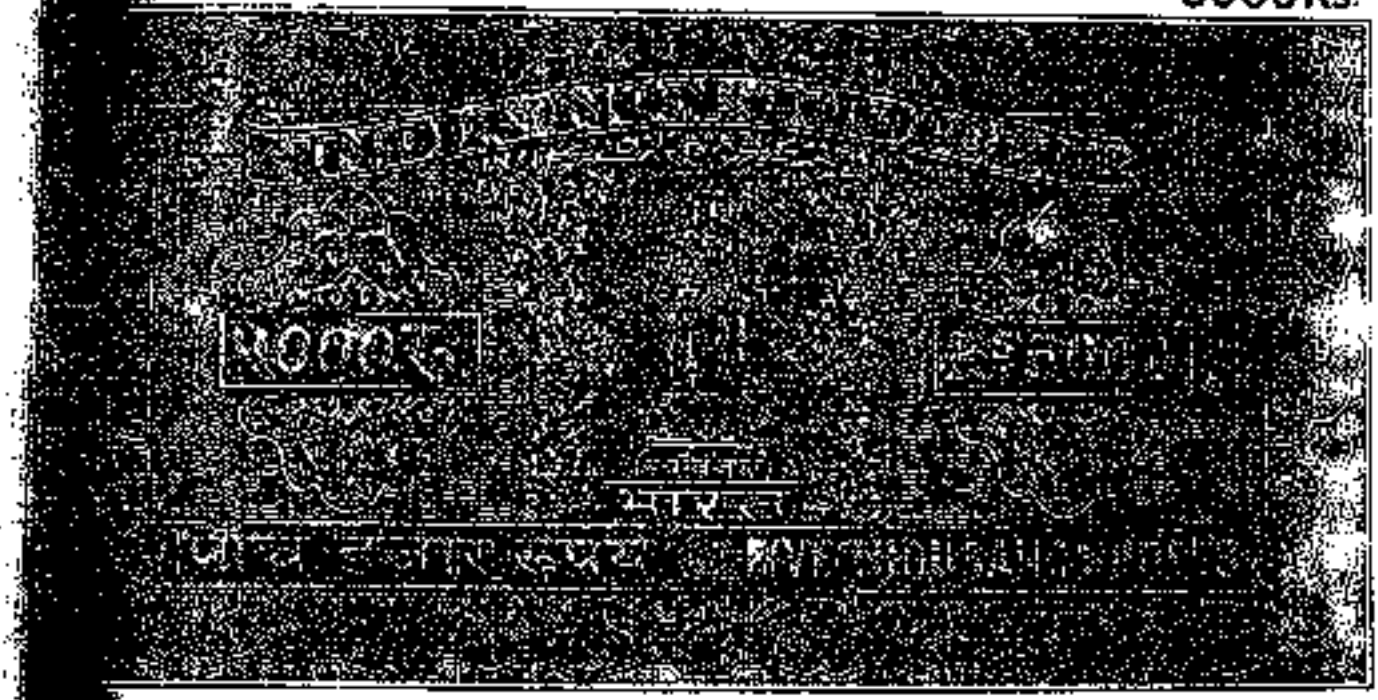

proof), the State Government with the consent of the Central Government shall from time to time and all times during the said term have the right (to be exercised by a notice in writing to the lessee/lessees forthwith take possession and control

Cont...

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of the works, plant, machinery and premises of the lessee/lessees) on or in connection with the said lands or operations under this lease and during such possession or control the lessee/lessees shall conform to and obey all directions given by or on

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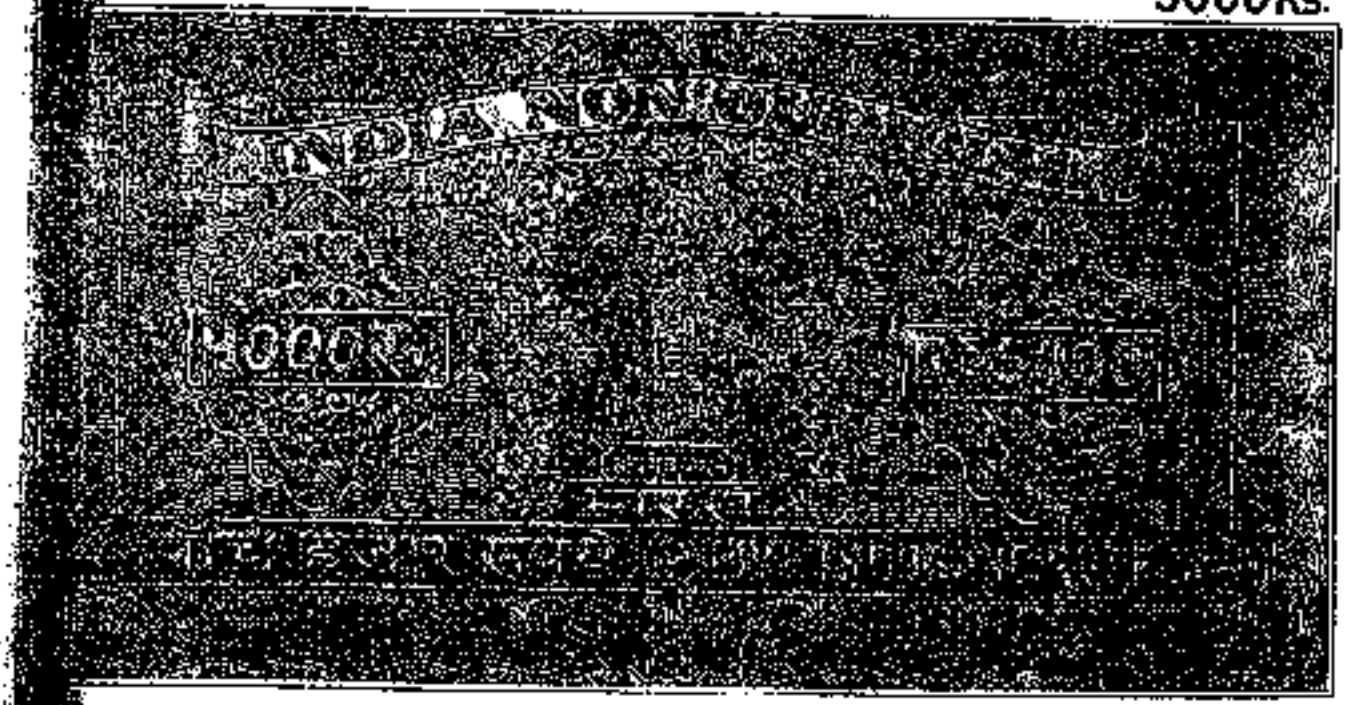

behalf of the Central Government or State Government regarding the use or employment of such works, plants, premises and minerals:

PROVIDED THAT fair compensation which shall be determined in default of agreement

Cont....

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by the State Government shall be paid to the lessee/lessees for all loss or damage sustained by him/them by reason or in consequence of the exercise of the powers conferred by this clause and PROVIDED ALSO that the exercise of such powers shall

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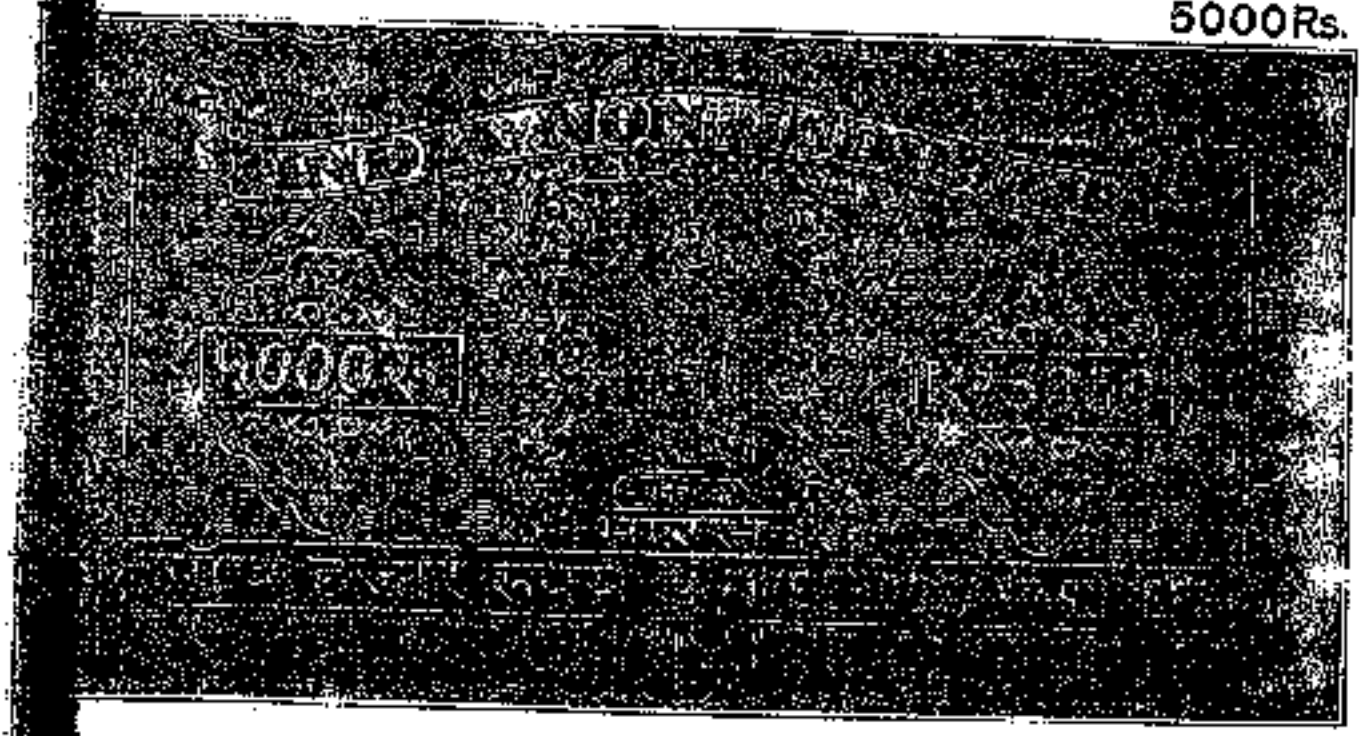

not determine the said term hereby granted or affect the terms and provisions of these presents further than may be necessary to give effect to the provisions of this clause.

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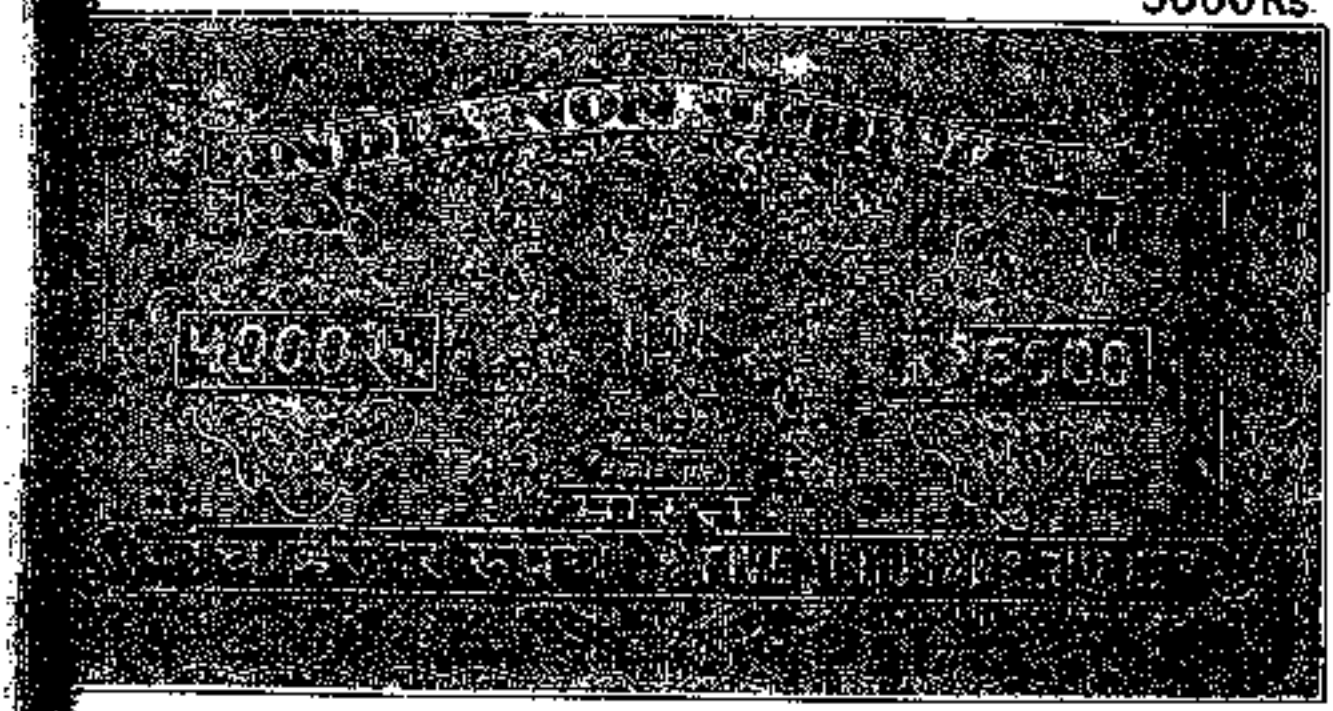

Employment of foreign national.

22. The lessee/lessees shall not employ, in connection with the mining operations any person who is not an Indian national except with the previous approval of the Central Government

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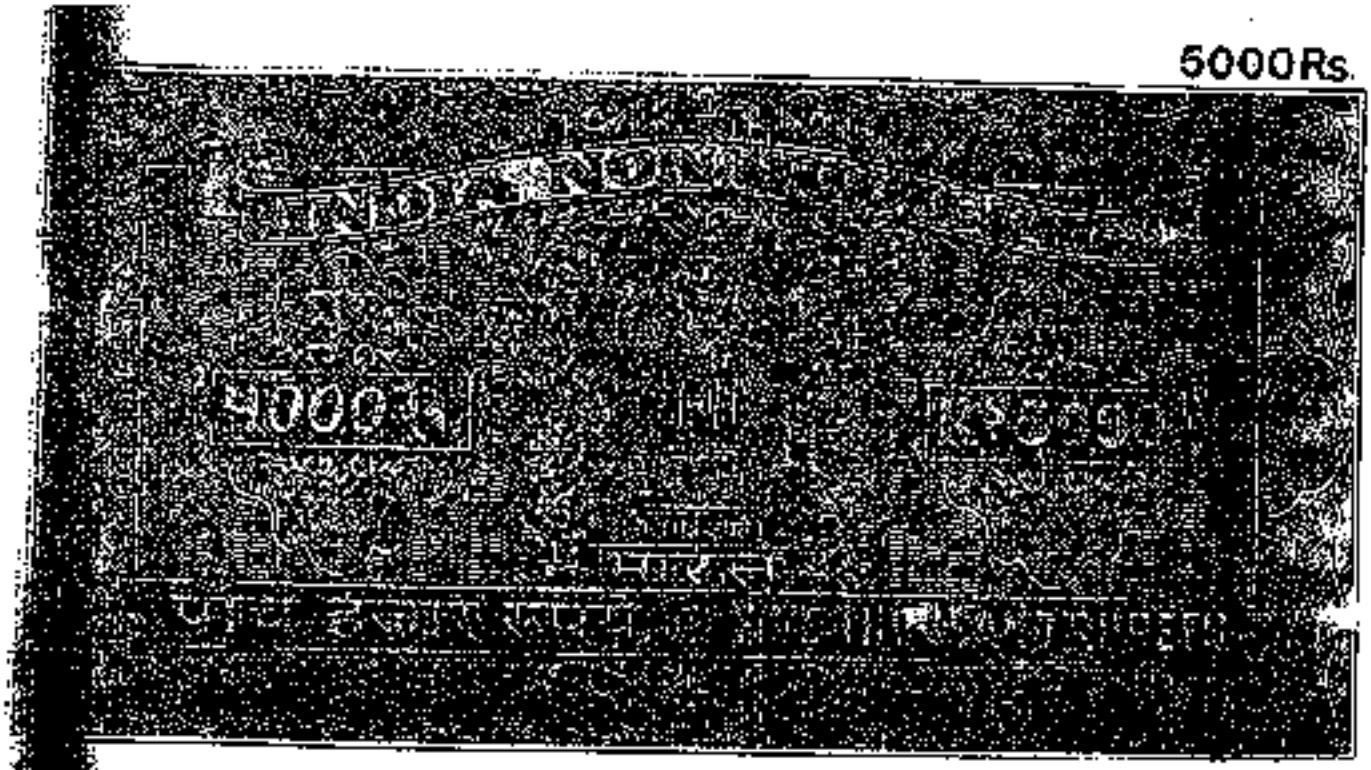

Recovery of expenses incurred by the State Government

23. If any of the works or matters which in accordance with the covenants in that behalf hereinbefore contained are to be carried or performed by the lessee/lessees be not so carried out or performed with in the time

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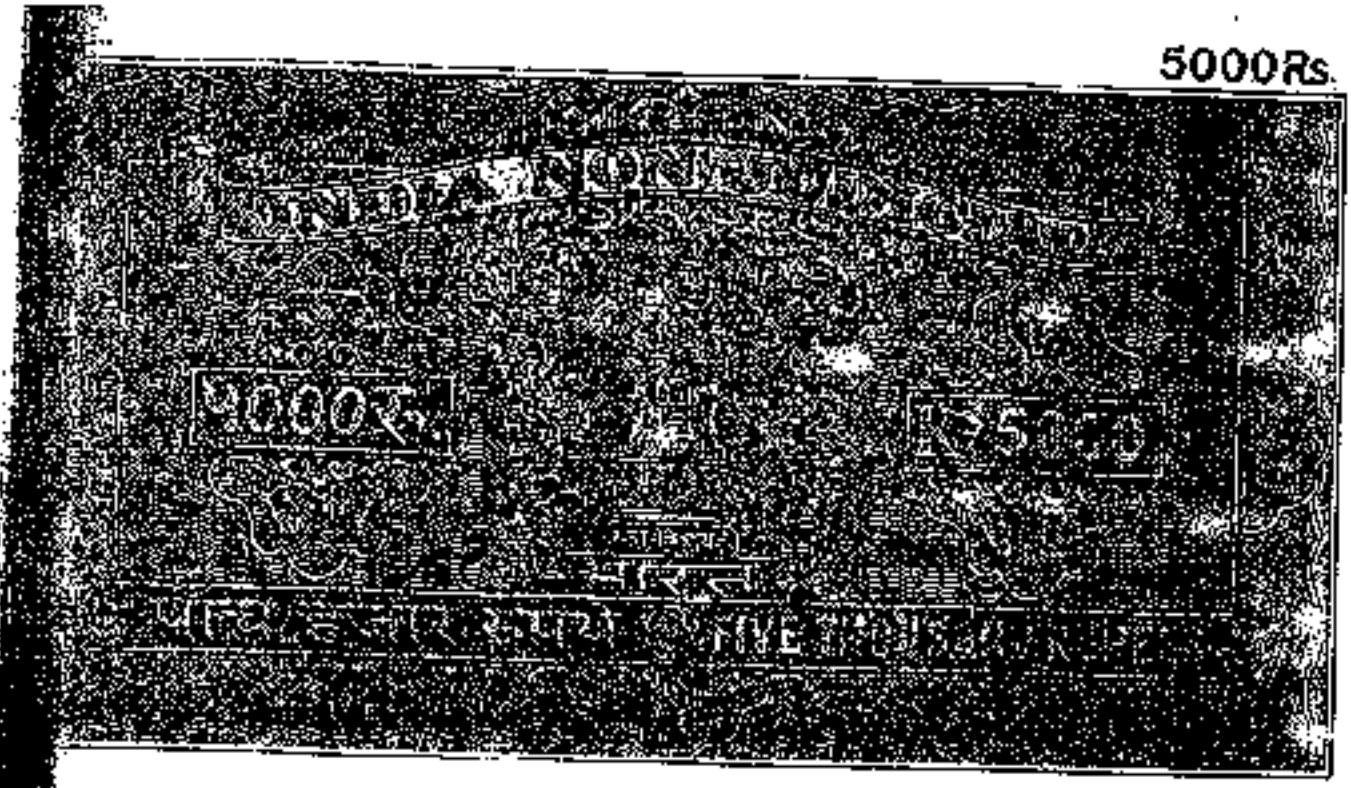

specified in that behalf, the State Government may cause the same to be carried out or performed and the lessee/lessees shall pay the State Government on demand all expenses which shall be incurred in such carrying out or performance of the

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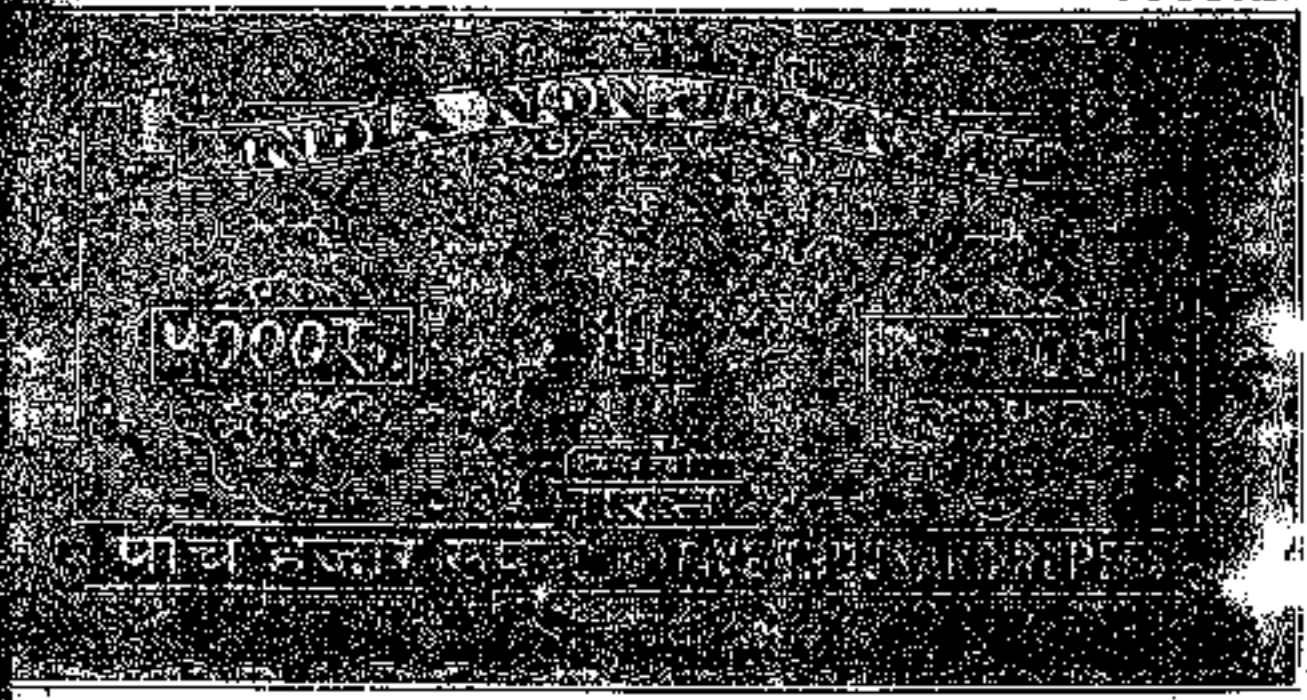

same and the decision of the State Government as to such expenses shall be final.

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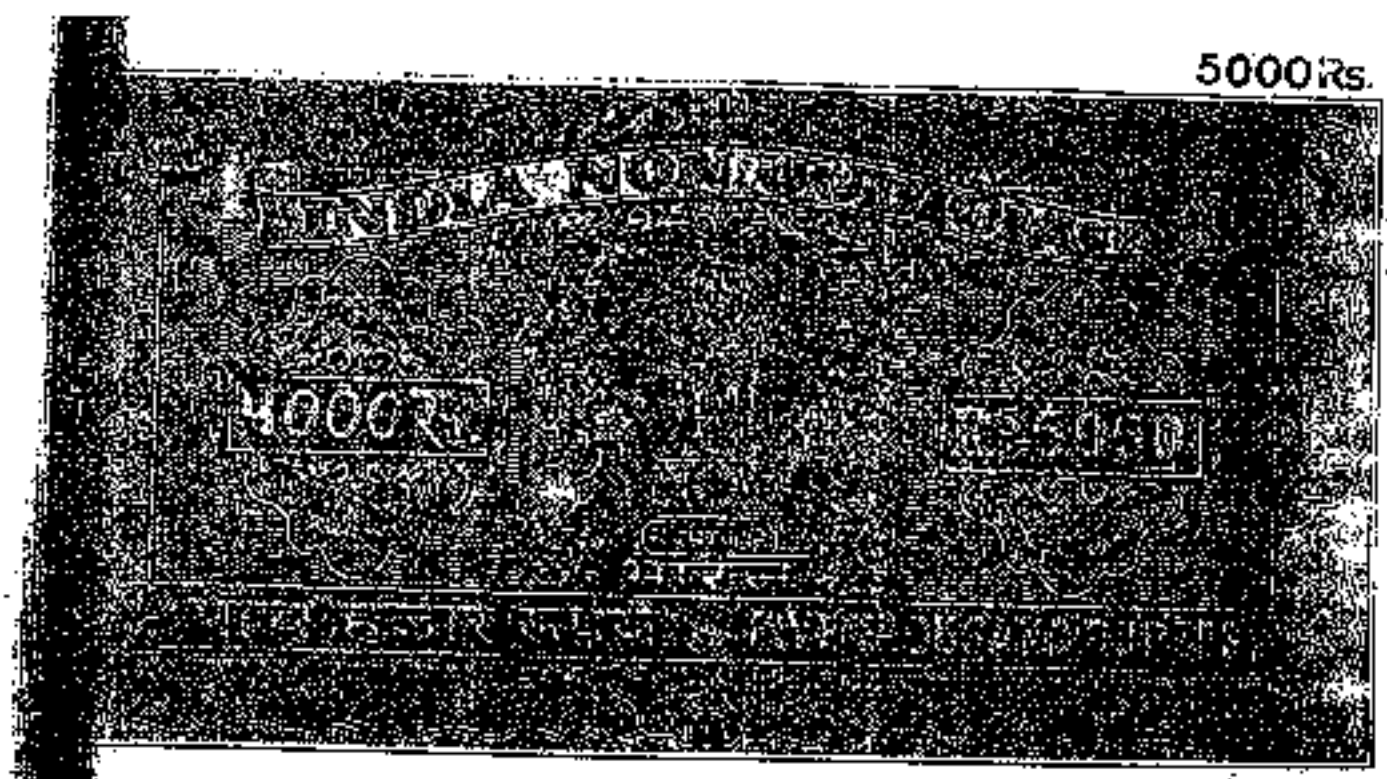

Furnishing of geophysical data

24. The lessee/lessees shall furnish:

a) all geophysical data relating to mining fields, or engineering and ground water surveys, such as anomaly maps, sections, plans, structures, contour maps, logging, collected by him/them during the course of mining operations to the

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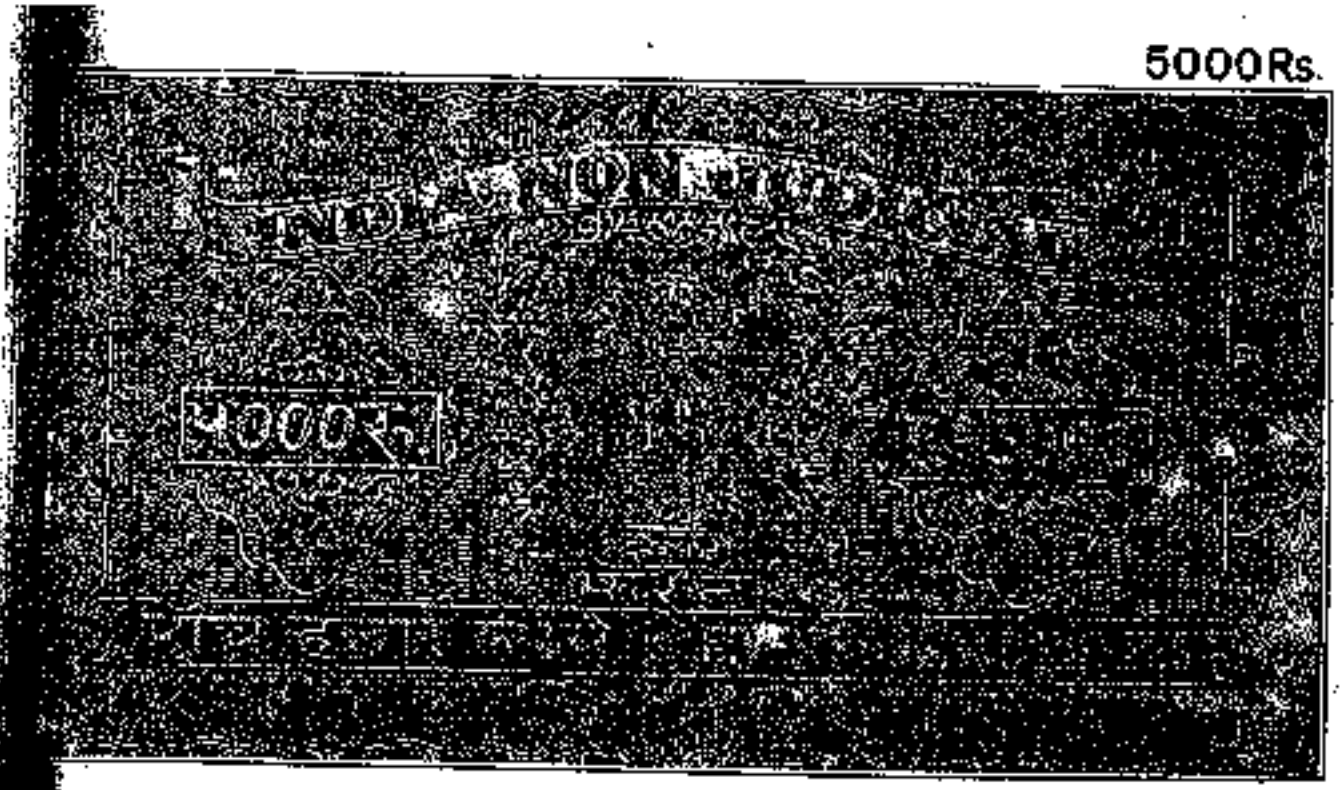

[Director-General, Geological Survey of India, Calcutta and to the Director of Mining & Geology, Orissa, Bhubaneswar

b) all information pertaining to investigations of radioactive minerals collected by him/them during course of mining operations to the Secretary, Department of Coal...

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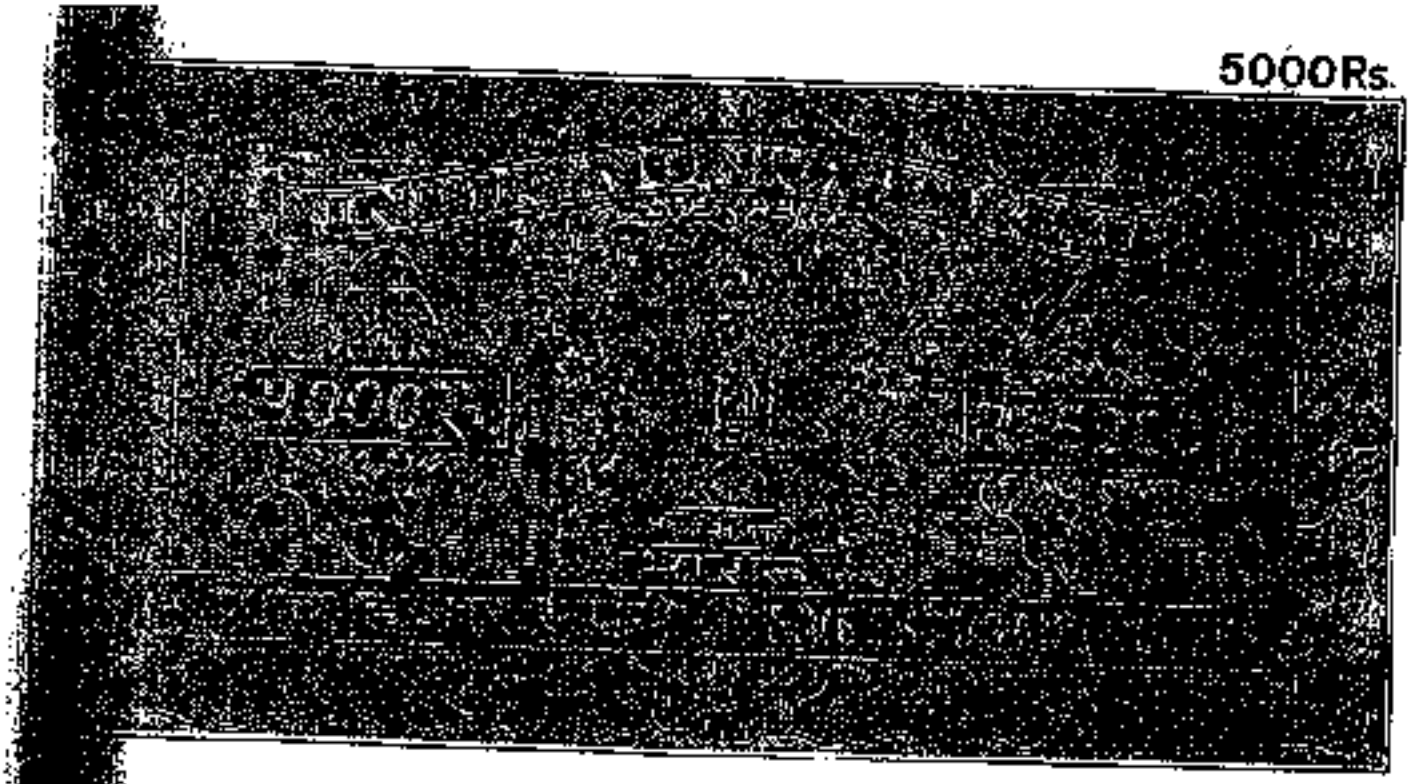

Atomic Energy, New Delhi and to the Director of Mines, Orissa, Bhubaneswar.

Data or information referred to above shall be furnished every year reckoned from the date of commencement of the mining lease.

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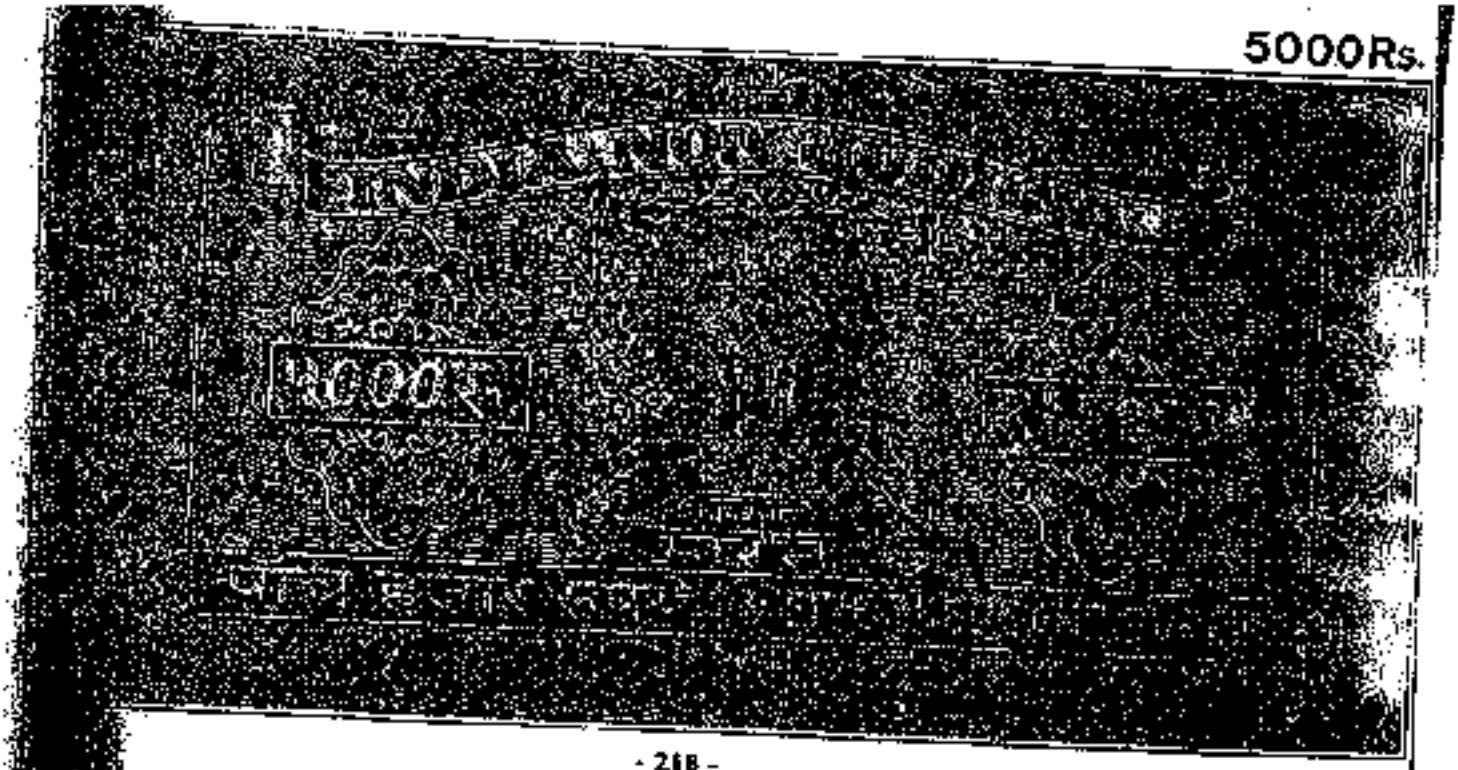

PART VIII

THE COVENANTS OF THE STATE GOVERNMENT

Lessee/Lessees may hold and enjoy rights quietly.

1. The lessee/lessees paying the rents, water rate and royalties hereby reserved and observing and performing all the covenants and

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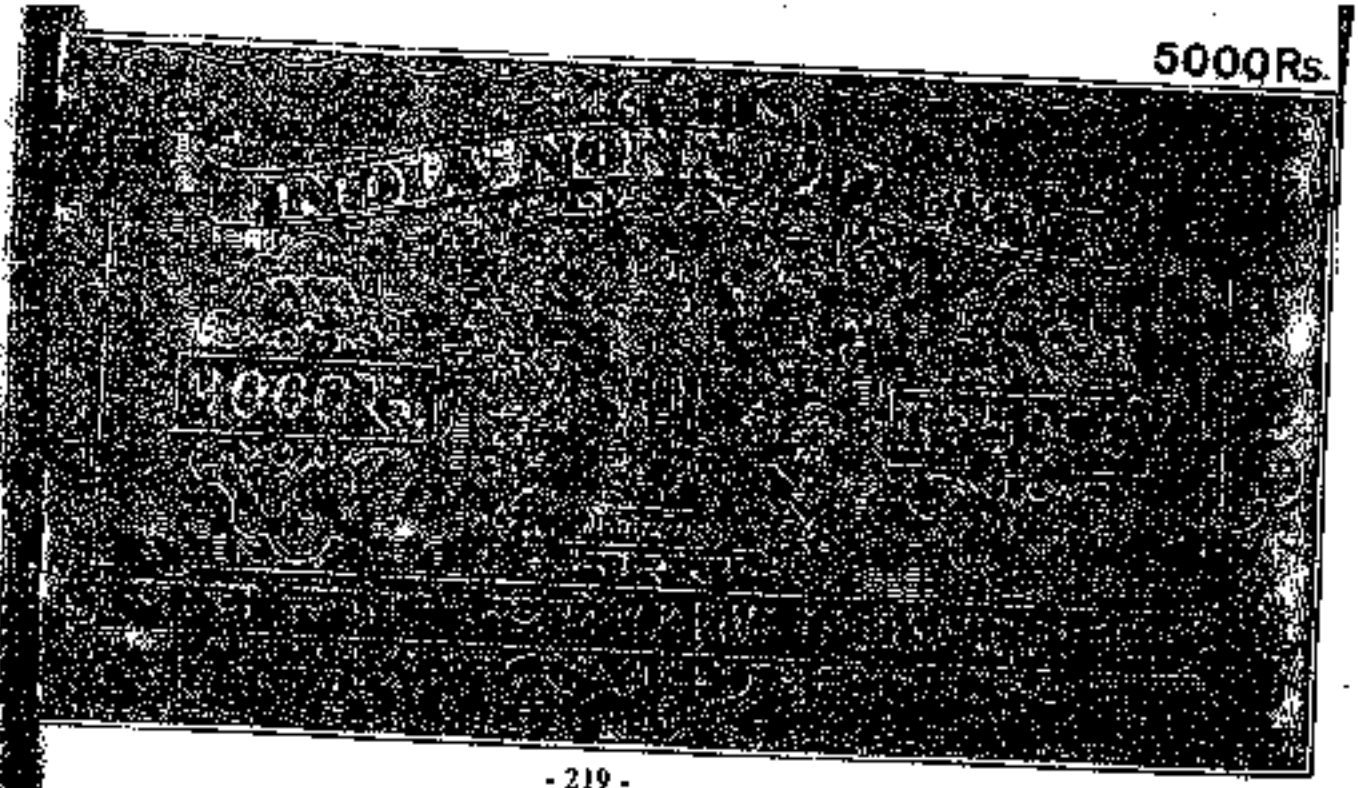

agreements herein contained and on the part of the lessee/lessees to be observed and performed shall and may quietly hold and enjoy the rights and premises hereby demised for and during the term hereby granted without any unlawful interruption

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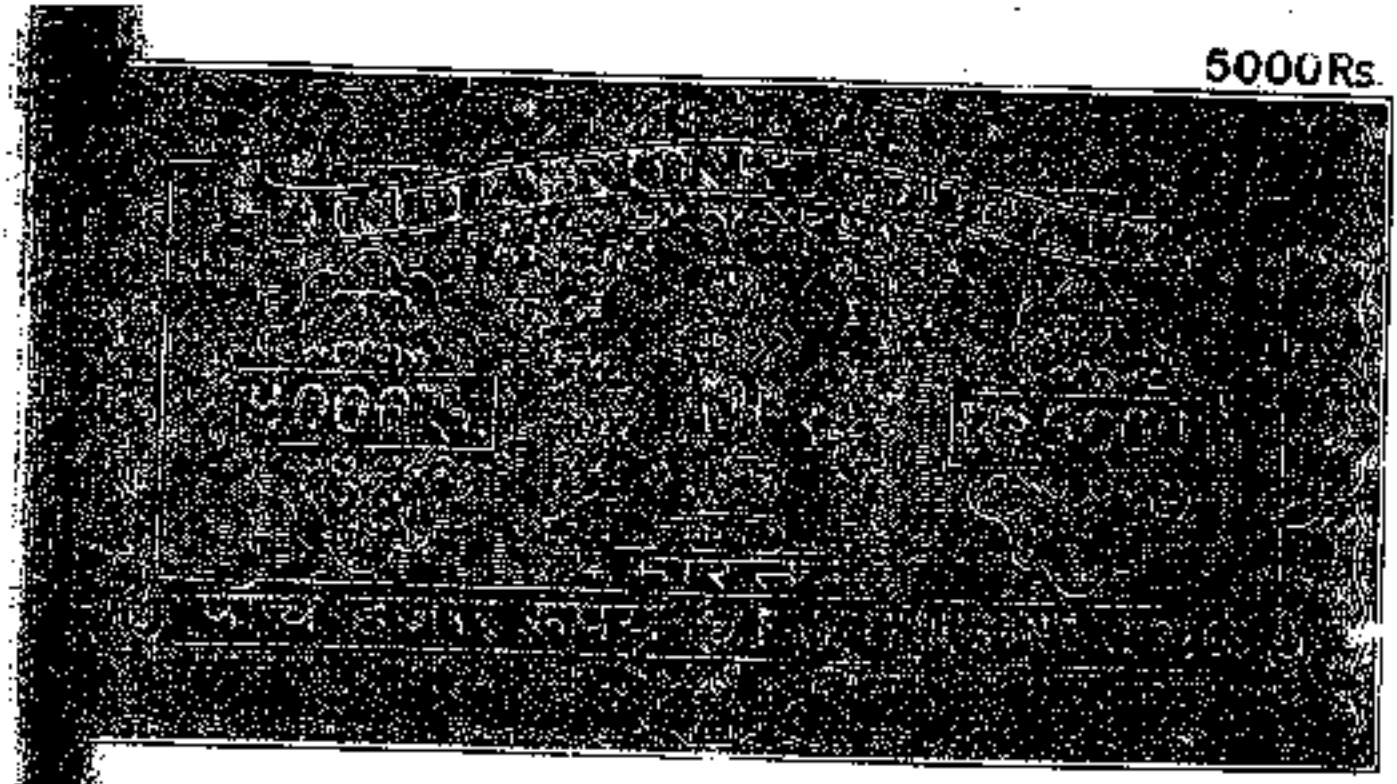

from or by the State Government, or any person rightfully claiming under it.

Acquisition of land of third parties and compensation thereof

2. If in accordance with the provision of clause 4 of Part VII of this Schedule the lessee/lessees shall offer to pay

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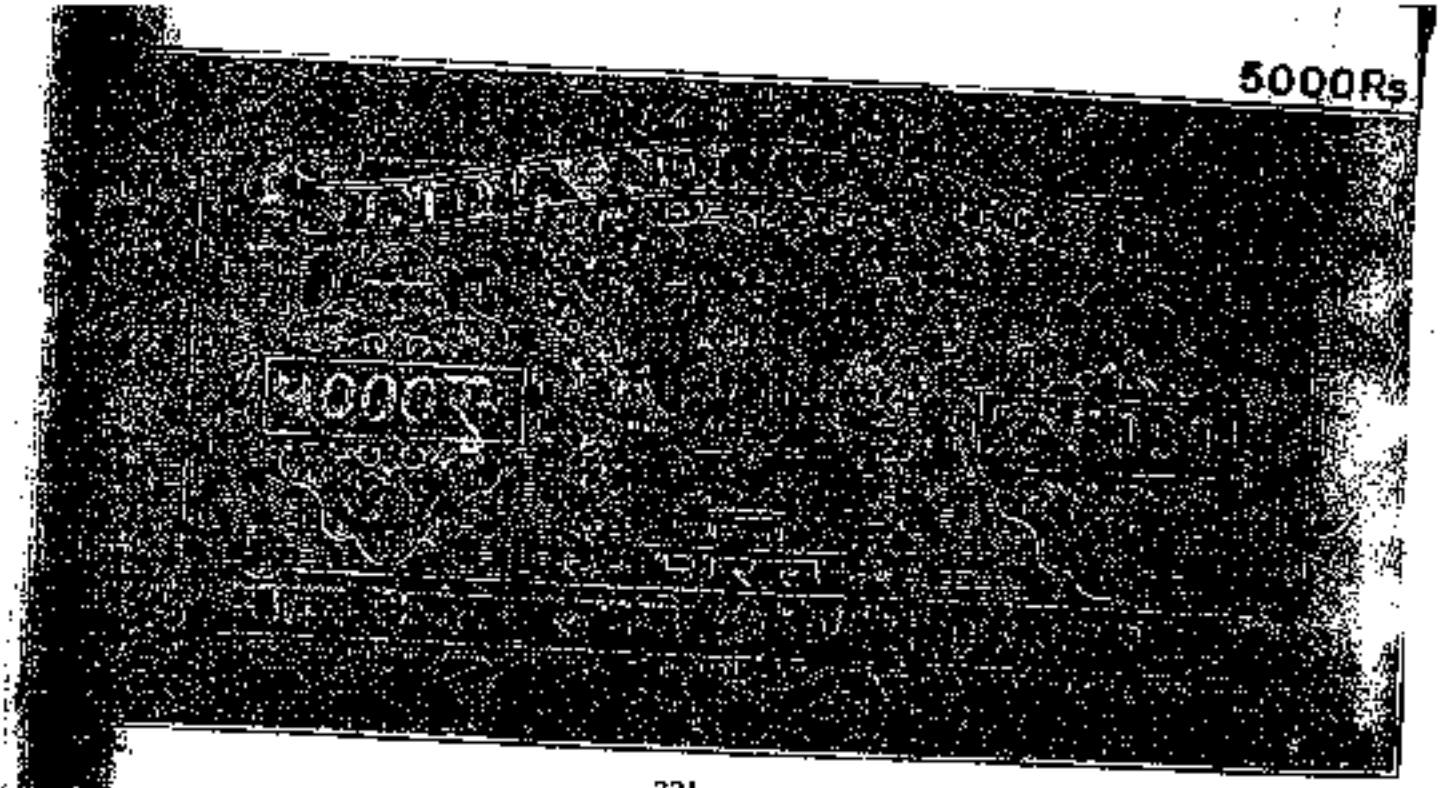

to an occupier of the surface of any part of the said lands compensation for any damage or injury which may arise from the proposed operations of the lessee/lessees and the said occupier shall refuse his consent to the exercise of the right and powers

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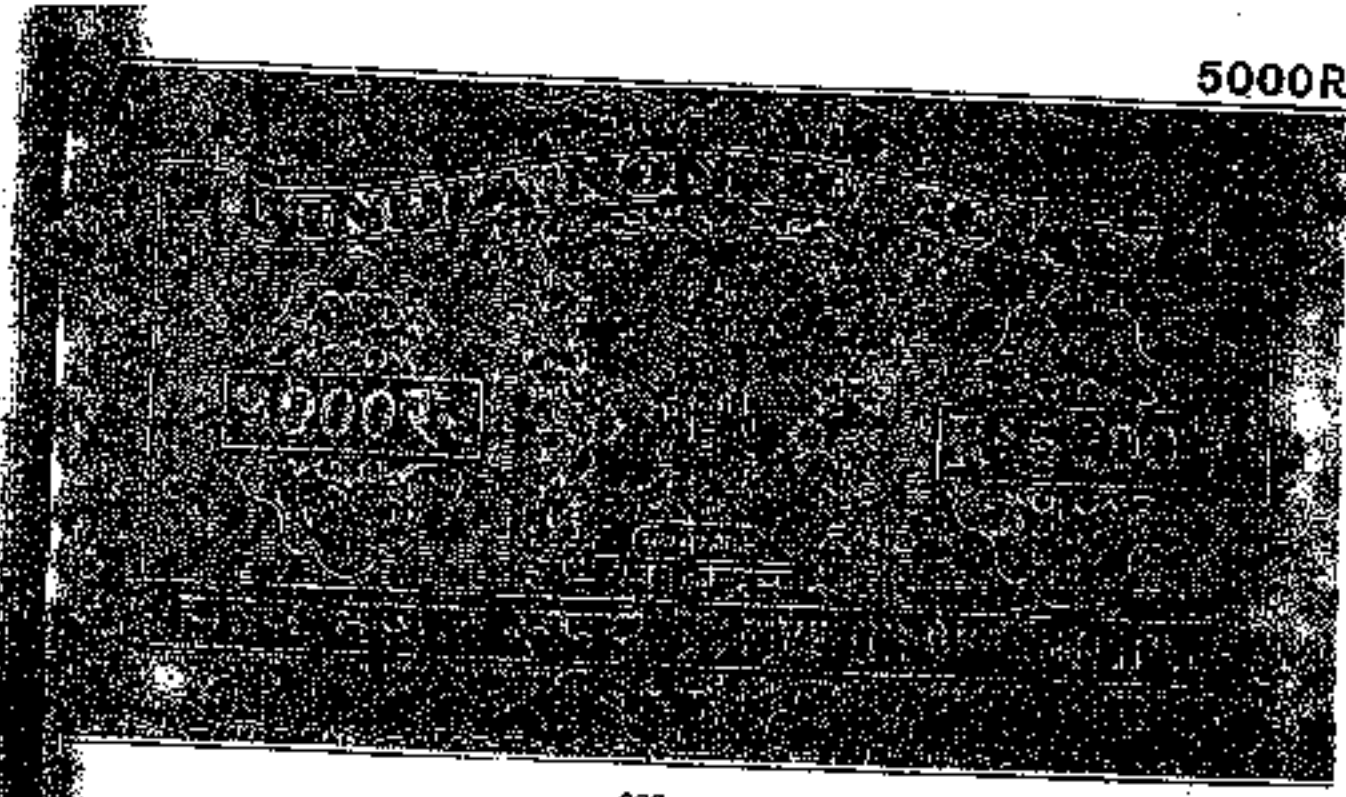

reserved to the State Government and demised to the lessee/lessees by these presents and the lessee/lessees shall report the matter to the State Government and shall deposit with it the amount offered as compensation and if the Central/State Government

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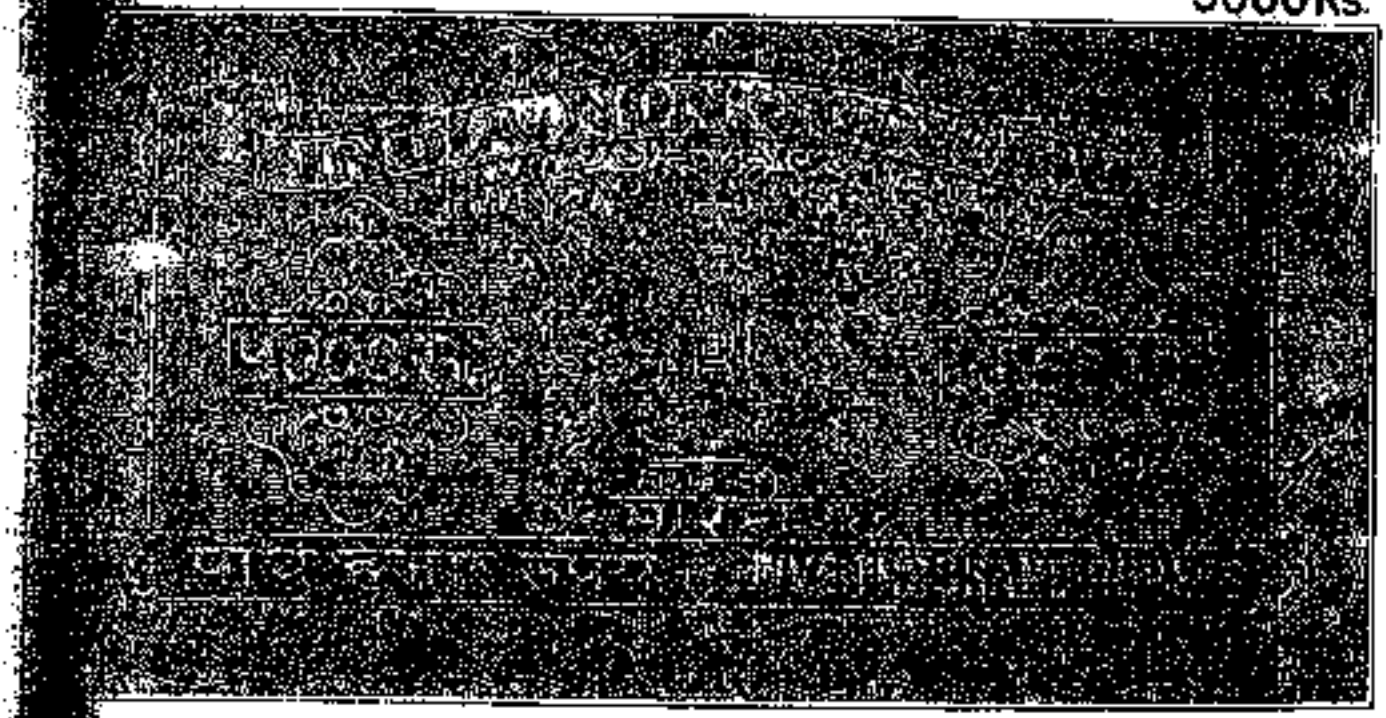

is satisfied that the amount of compensation offered is fair and reasonable or if it is not so satisfied and the lessee/lessees shall have deposited with it such further amount as the State and Central Government shall consider fair and reasonable the

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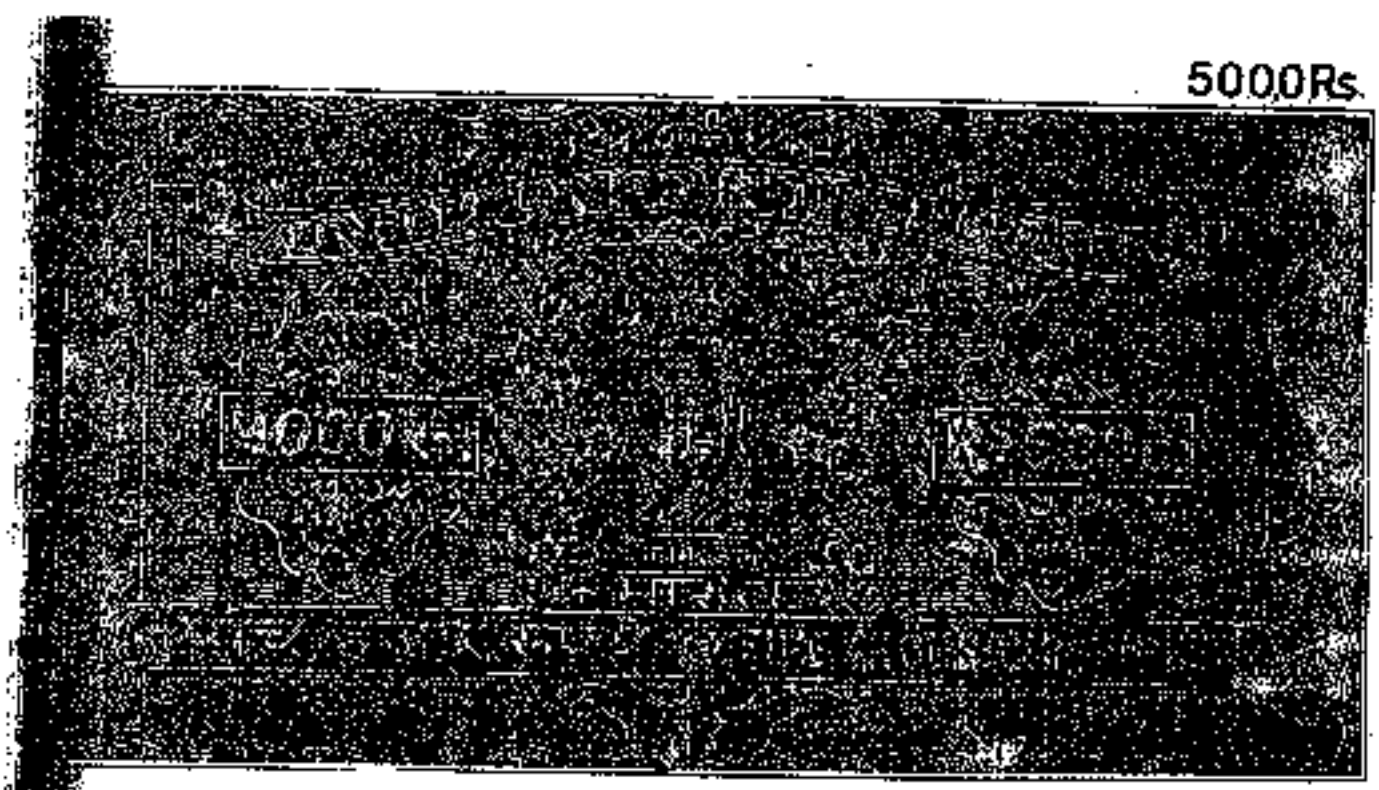

State Government shall order the occupier to allow the lessee/ lessees to enter the land and to carry out such operations as may be necessary for the purpose of this lease. In assessing the amount of such compensation the State Government

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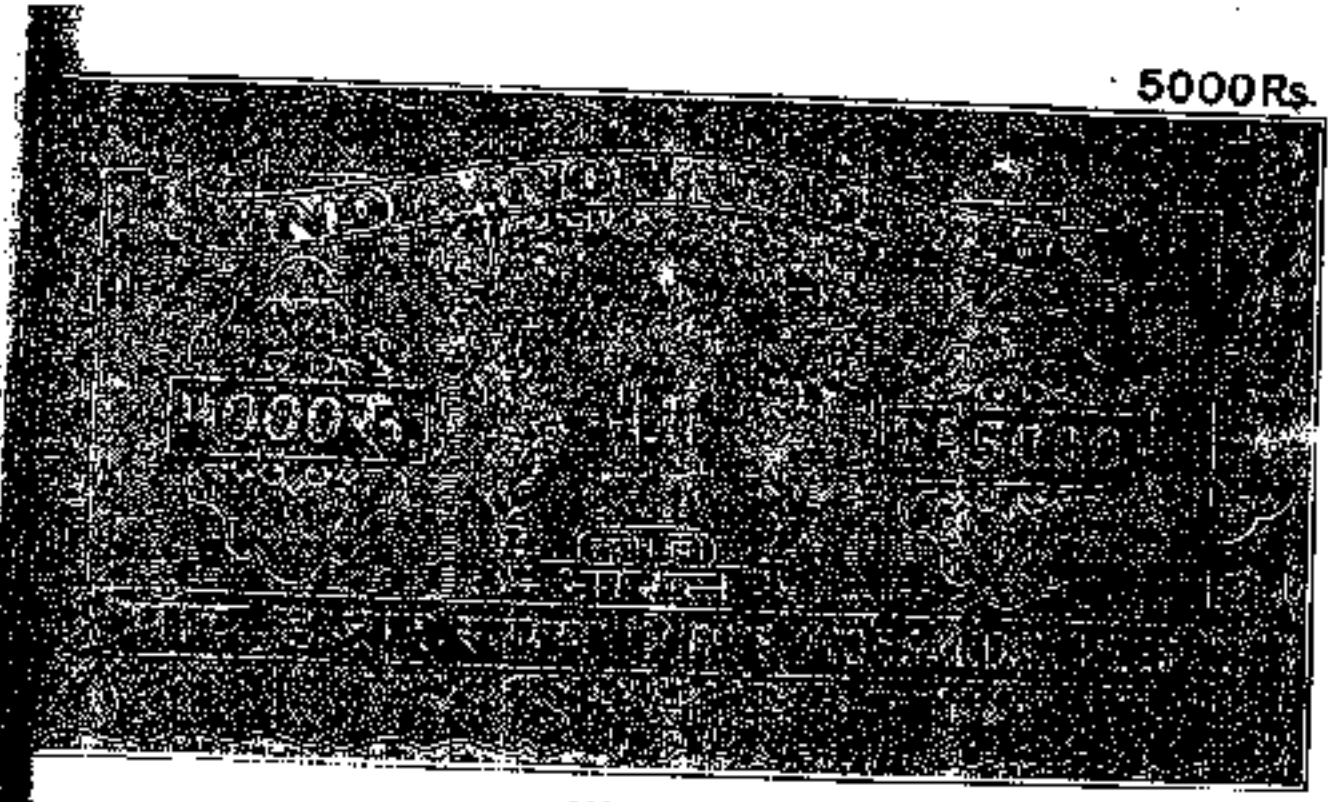

shall be guided by the principles of the Land Acquisition Act.

To renew.

3. The mining lease is renewable in terms of the provisions of the Act and the rules made thereunder.

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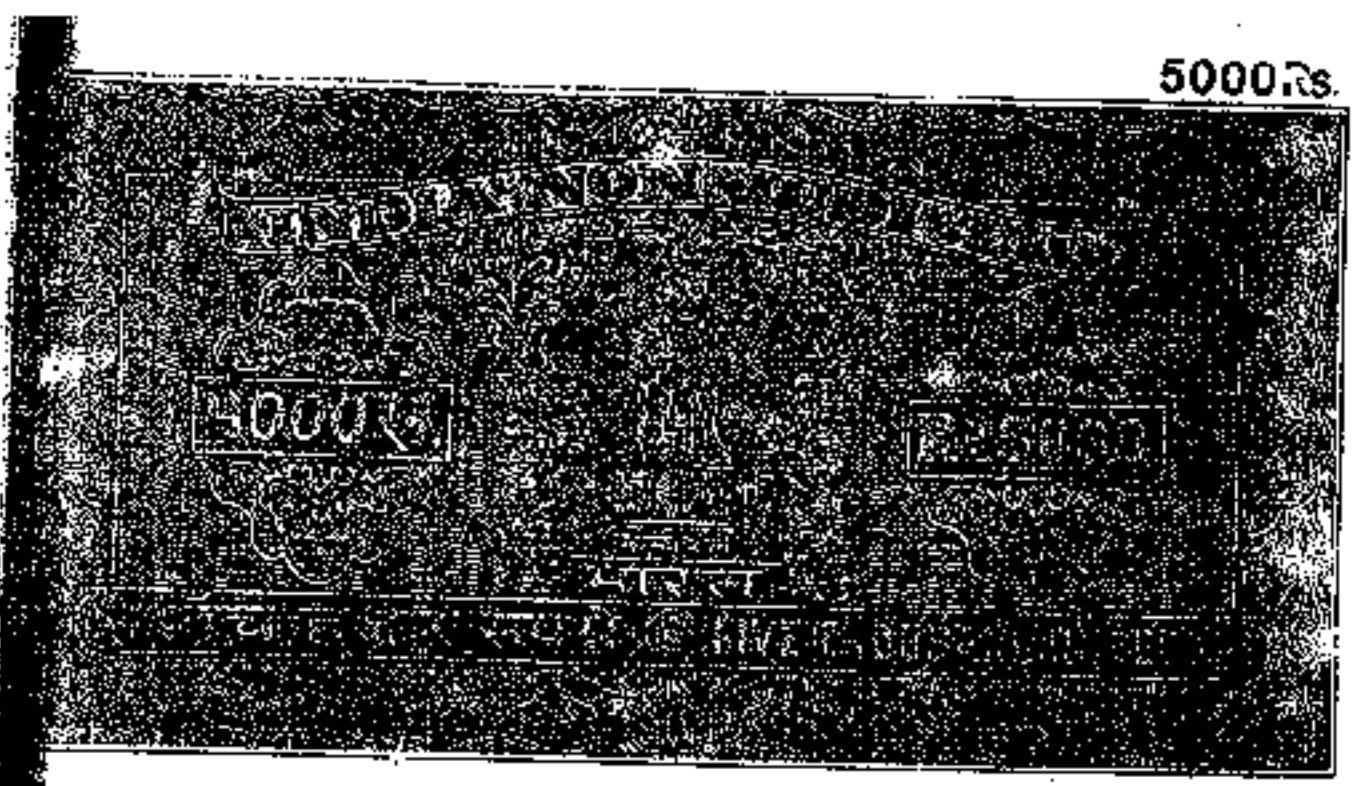

Provided that the State Government may for reasons to be recorded in writing reduce the area applied for.

If the lease is in respect of minerals specified in the First Schedule to the

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INDIAN RARE EARTHS LTD.

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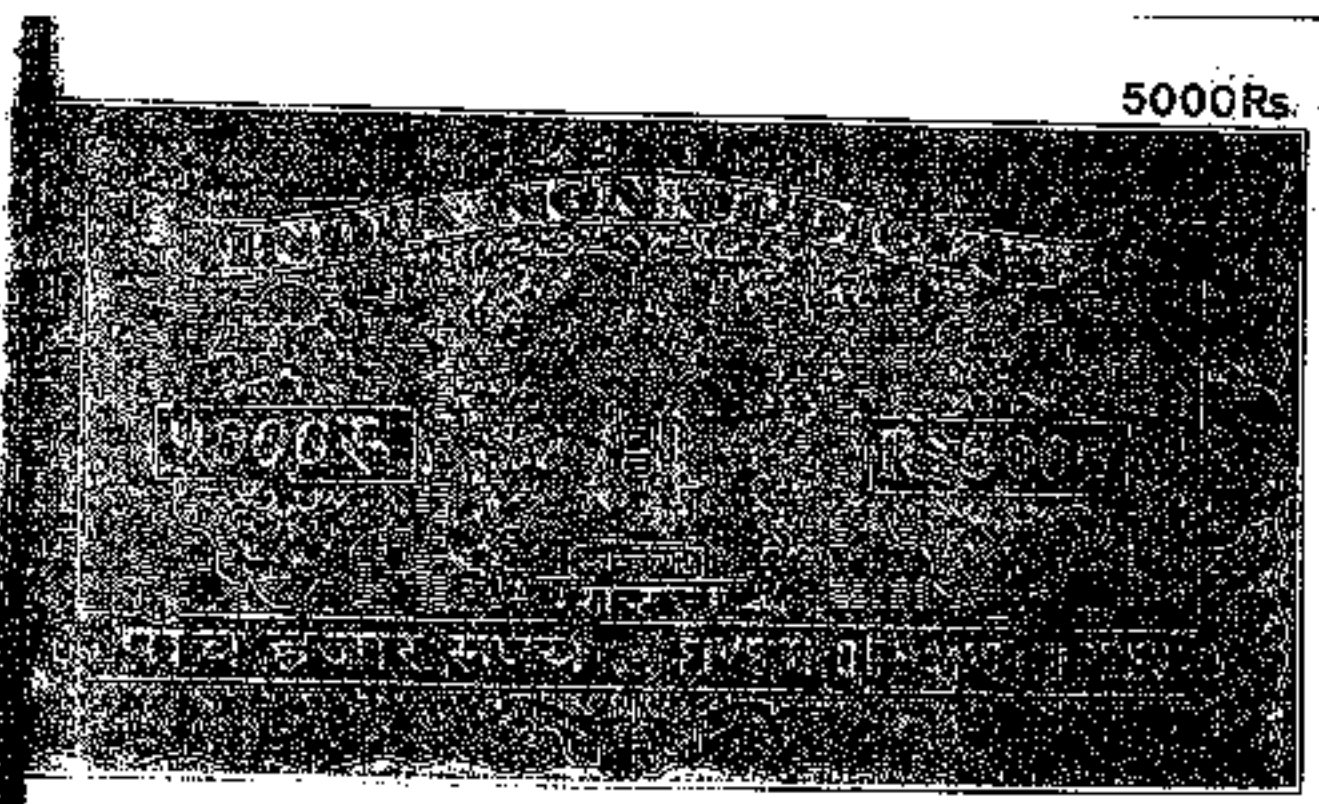

Act, renewal will be subject to the prior approval of the Central Government.

If the lessee/lessees be desirous of taking a renewed lease of the premises hereby demised or of any

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...AN METALS & FERRO ALLOYS LTD.

CONSTITUED ATTORNEY

COLLECTOR, JAIPUR

parts of them for a further term from the expiration of the term hereby granted and is otherwise eligible, he/they shall prior to expiration of the last mentioned term give to the State Government [twelve calendar months] previous notice in writing

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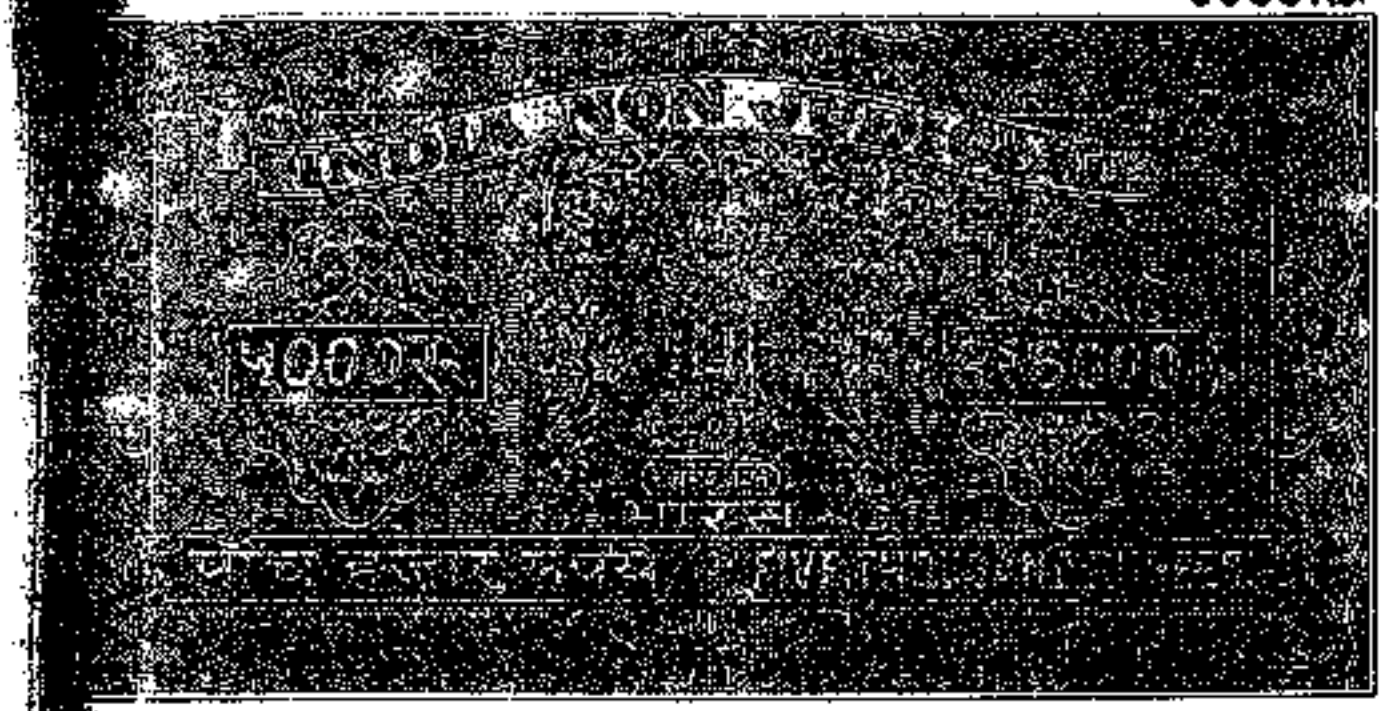

and shall pay the rent, rates and royalties hereby reserved and shall observe and perform the several covenants and agreements herein contained and on the part of the lessee/lessees to be observed and performed up to the expiration of the

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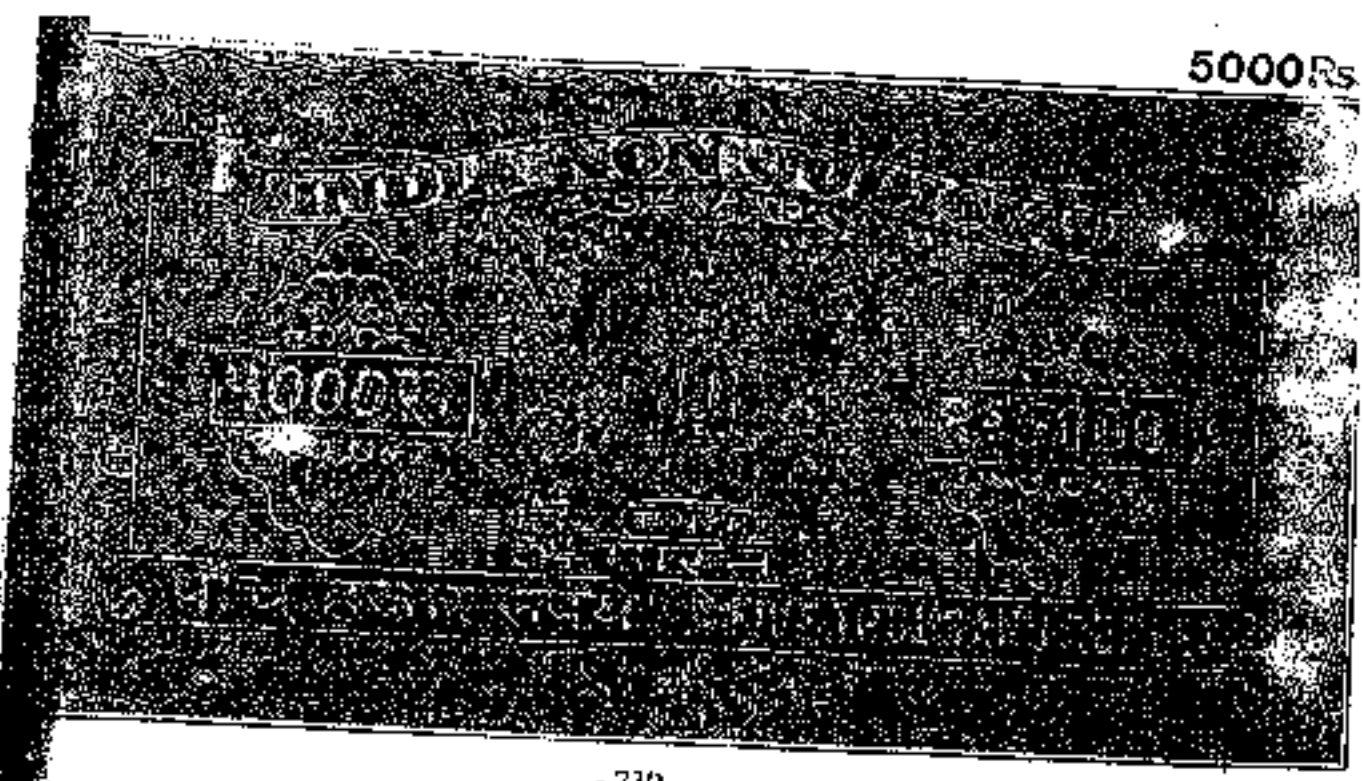

term hereby granted. The State Government on receipt of application for renewal, shall consider it in accordance with the provisions of the Act and the rules made thereunder and shall pass orders as it deems fit.

If renewal is granted, the State

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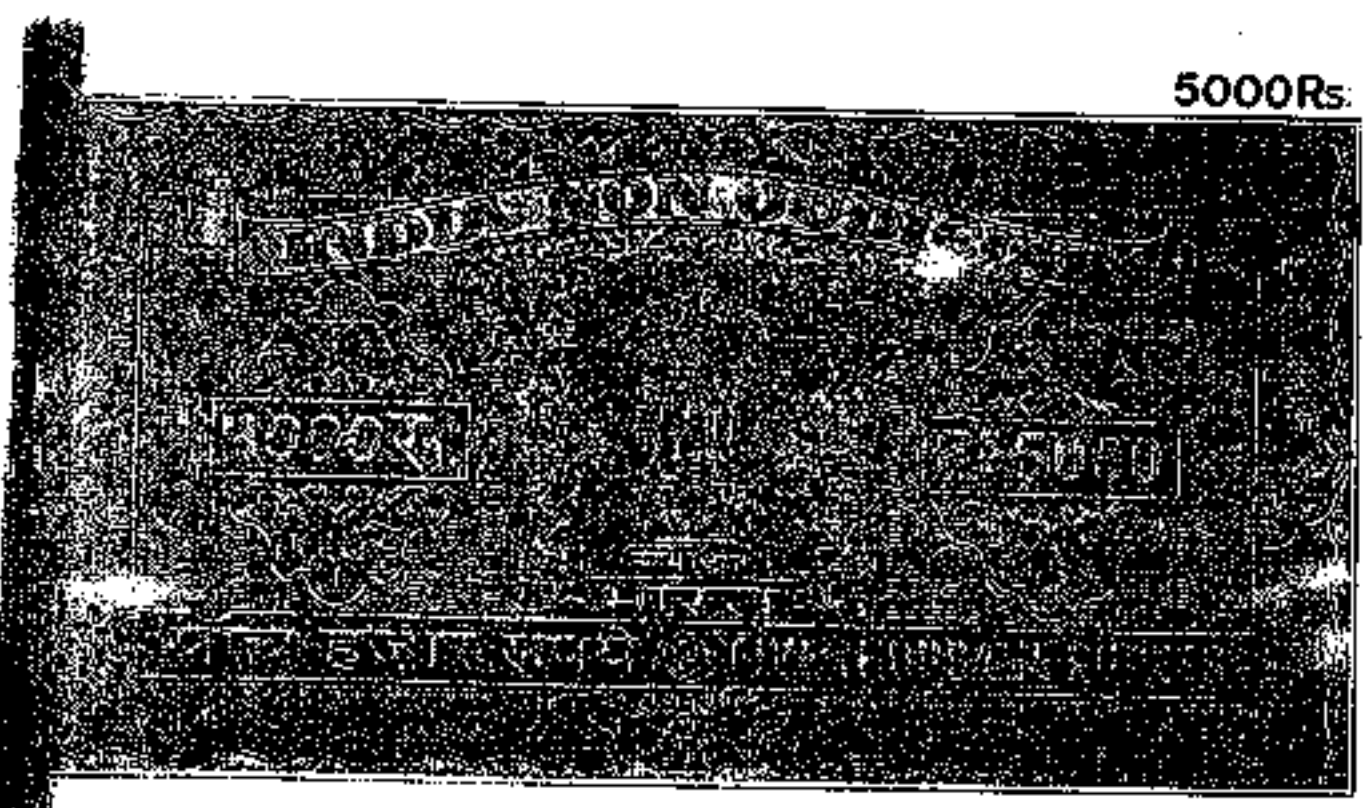

Government will at the expense of the lessee/lessees and upon his executing and delivering to the State Government if required a counterpart thereof execute and deliver to the lessee/lessees a renewed lease of the said premises or part thereof for the

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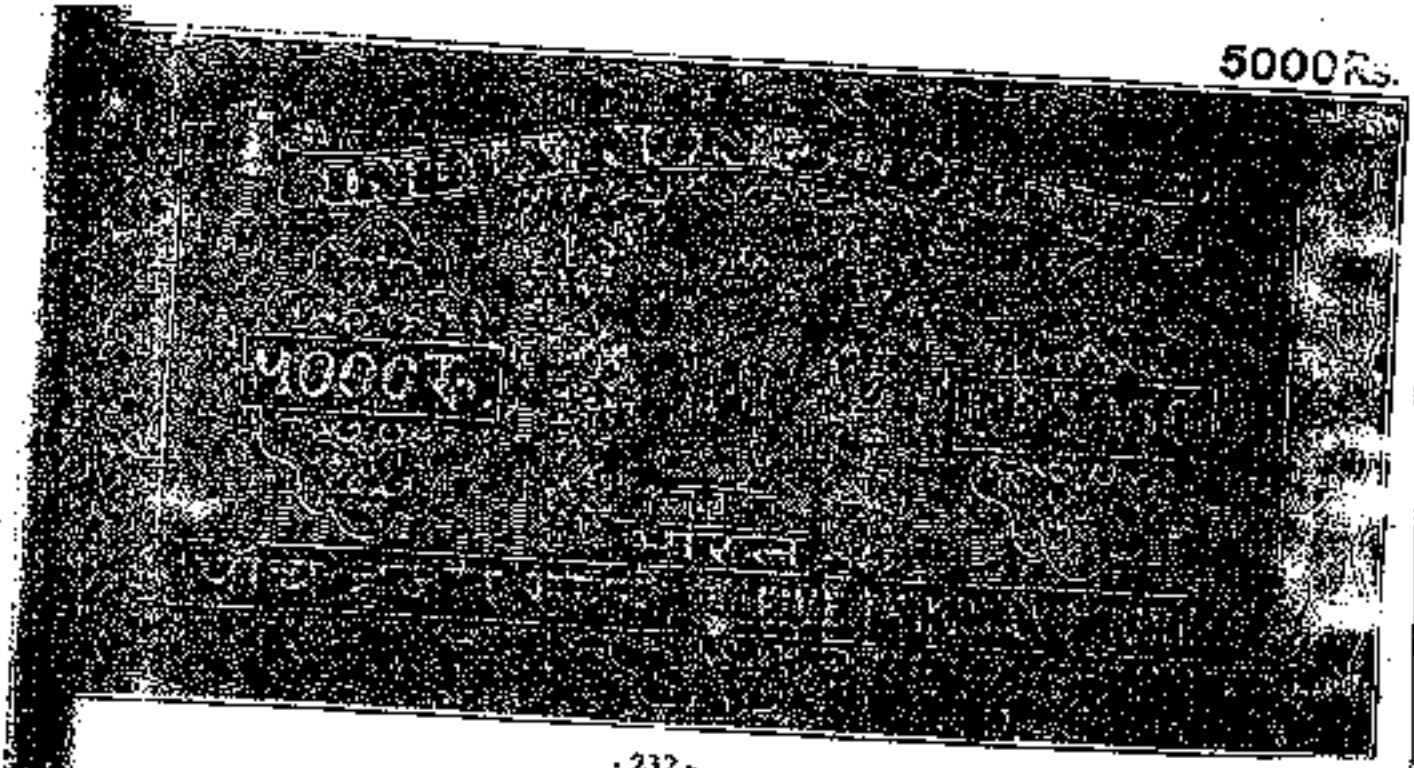

further term of 20 years at such rents, rates and royalties and on such terms and subject to such rents, rates and royalties and on such terms and subject to such covenants and agreements, including this present covenant to renew as shall be in

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INDIAN REVENUE SERVICE

CONSTITUED ATTORNEY

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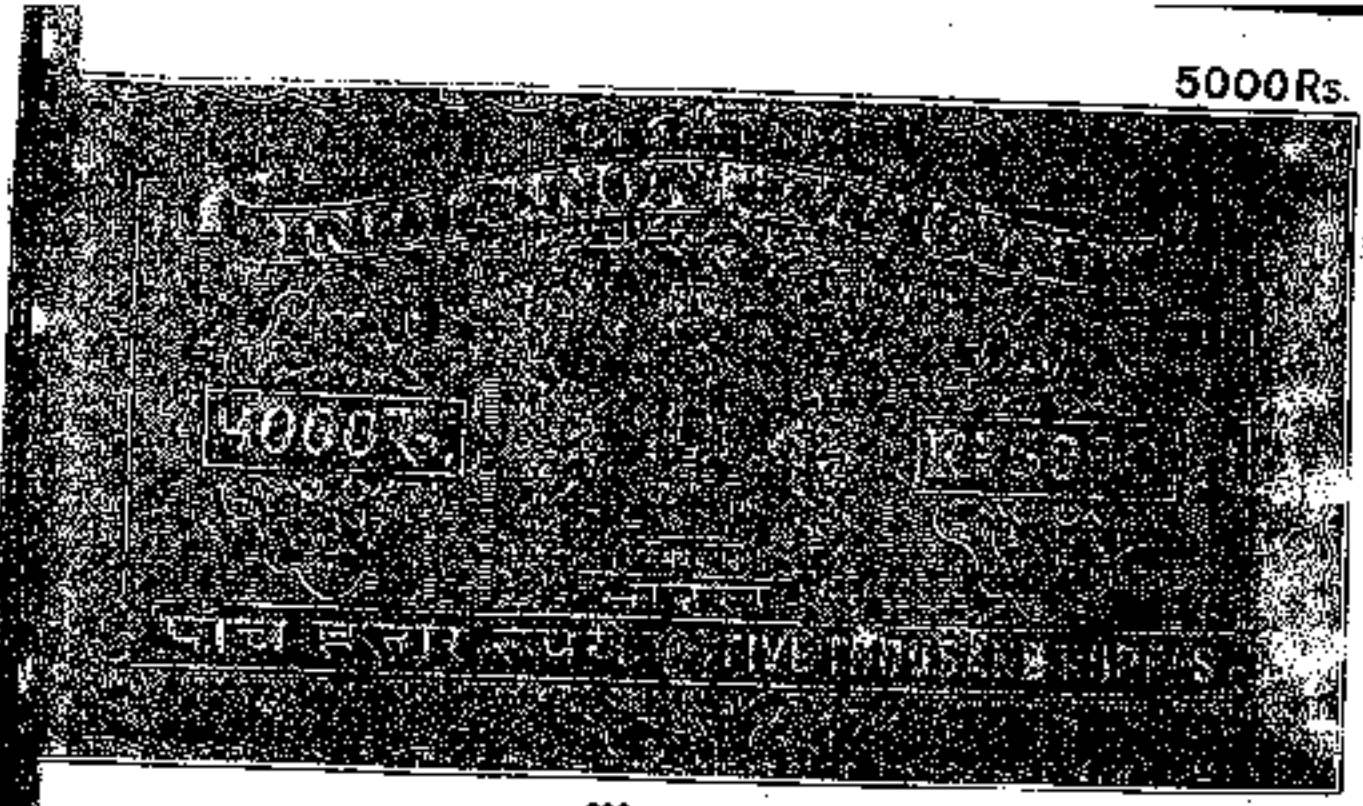

accordance with the Mineral Concession Rules, 1960, applicable to chromite (name of minerals) on the day next following the expiration of the term hereby granted.

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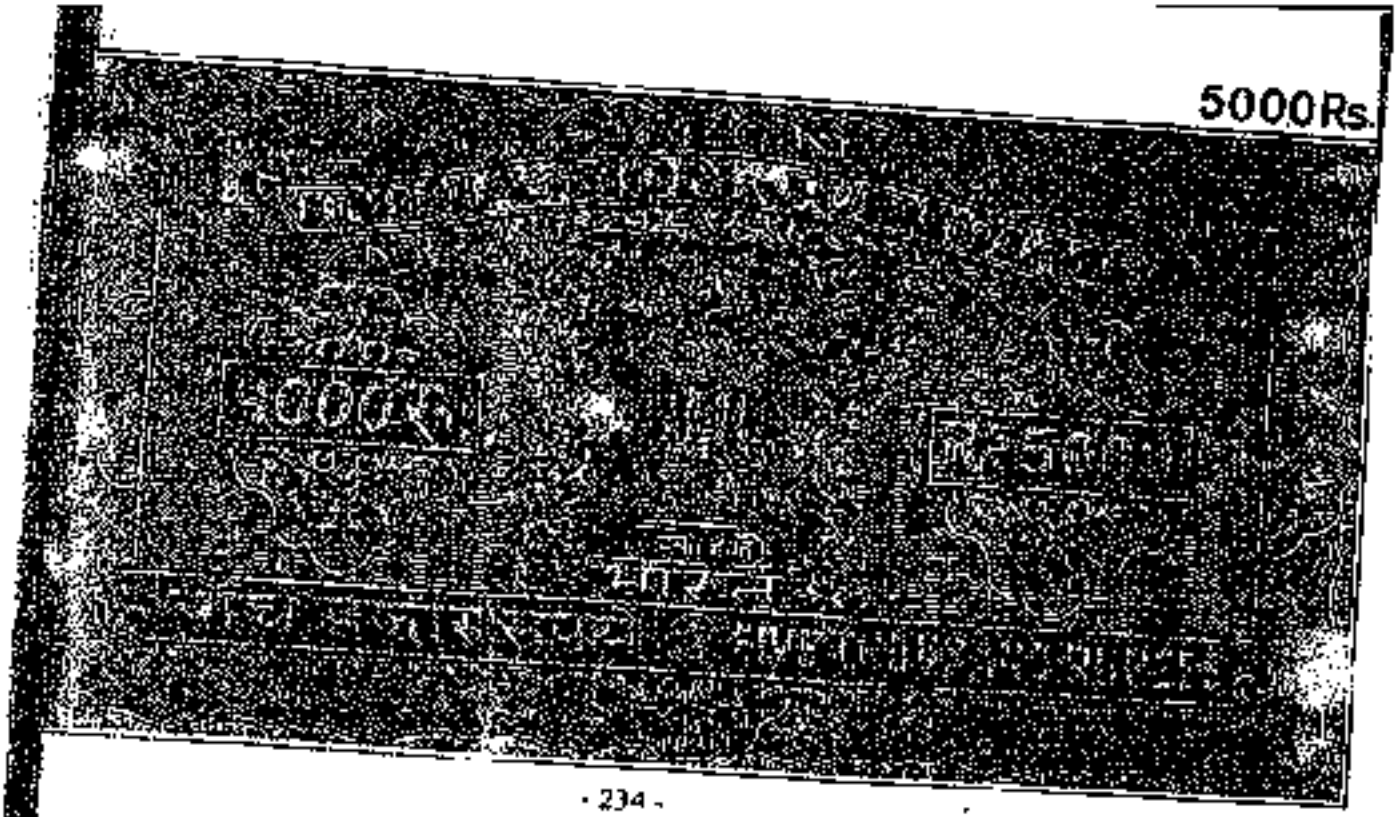

Liberty to determine the lease.

4. The lessee/lessees may at any time determine this lease by not less than 12 calendar months notice in writing to the State Government or to such officer, or authority as the State Government may specify in this

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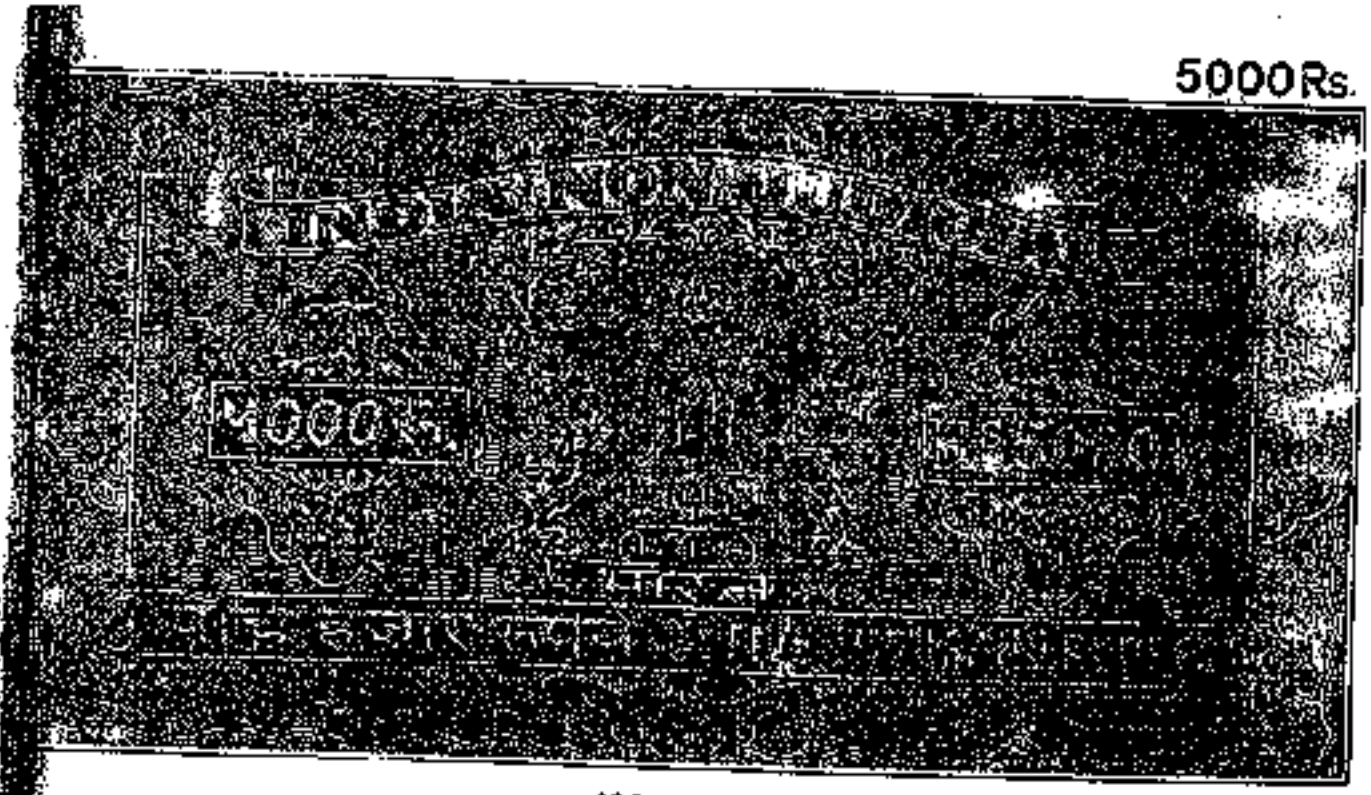

behalf and upon the expiration of such notice provided that the lessee/lessees shall upon such expiration render and pay all rents, water rates, royalties, compensation for damages and other moneys which may then be due and payable under

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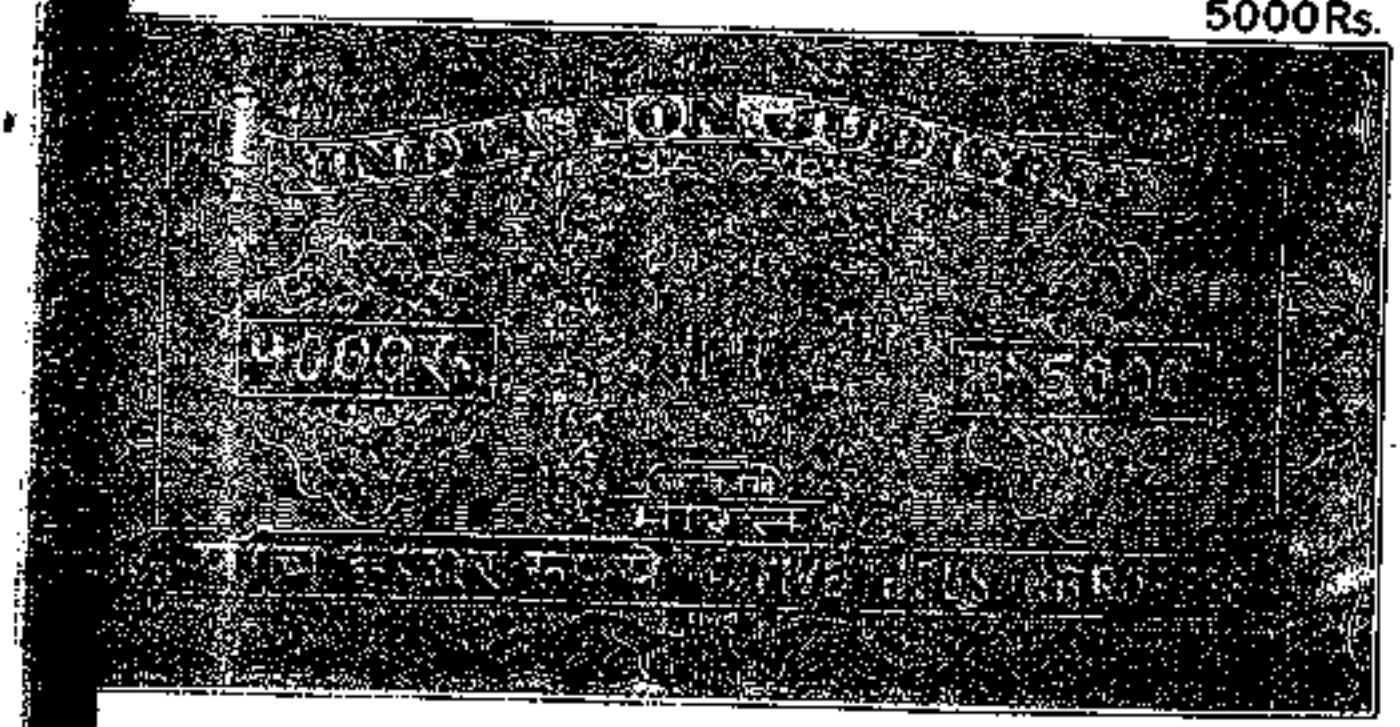

these presents to the lessor or any other person or persons and shall deliver these presents to the State Government then this lease and the said term and the liberties, powers and privileges hereby granted shall absolutely cease and determine but

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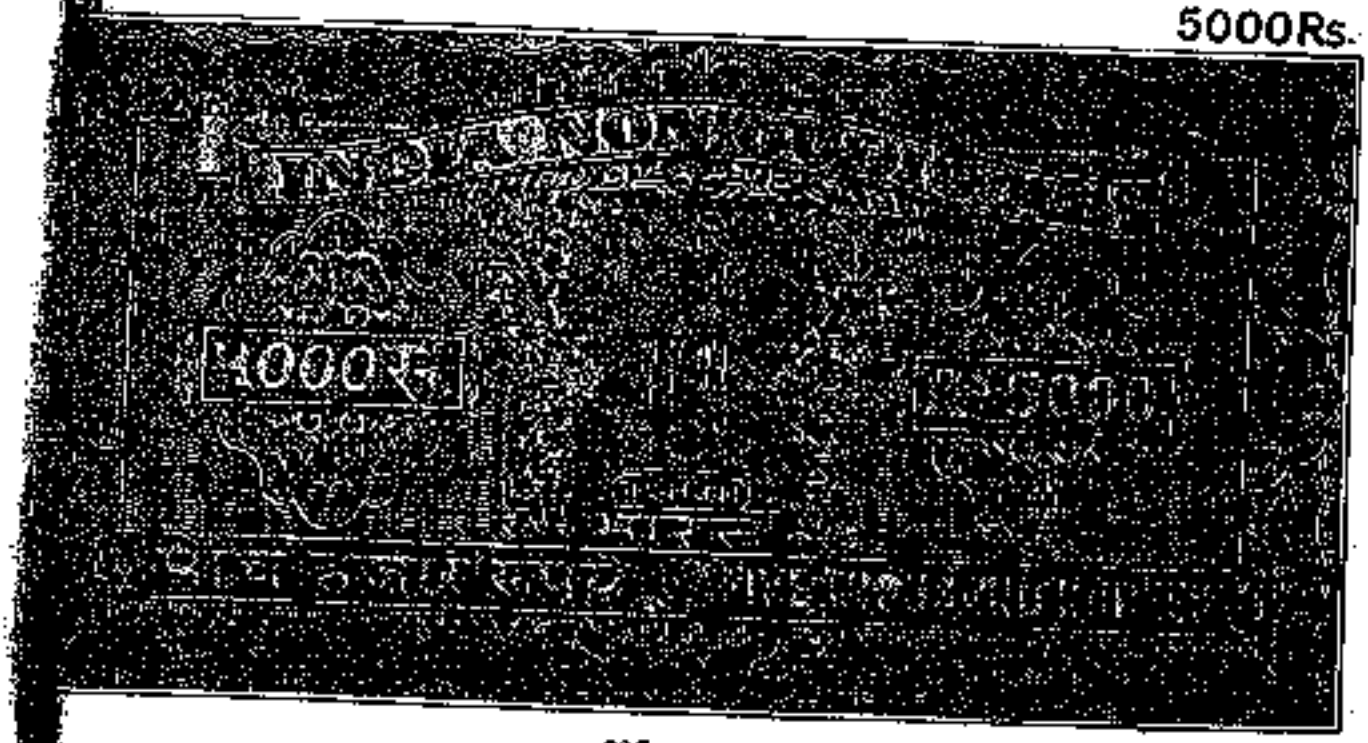

without prejudice to any right or remedy of the lessor in respect of any breach of any of the covenants or agreements contained in these presents.

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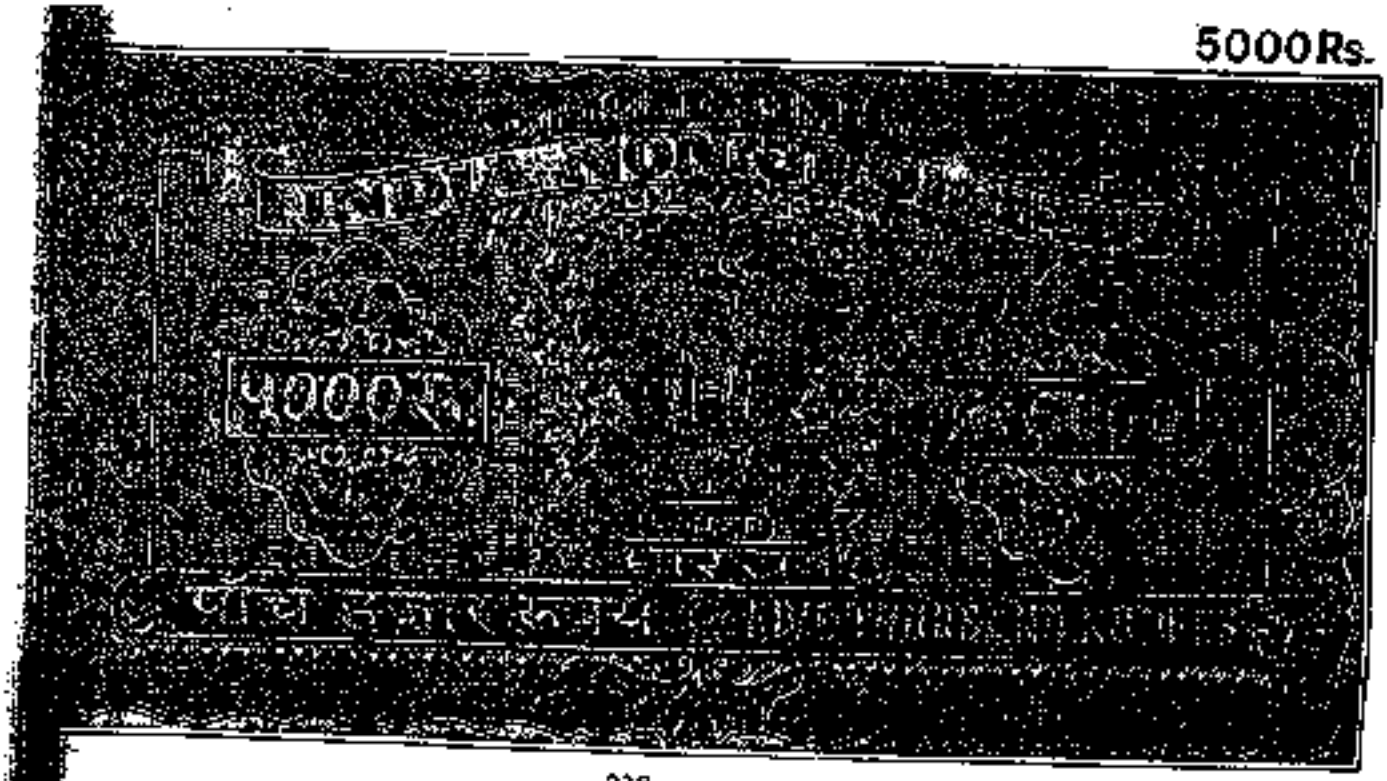

4A. The State Government may on an application made by the lessee permit him to surrender one or more minerals from his lease which is for a group of minerals on the ground that deposits of that/mineral have since exhausted or depleted to such an

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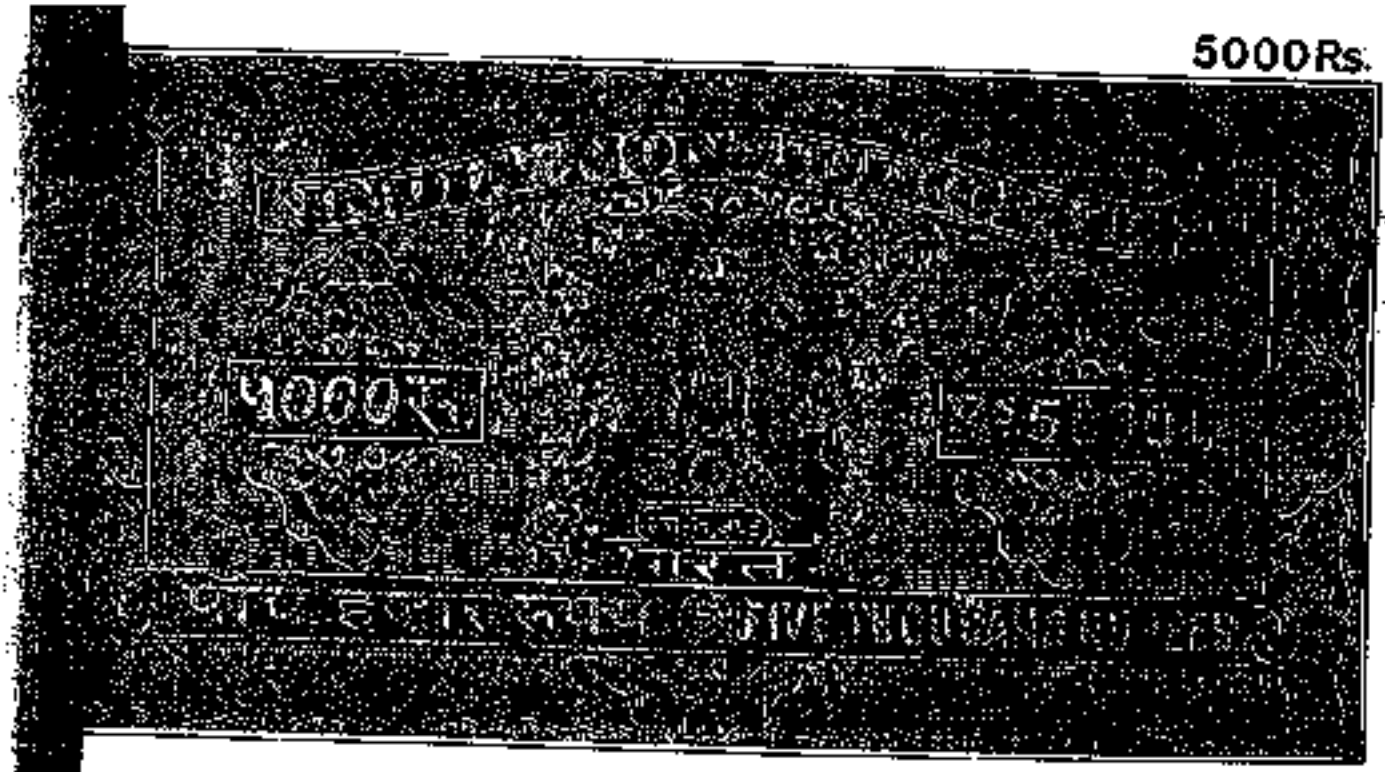

extent that it is no longer possible to work the mineral economically, subject to the condition that the lessee -

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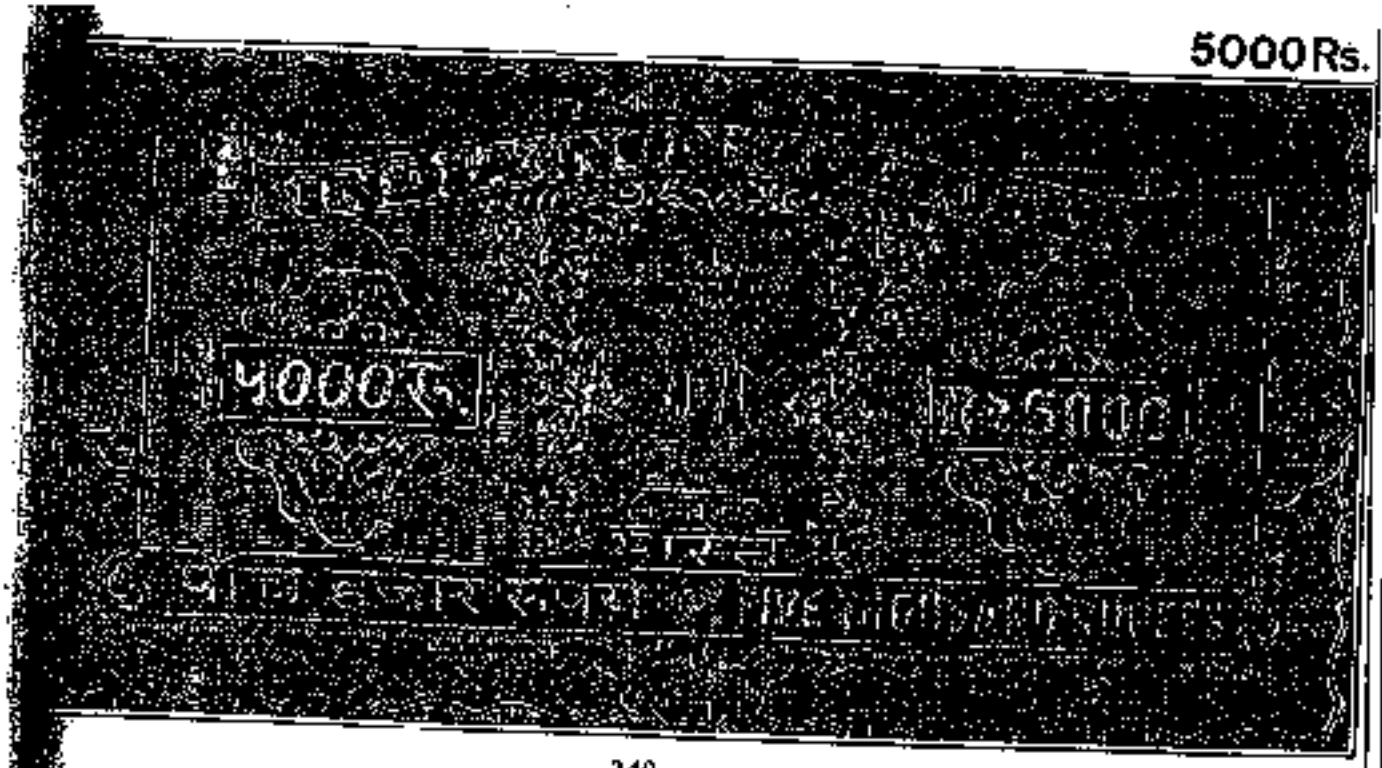

a) Makes an application for such surrender of mineral atleast six months before the intended date of surrender; and

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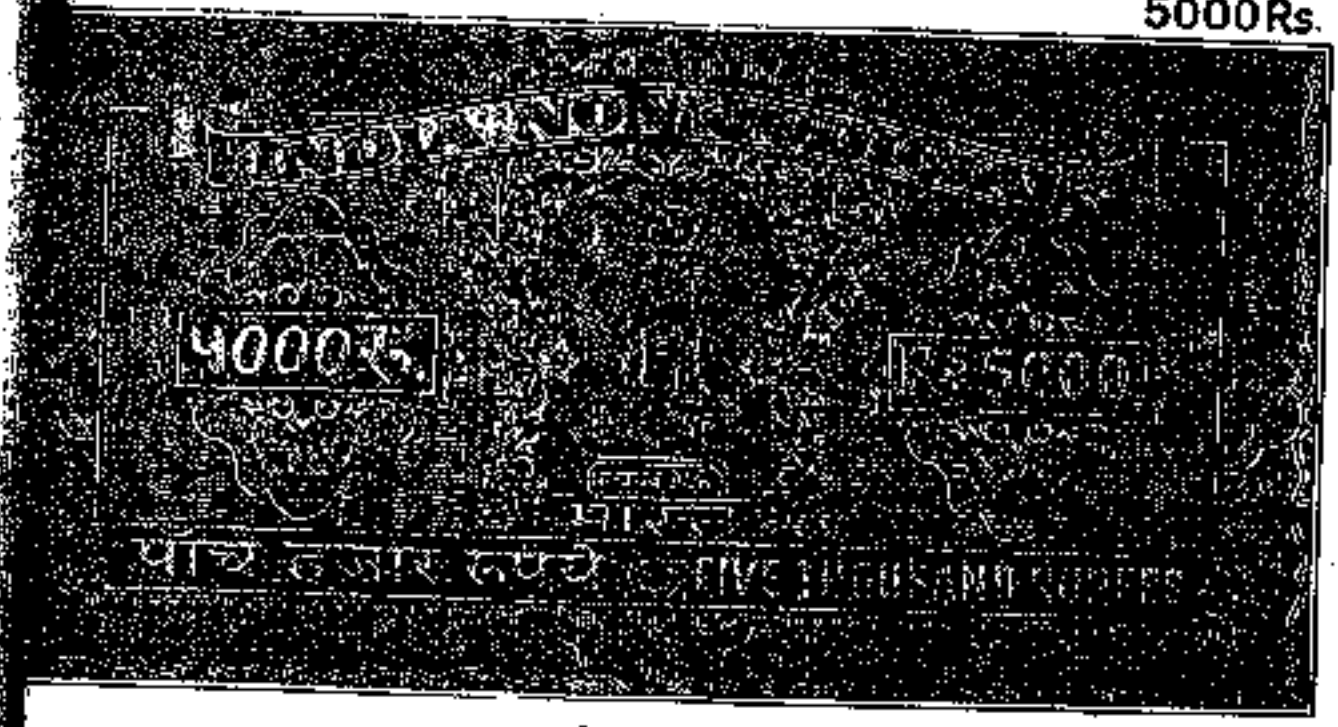

b) Gives an undertaking that he will not cause any hindrance in the working of the mineral so surrendered by any other person who is subsequently granted a mining lease for that mineral.

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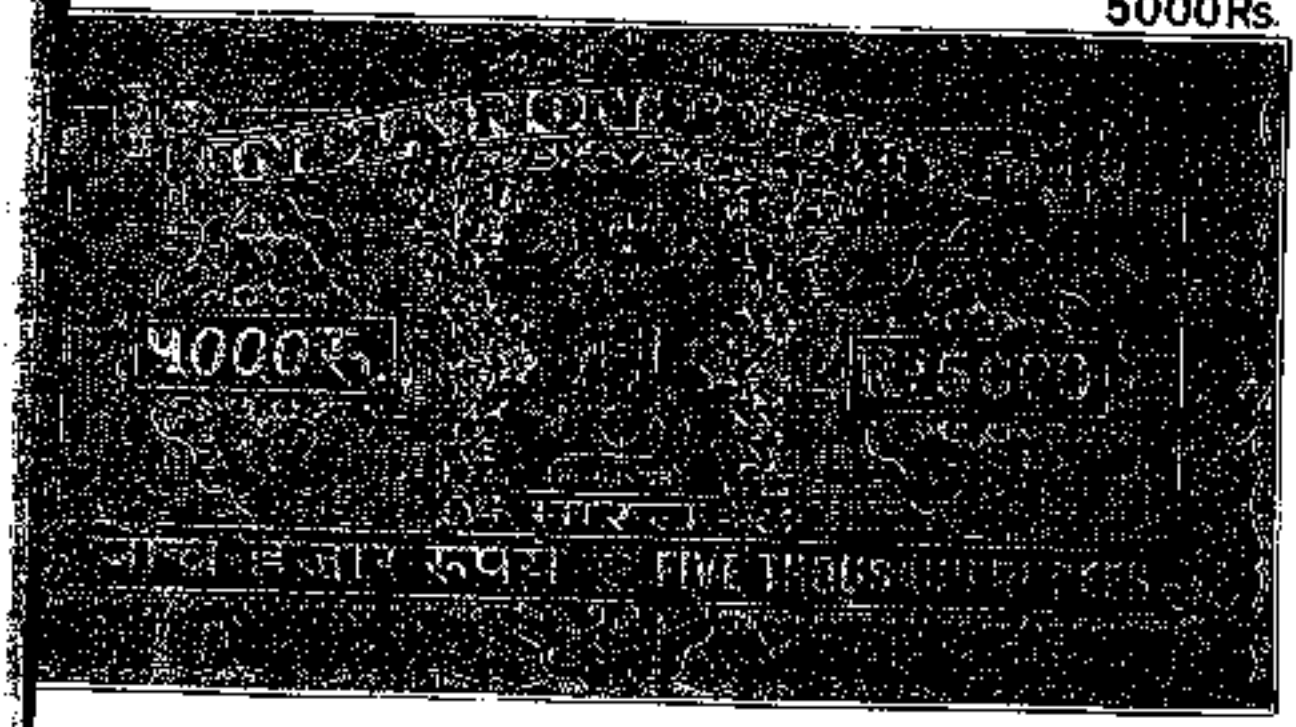

Refund of Security deposits.

5. On such date as the State Government may elect within 12 calendar months after the determination of this lease or of any renewal thereof, the amount of the security deposit paid in respect of

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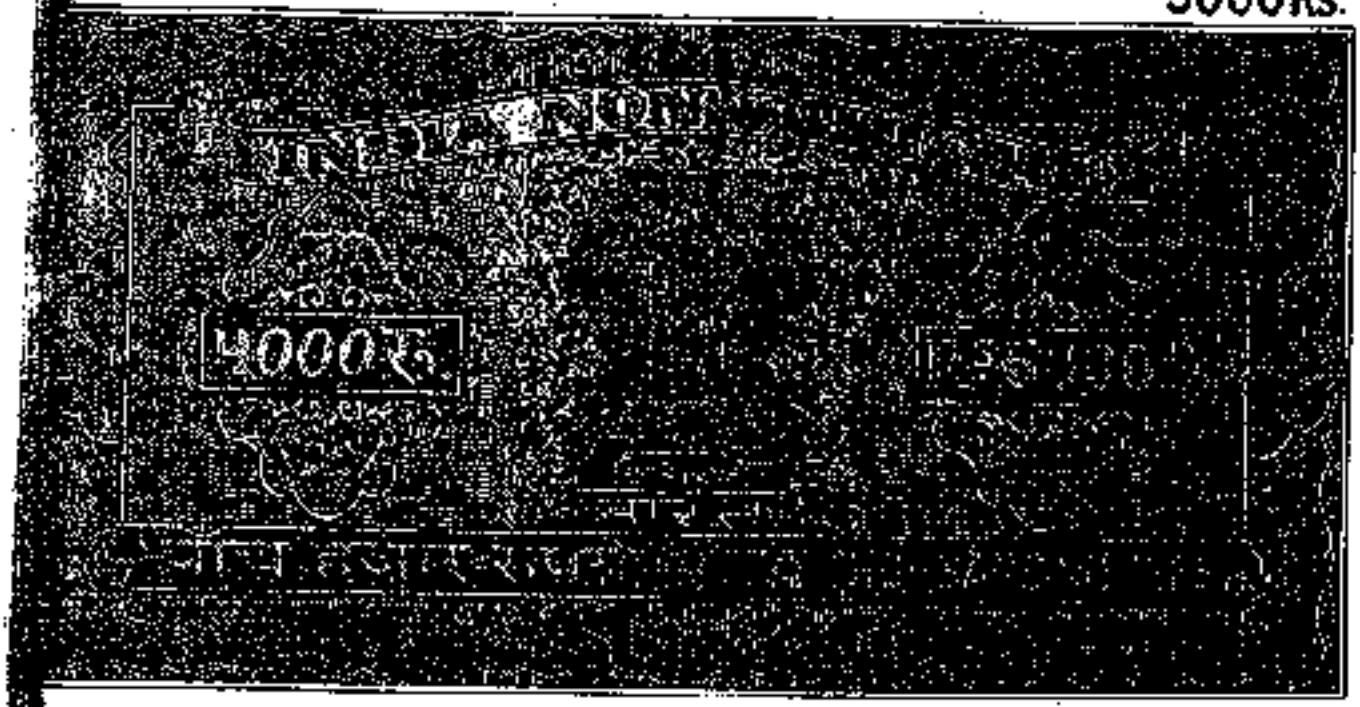

this lease and then remaining in deposit with the State Government and not required to be applied to any of the purposes mentioned in this lease shall be refunded to the lessee/lessees. No interest shall run on the security deposit.

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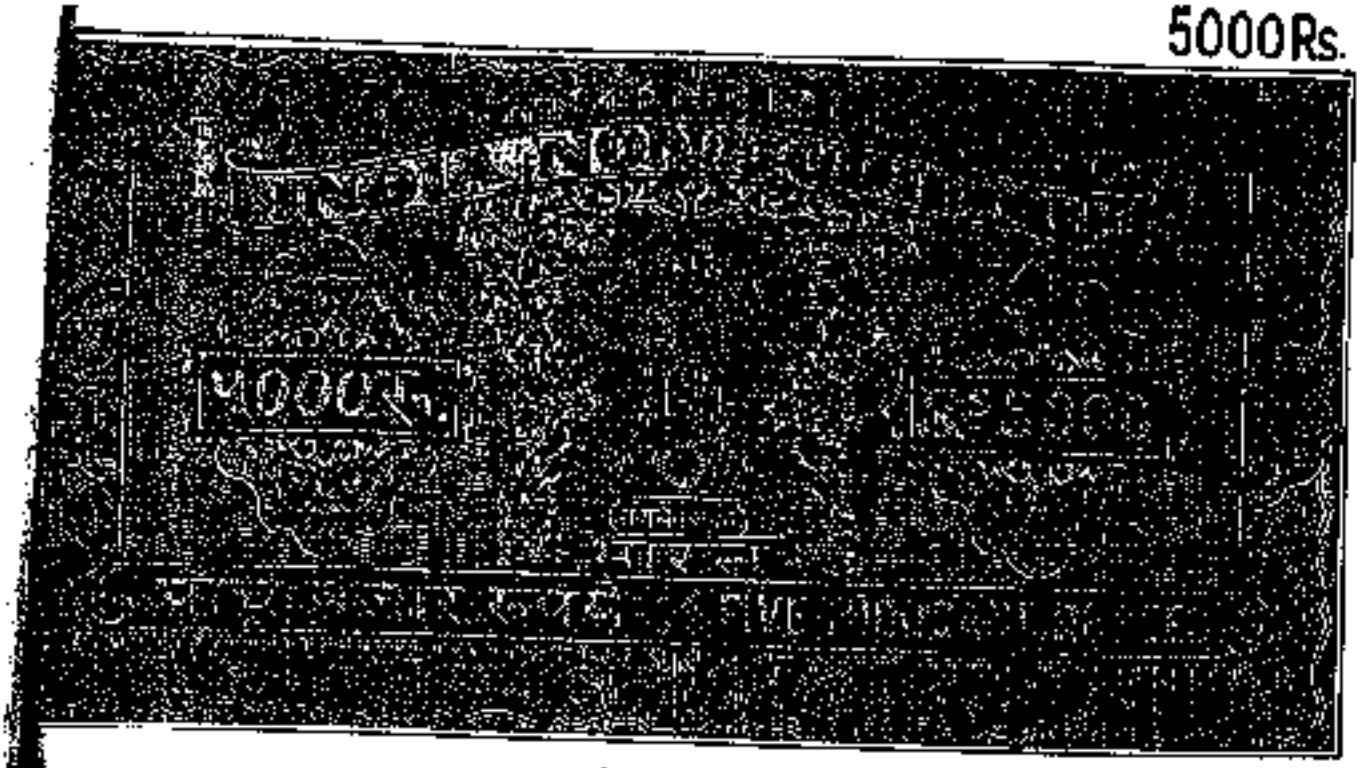

PART IX

GENERAL PROVISIONS

Obstructions to inspection

1. In case the lessee/lessees or his/their transferee/assignee does/do not allow entry or inspection by the officers

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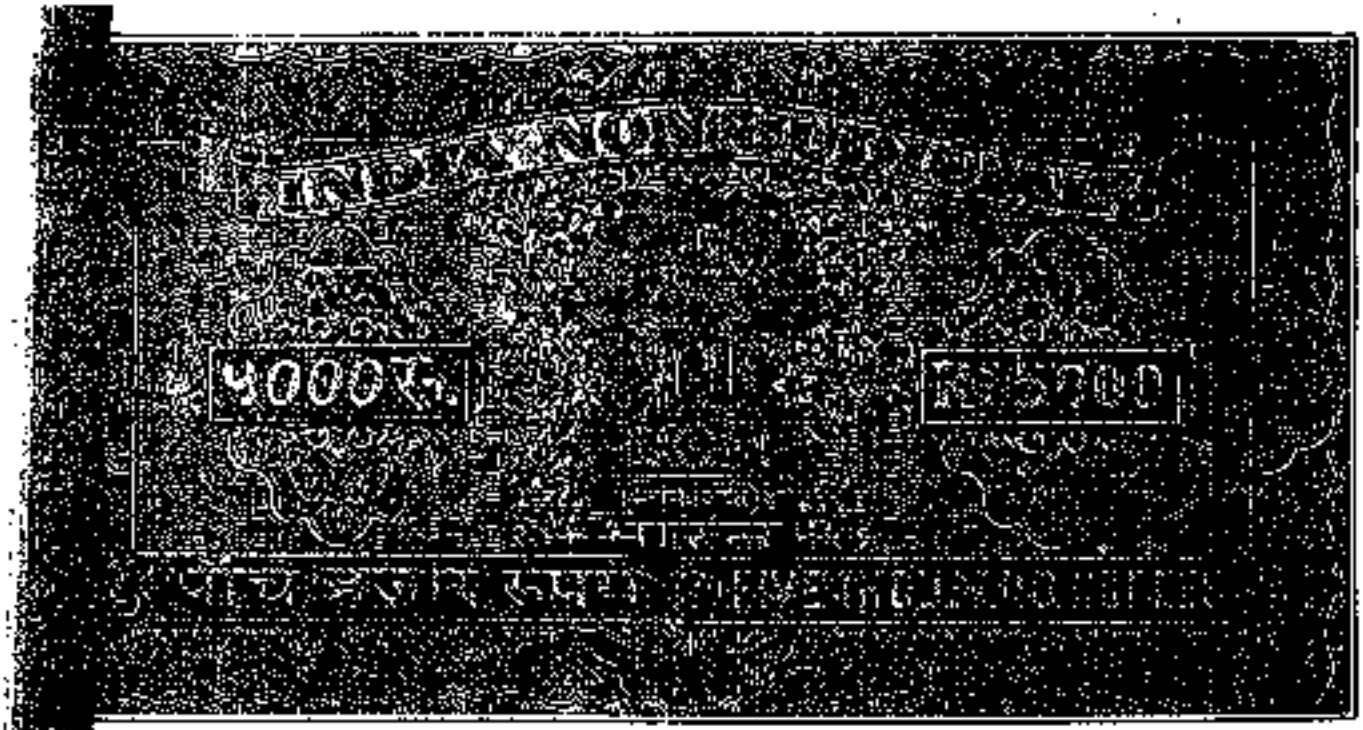

authorised by the Central or State Government under clauses (i), (j) or (l) of sub-rule (1) of rule 27 of said Rules, the State Government shall give notice in writing to the lessee/lessees requiring him/them to

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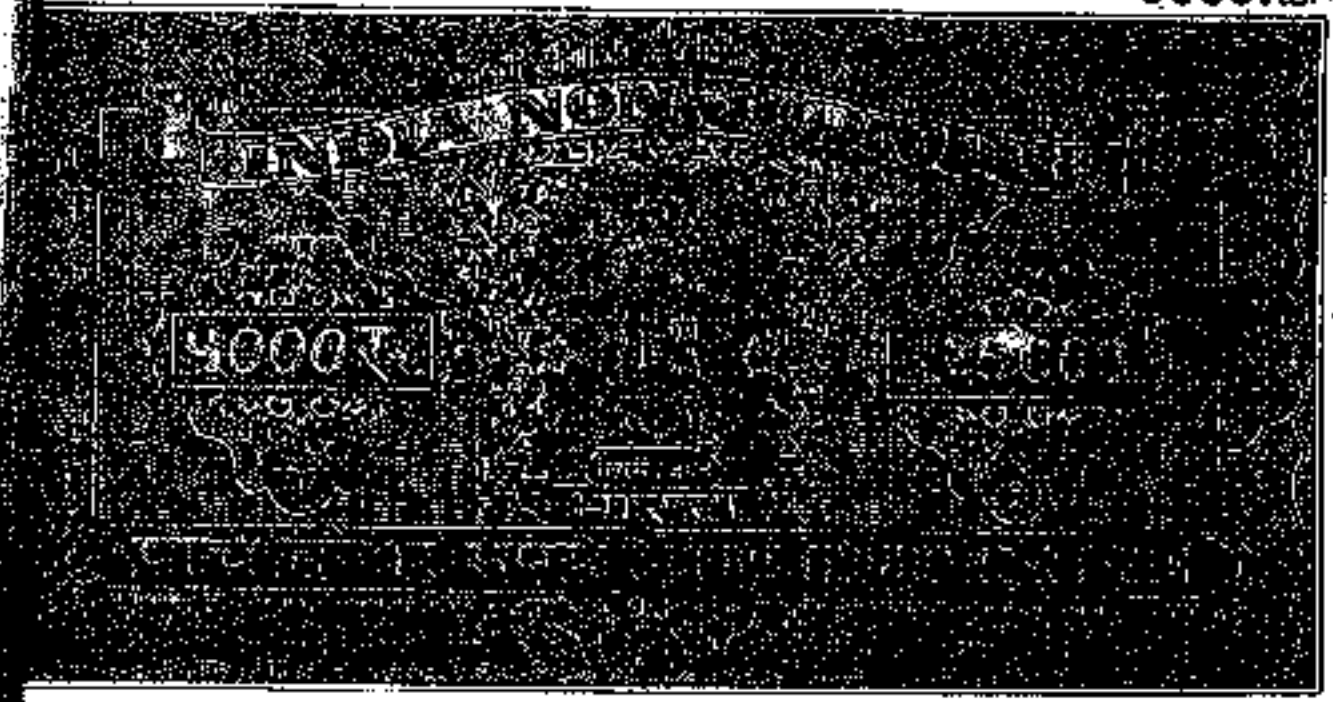

show cause within such time as may

be specified in the notice why the

lease should not be determined and

his/their security deposit forfeited;

and if the lessee/lessees fails/fail to

show cause within the aforesaid time

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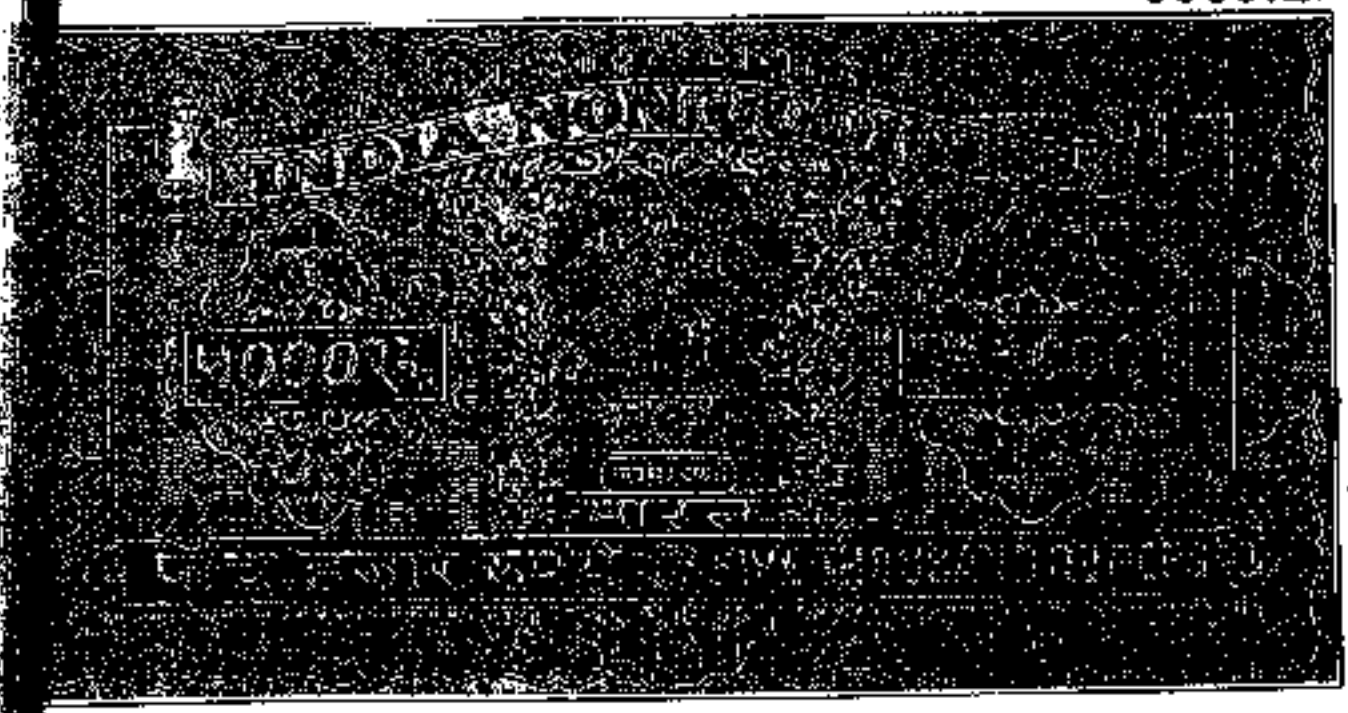

to the satisfaction of the State Government, the State Government may determine the lease and forfeit the whole or part of the security deposit.

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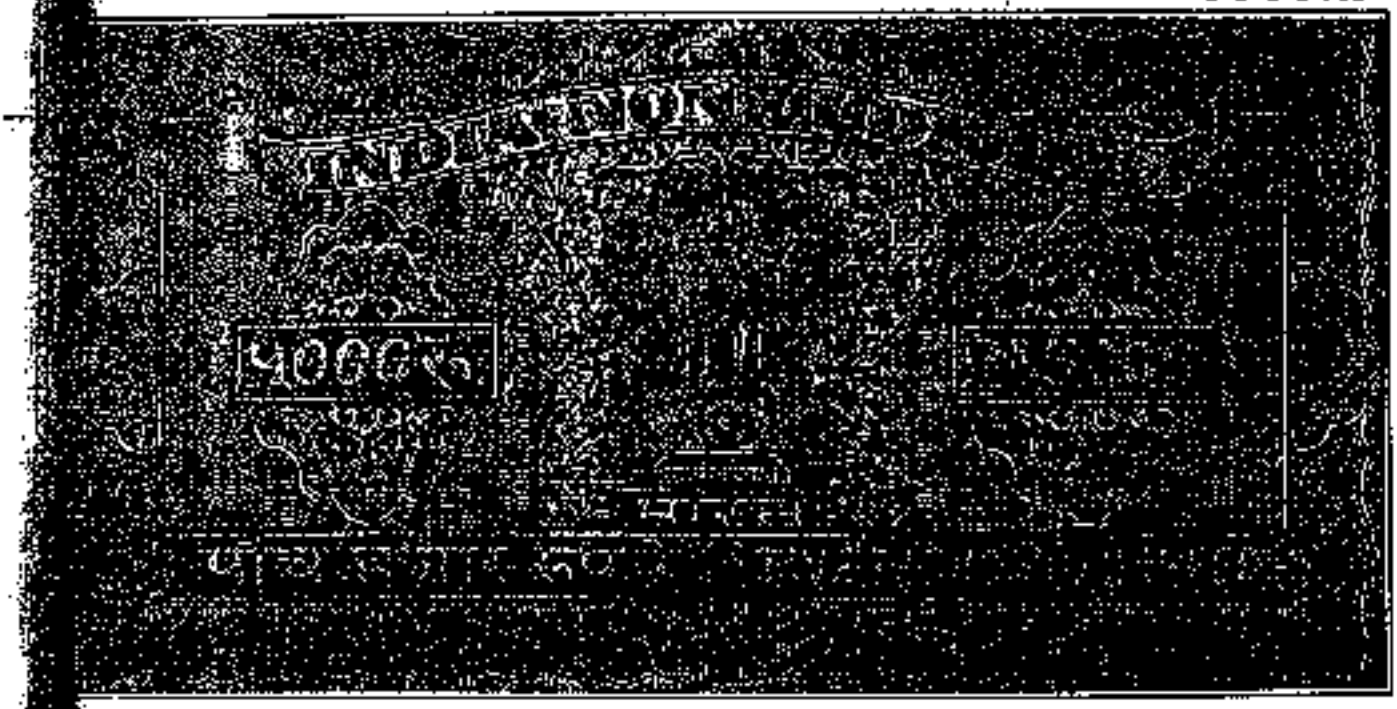

Penalty in case of default in payment of royalty and breach of covenants.

2. If the lessee/ lessees or his/ their transferee or assignee makes/make any default in payment of rent or water rate or royalty as required by section 9 of the Act or commits a breach of any of the conditions and

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...MITED OFFICER 'O' AREAS LTD.

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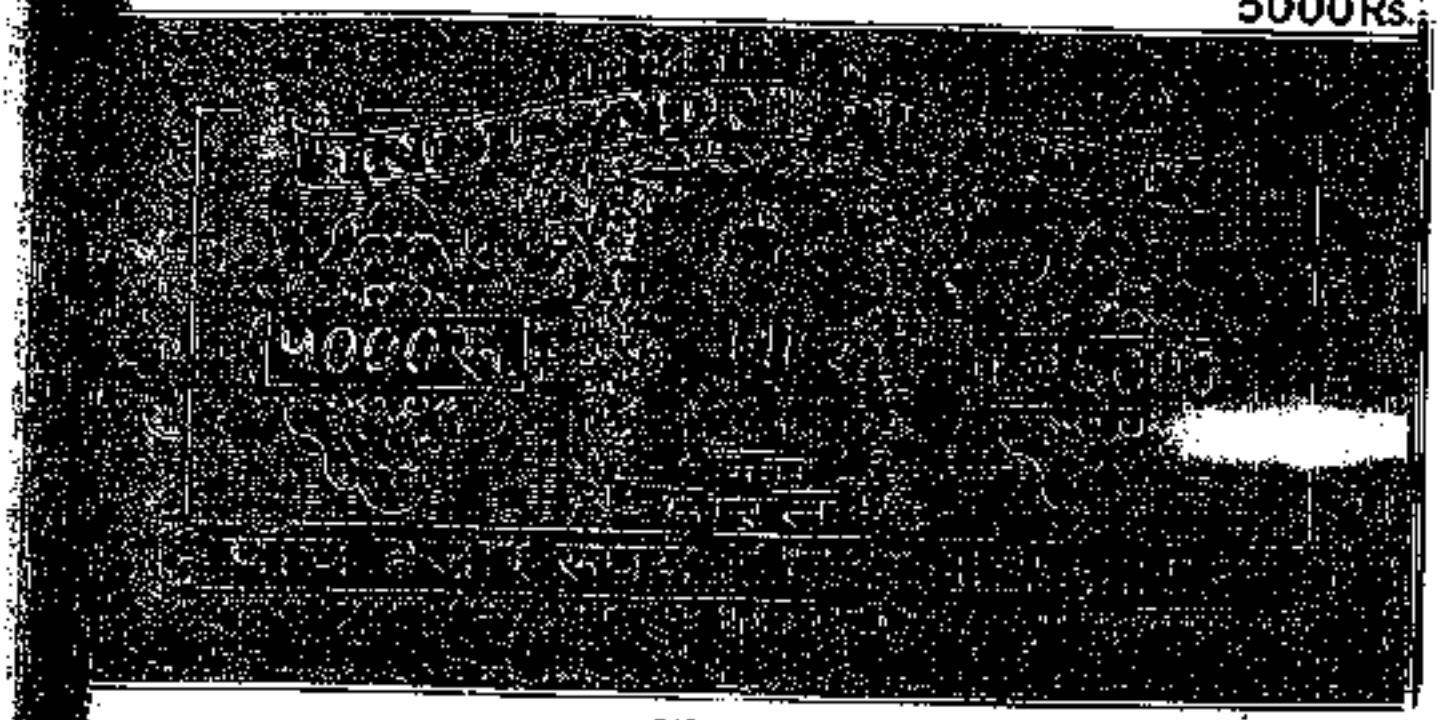

covenants other than those referred to in covenant (I) above, the State Government shall give notice to the lessee/lessees requiring him/them to pay the rent, water rate, royalty or remedy the breach, as the case may

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CONSTITUED ATTORNEY

COLLECTOR, JAIPUR

5000Rs.

be, within sixty days from the date of receipt of the notice and if the rent, water rate and royalty are not paid or the breach is not remedied within such period, the State Government may without prejudice to any

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HINDUSTAN ZINC SILVER & ALLOYS LTD.

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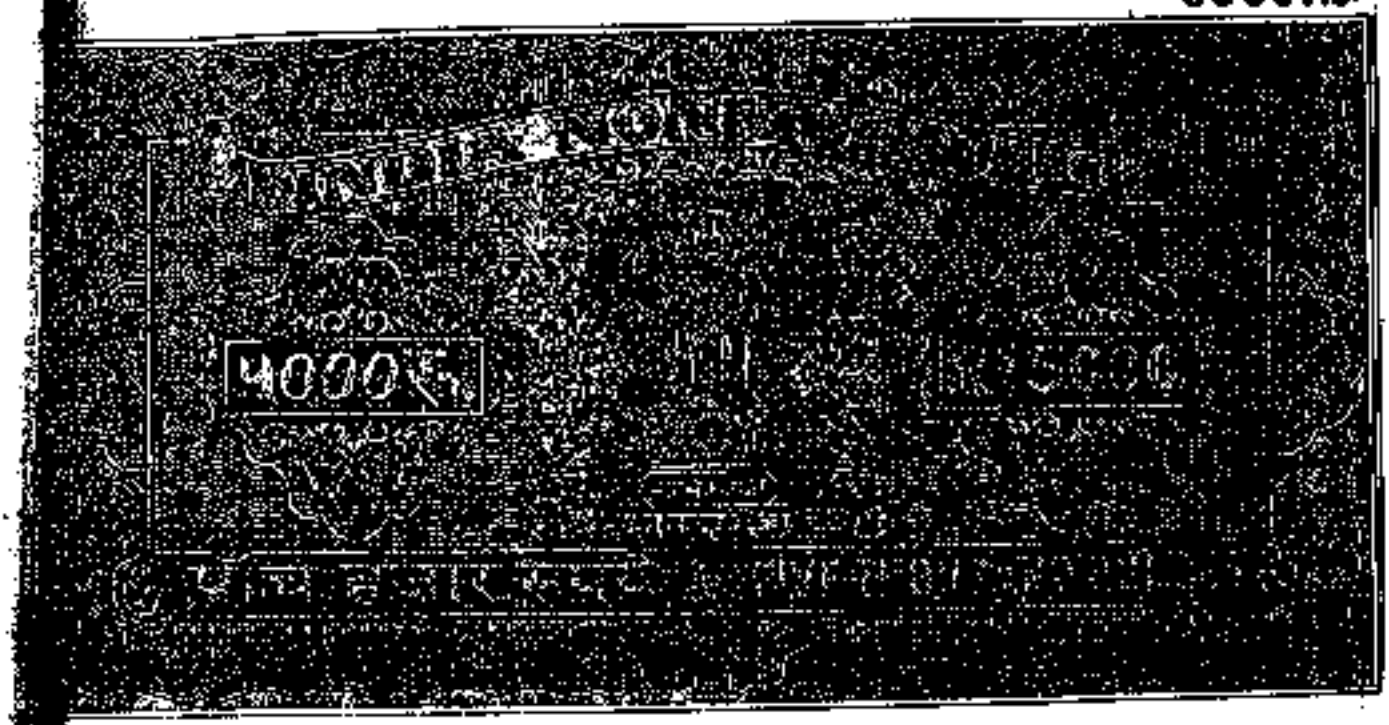

proceedings that may be taken against him/them, determine the lease and forfeit the whole or part of the security deposit.

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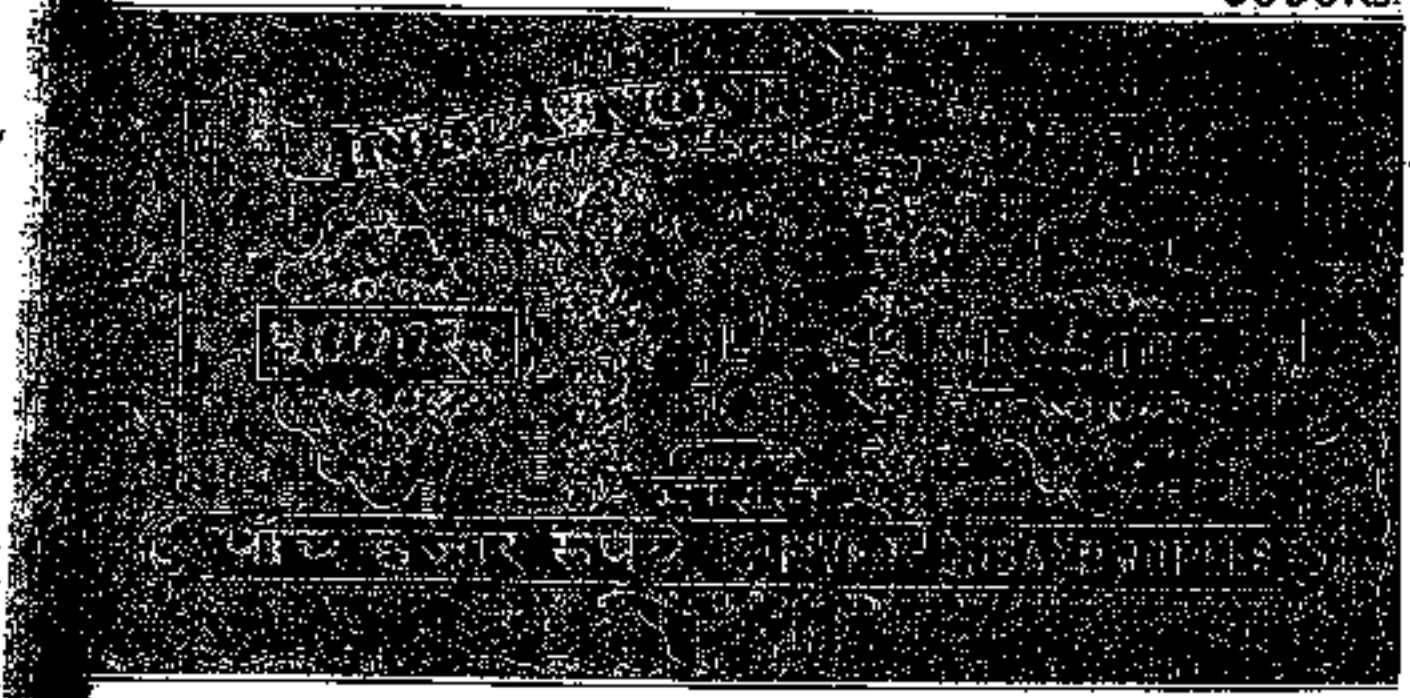

Penalty for repeated breaches of covenants.

3. In cases of repeated breaches of covenants and agreements by the lessee/lessees for which notice has been given by the State Government in accordance with clauses (1) and (2) aforementioned

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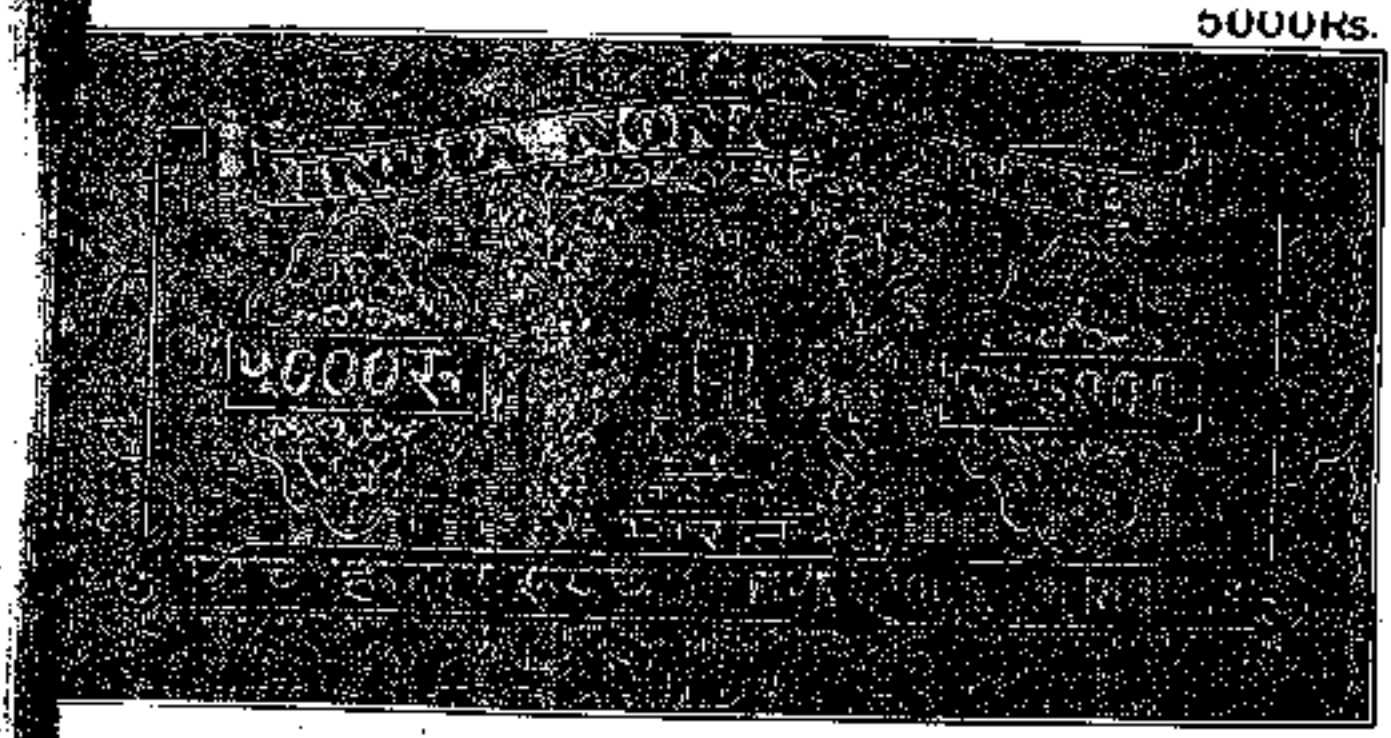
INDIAN METALS & FERRO ALLOYS LTD.

CONSTITUED ATTORNEY

COLLECTOR, JAIPUR

5000Rs.



on earlier occasion, the State Government without giving any further notice, may impose such penalty, not exceeding twice the amount of annual dead rent specified in clause 2, Part V.

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[illegible] METALS & FERRO ALLOYS LTD.

CONSTITUED ATTORNEY

COLLECTOR, [illegible]PUR

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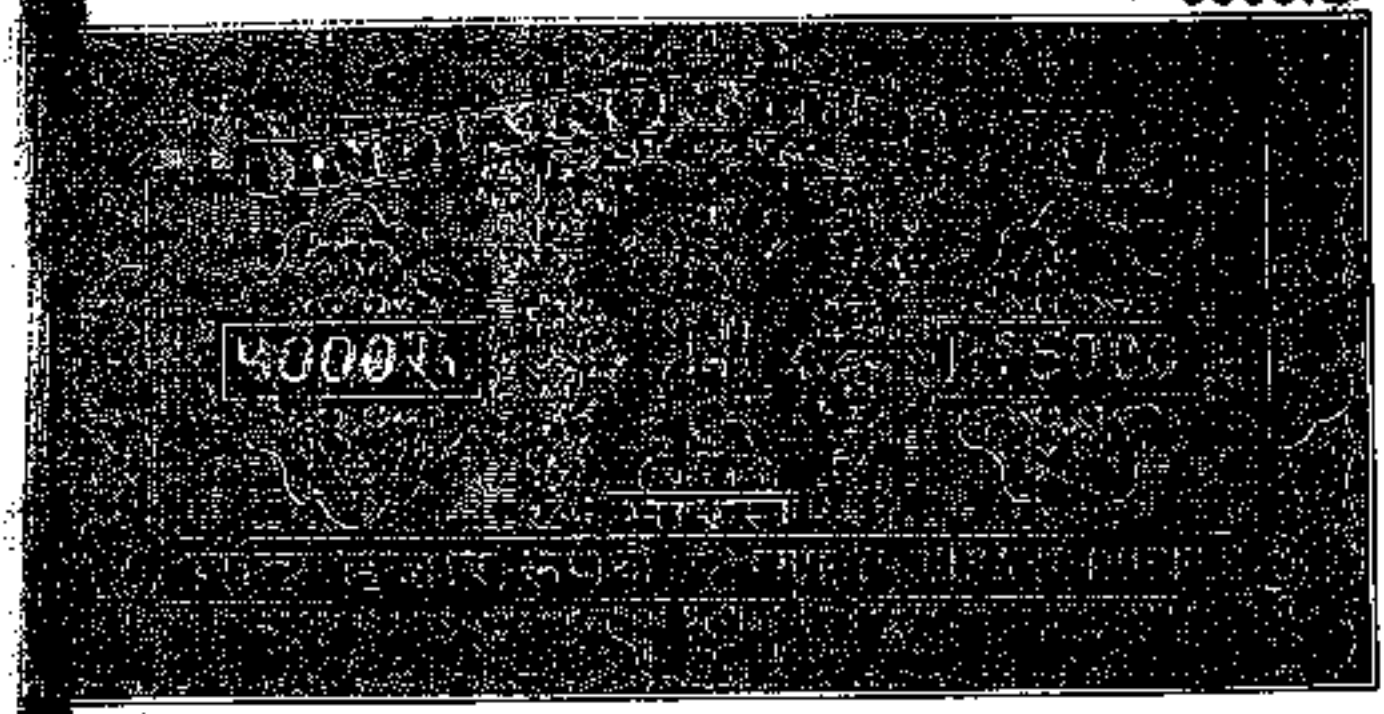


Failure to fulfil the terms of leases due to "Force Majeure"

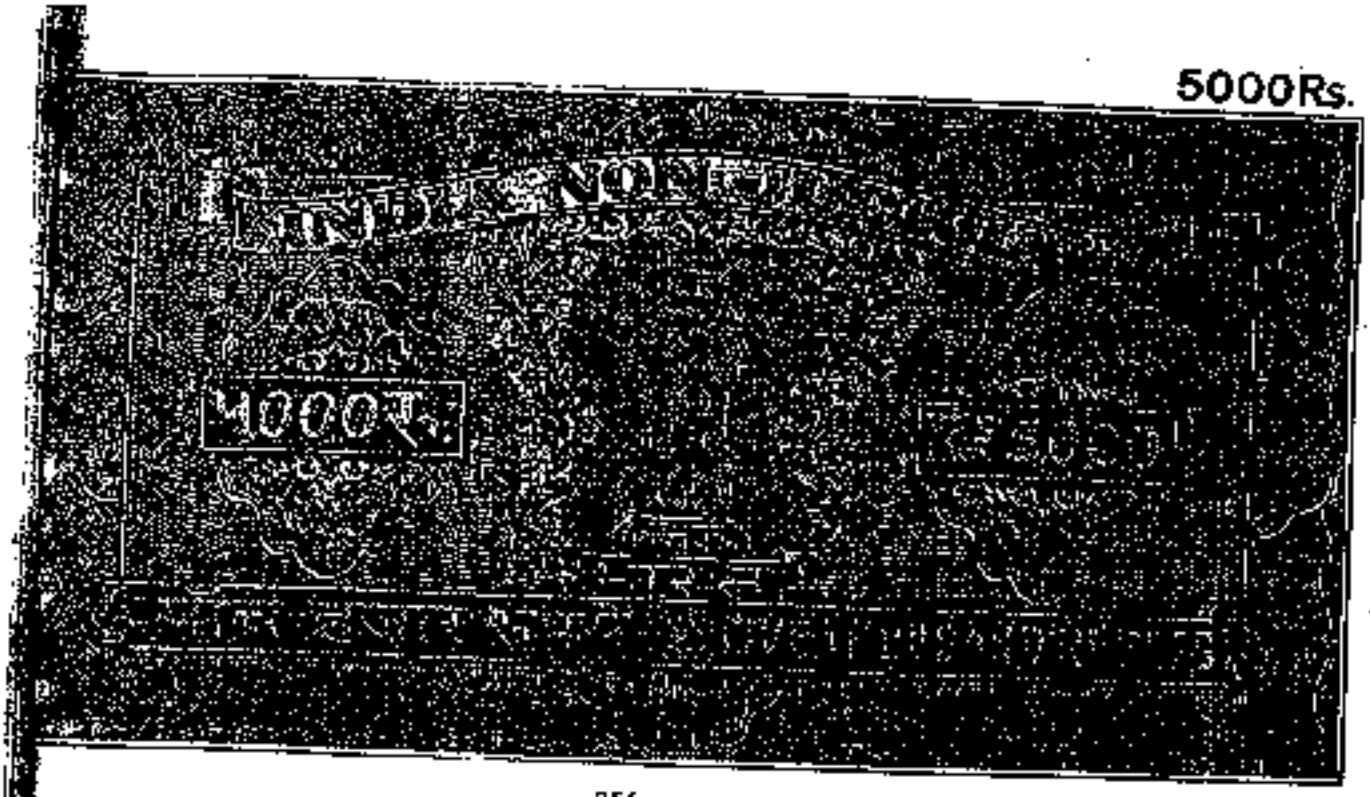
4. Failure on the part of the lessee/lessees to fulfil any of the terms and conditions of this lease shall not give the Central or State

Cont....

METALS & ALLOYS LTD.

CONSTITUTED ATTORNEY

COLLECTOR, JAIPUR



Government any claim against the lessee/lessees or be deemed a breach of this lease, in so far as such failure is considered by the said Government to arise from force majeure, and if through force

Cont....

INDIAN [illegible]

CONSTITUED ATTORNEY

COLLECTOR, JAIPUR

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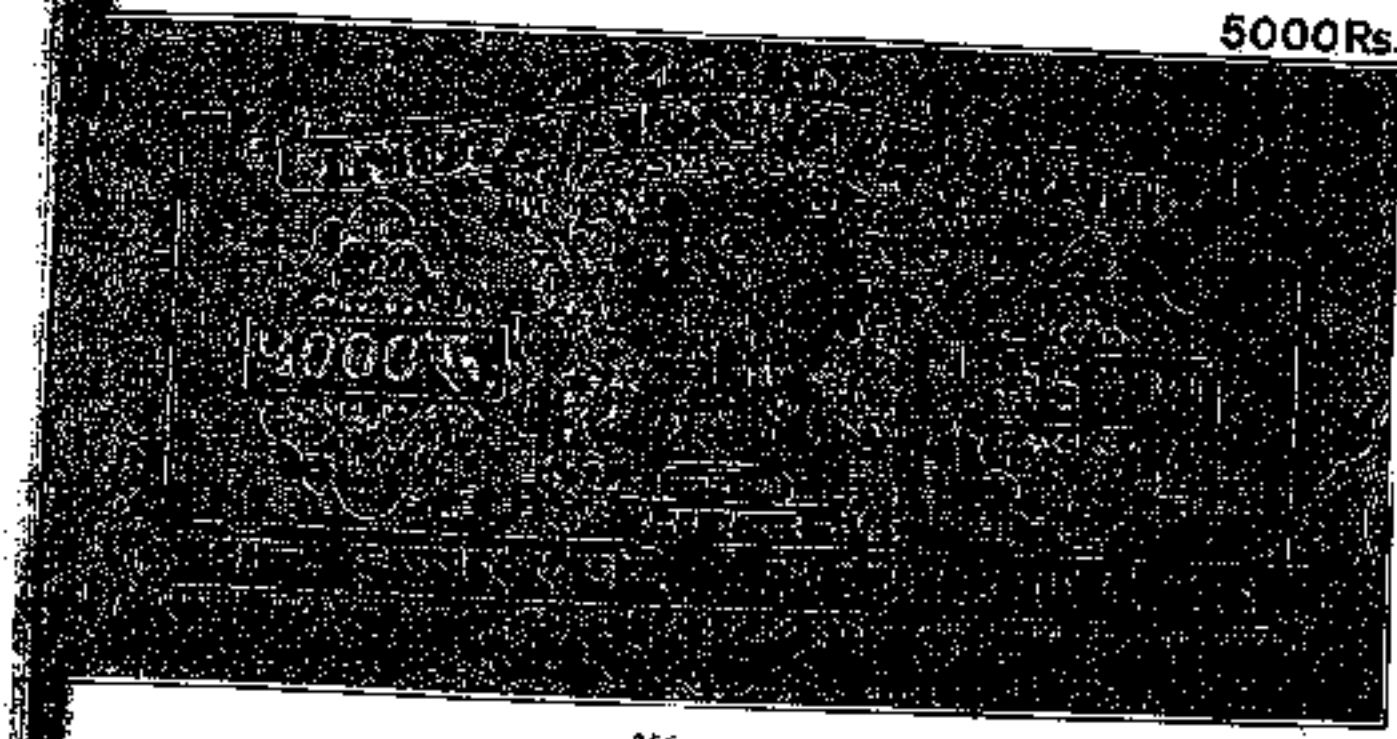


majeure the fulfilment by the lessee/lessees of any of the terms and conditions of this lease be delayed, the period of such delay shall be added to the period fixed by this lease. In this clause the expression

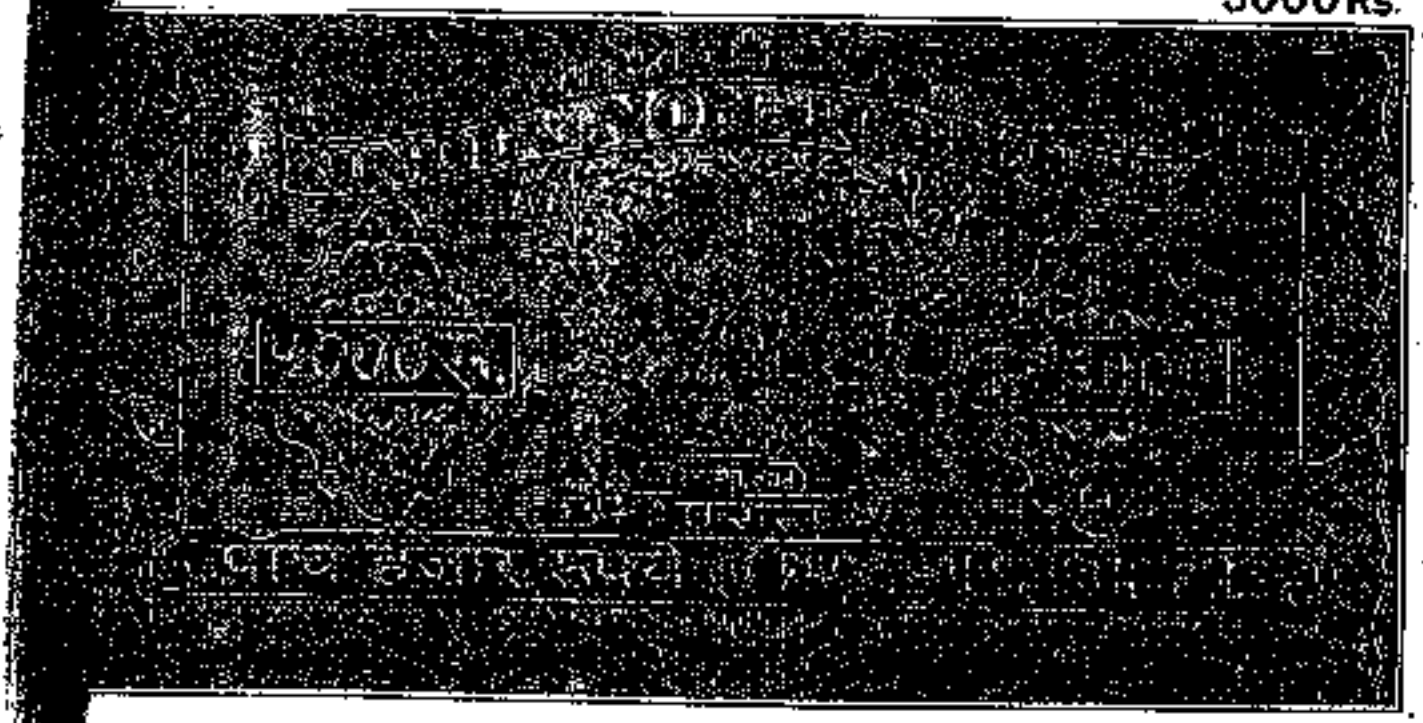
Cont....

BHARAT HOTELS & PER'O AGENCIES LTD.

CONSTITUTED ATTORNEY

COLLECTOR, JAIPUR

5000Rs.



"Force Majeure" means act of God, war, insurrection, riot, civil commotion, strike, earth quake, tide, storm, tidal wave, flood, lightning, explosion, fire, earthquake and any other happening which the

Cont....

CONSTITUED ATTORNEY

COLLECTOR, JAIPUR

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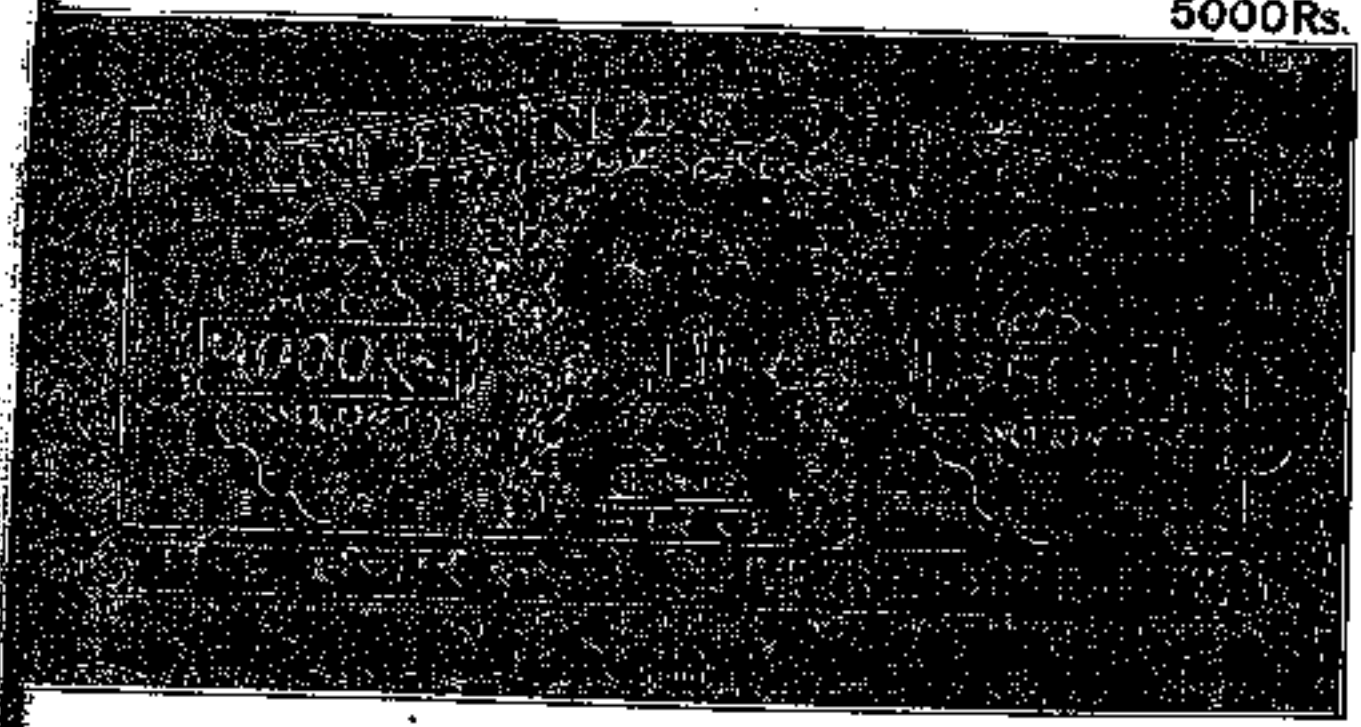


lessee/lessees could not reasonably

prevent or control.

Lessee/Lessees to remove his/their properties on the expiry of lease.

5. The lessee/lessees having first paid

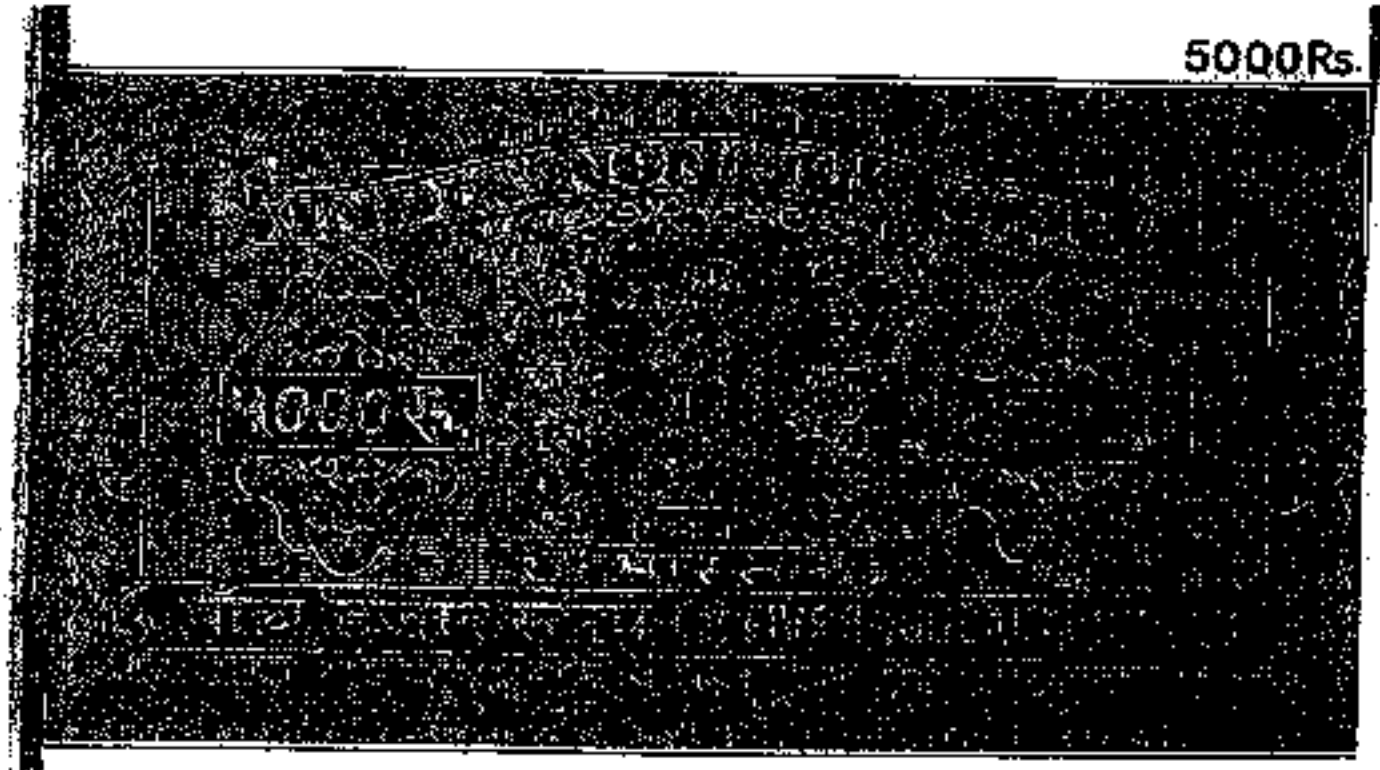
discharged rents, rates and royalties

Cont...

CONSTITUTED-ATTORNEY

COLLECTOR, JAIPUR

5000Rs.



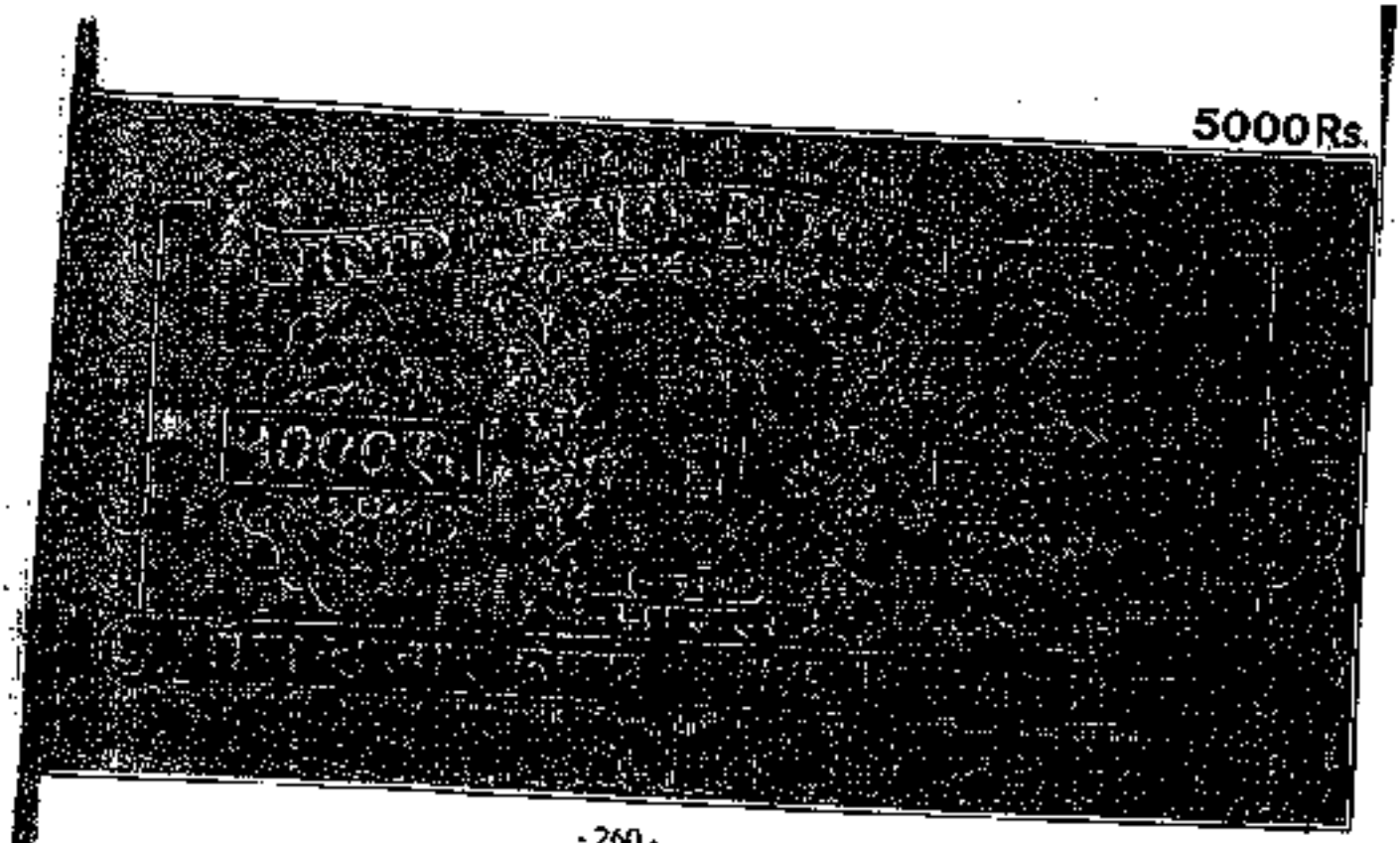
payable by virtue of these presents may at the expiration or sooner determination of the said term or within six calendar months thereafter (unless the lease shall be determined under clauses 1 and 2 of

Cont....

HINDUSTAN ZINC LTD.

CONSTITUTED ATTORNEY

COLLECTOR, JAIPUR

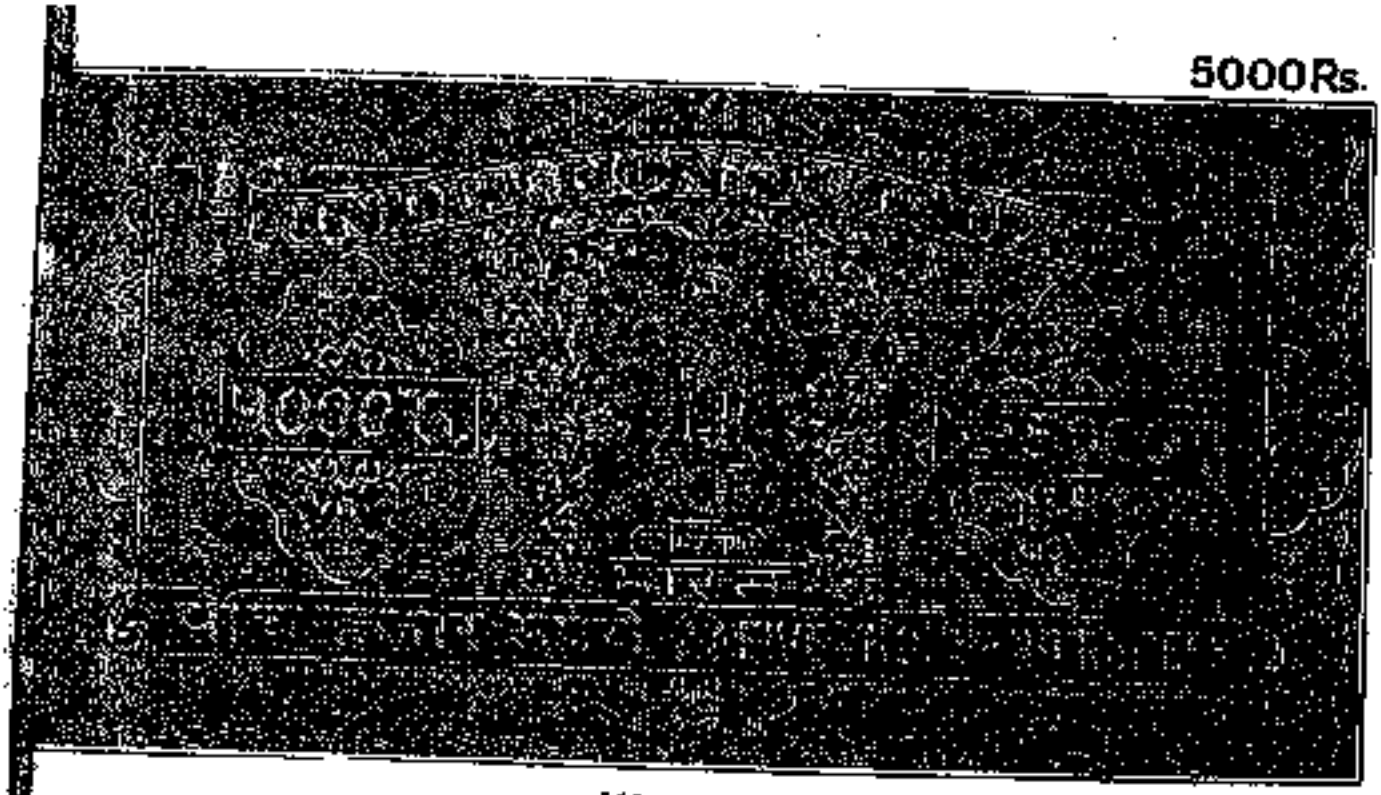


this Part and in that case at any time not less than three calendar months nor more than six calendar months after such determination) take, down and remove for his/their own benefit all or any engines,

Cont....

CONSTITUED ATTORNEY

COLLECTOR, JAIPUR



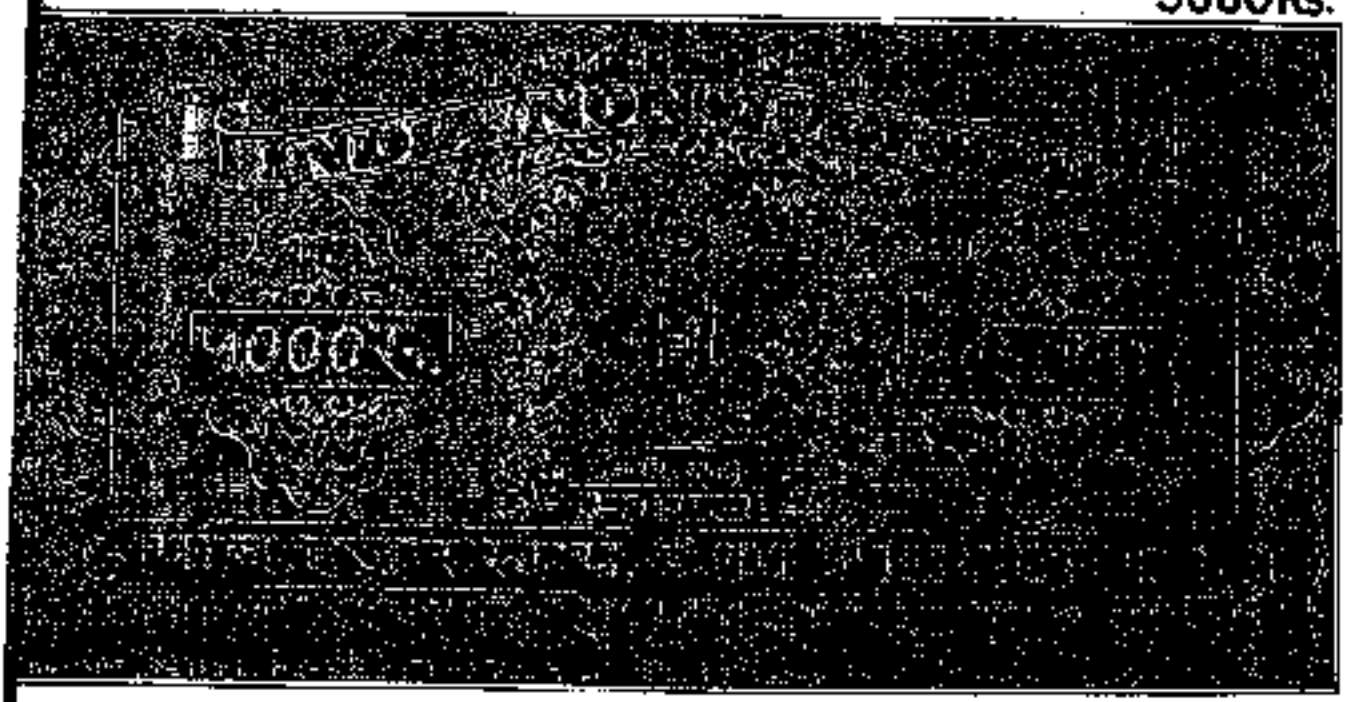
machinery, plant, buildings structures, tramways, railways and other works, erections and conveniences which may have been erected, set up or placed by the lessee/lessees in or upon the said

Cont...

COLLECTOR, JAIPUR

CONSTITUED ATTORNEY

5000Rs.



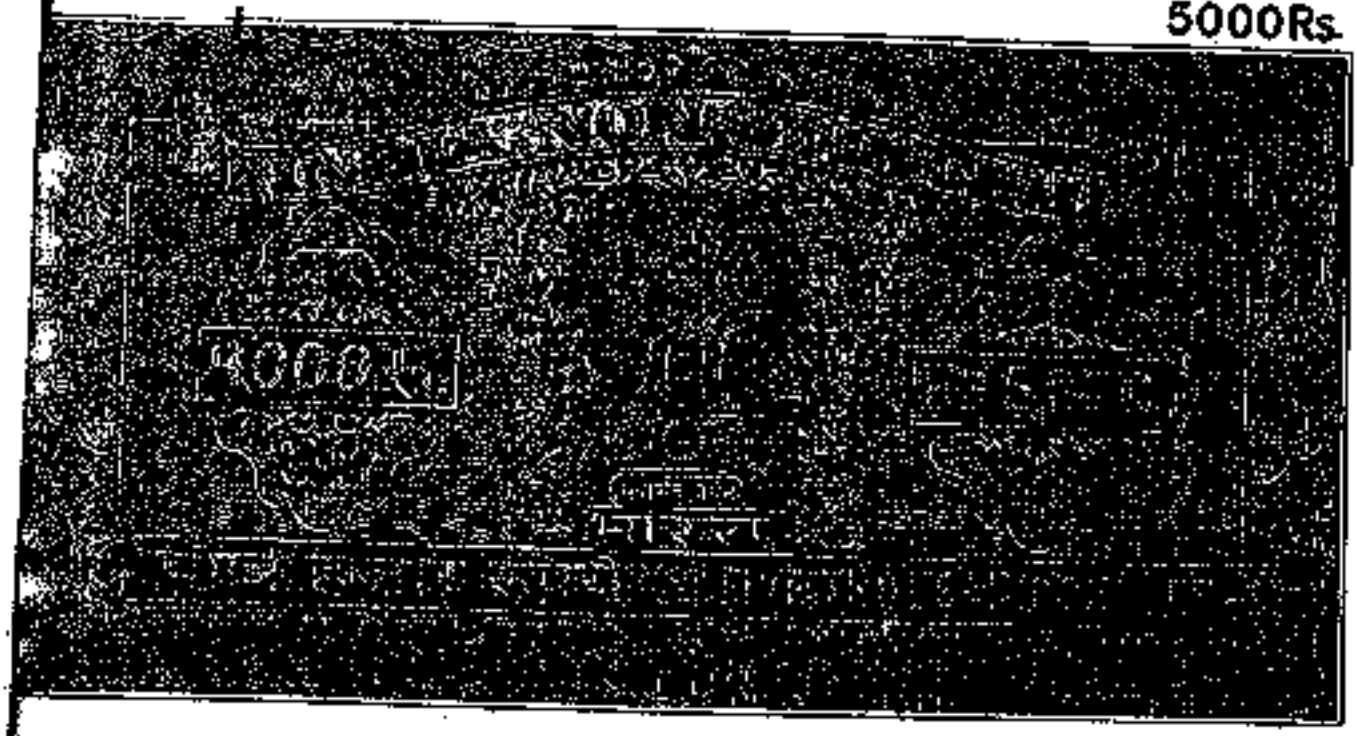
lands and which the lessee/lessees is/are not bound to deliver to the State Government under clause 20 of Part VII of this Schedule and which the State Government shall not desire to purchase.

Cont....

(CONSTITUTED ATTORNEY)

COLLECTOR, JAIPUR

5000Rs.



Forfeiture of property left more than six months after determination of lease.

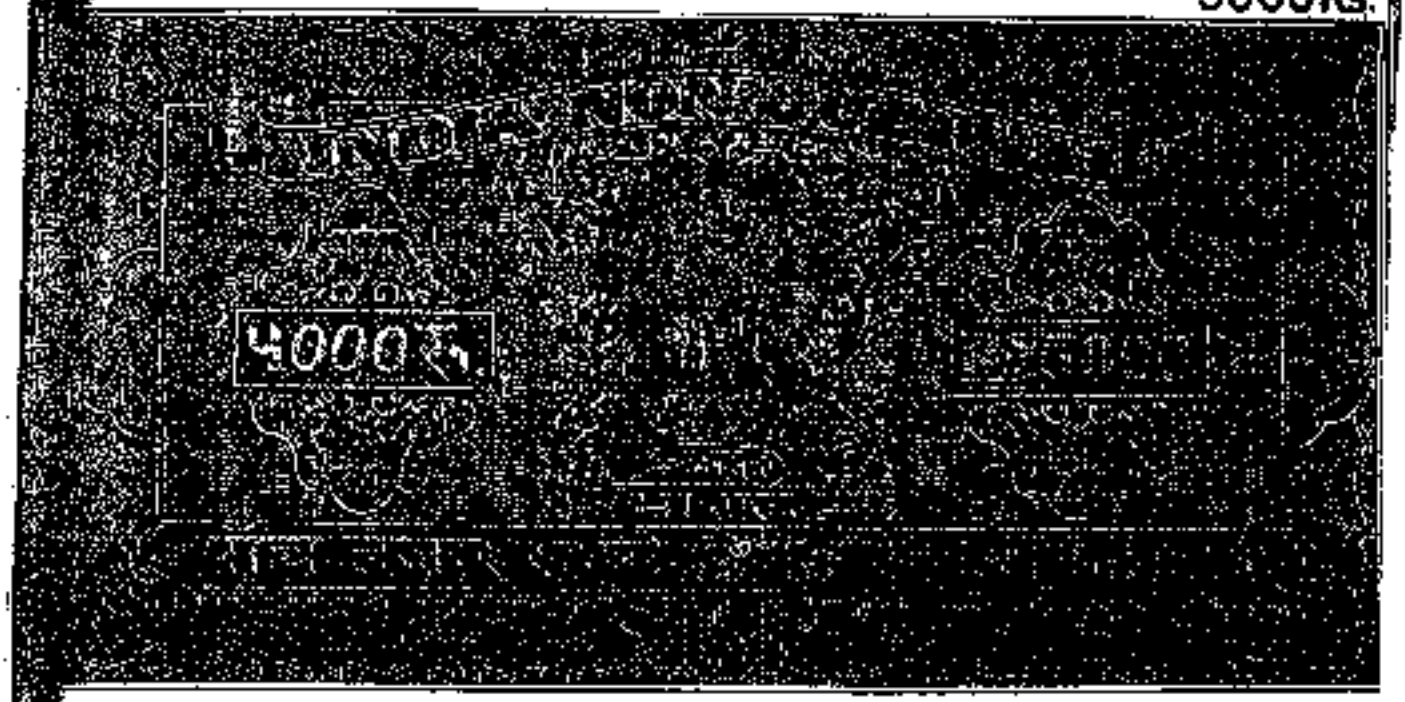
6. If at the end of six calendar months after the expiration or sooner determination of the said term under

Cont....

CONSTITUED ATTORNEY

COLLECTOR, JAIPUR

5000Rs.



the provision contained in clause 4 of Part VIII of this Schedule become effective there shall remain in or upon the said land any engines, machinery, plant, buildings structures, tramways, railways and other

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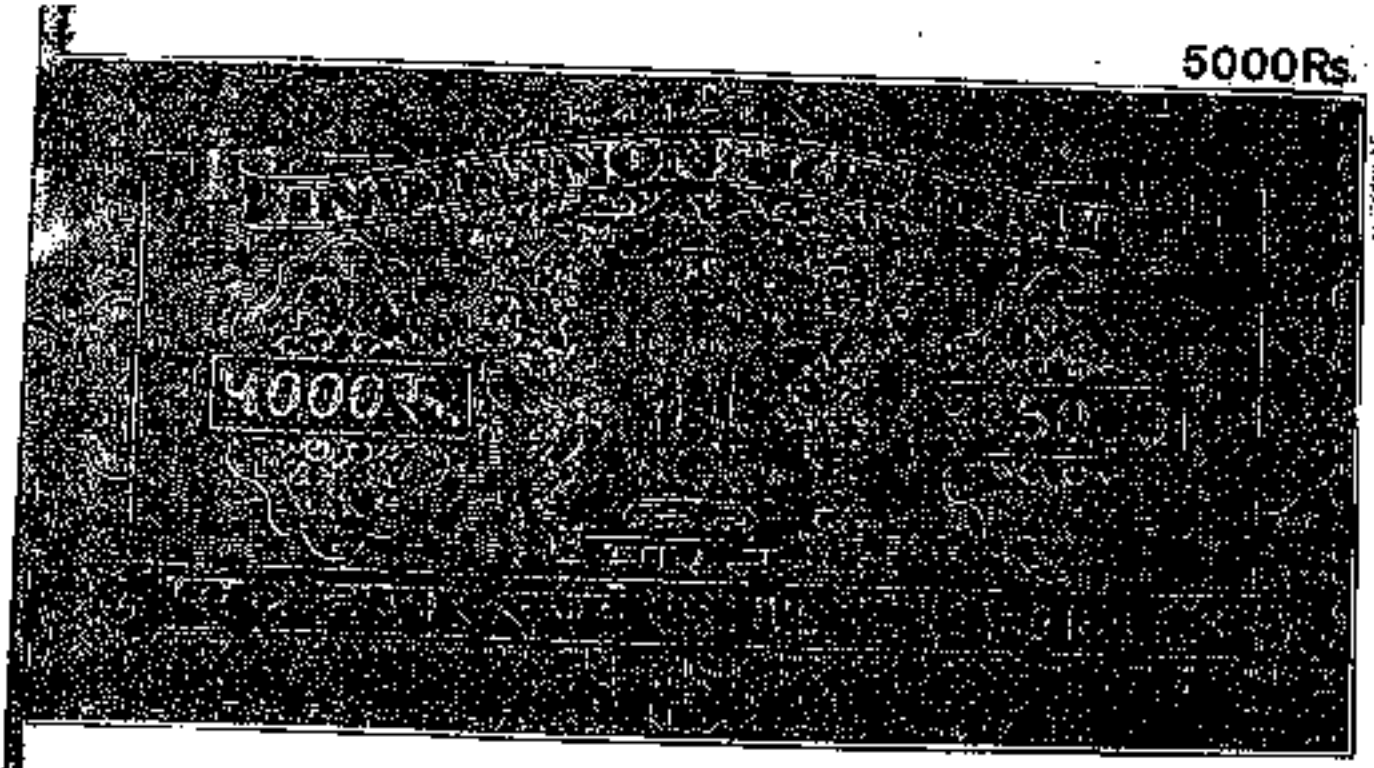
CONSTITUTED ATTORNEY

COLLECTOR, JAIPUR



mining lease the same shall if not be removed by the lessee/lessees within one calendar month after notice in writing requiring their removal has been given to lessee/lessees by the State Government be

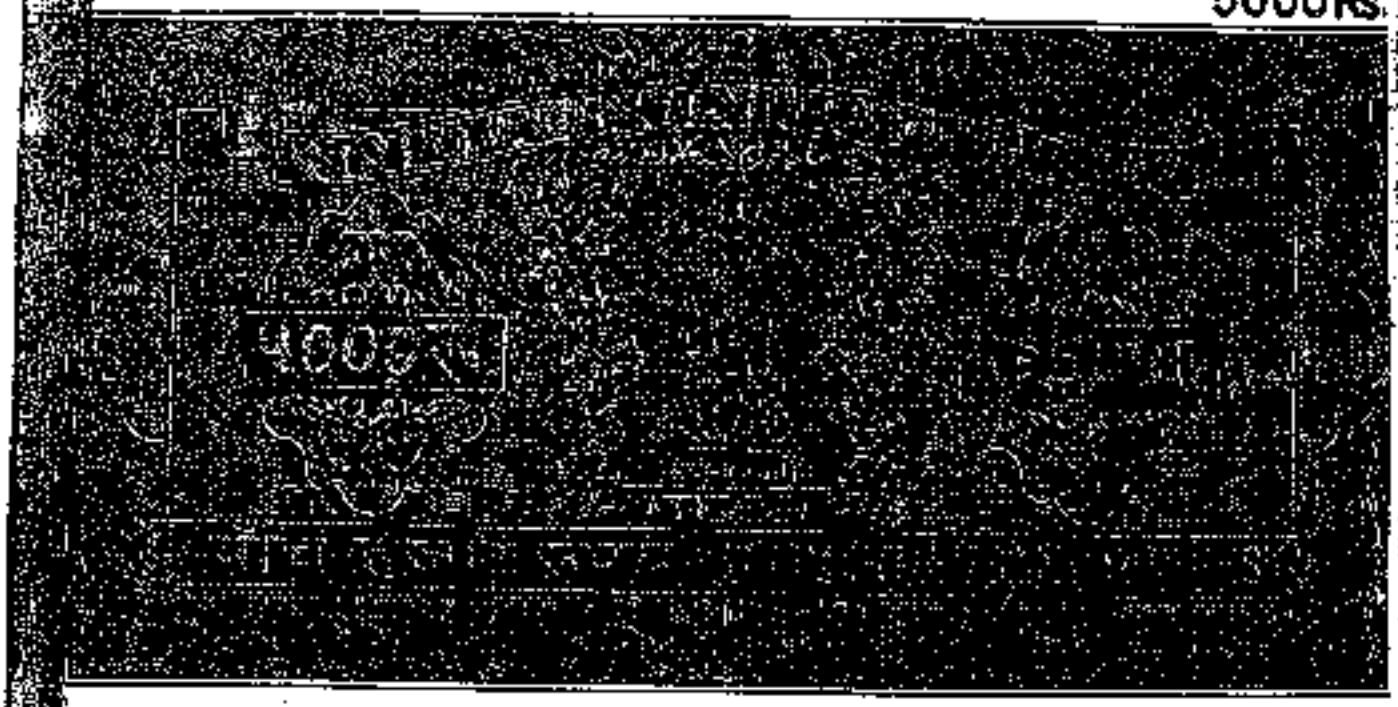
Cont...

For BHORUKA METALS & FERRO ALLOYS LTD.

CONSTITUED ATTORNEY

COLLECTOR, JAIPUR

5000Rs.



deemed to become the property of the State Government and may be sold or disposed of in such manner as the State Government shall deem fit without liability to pay any compensation or to

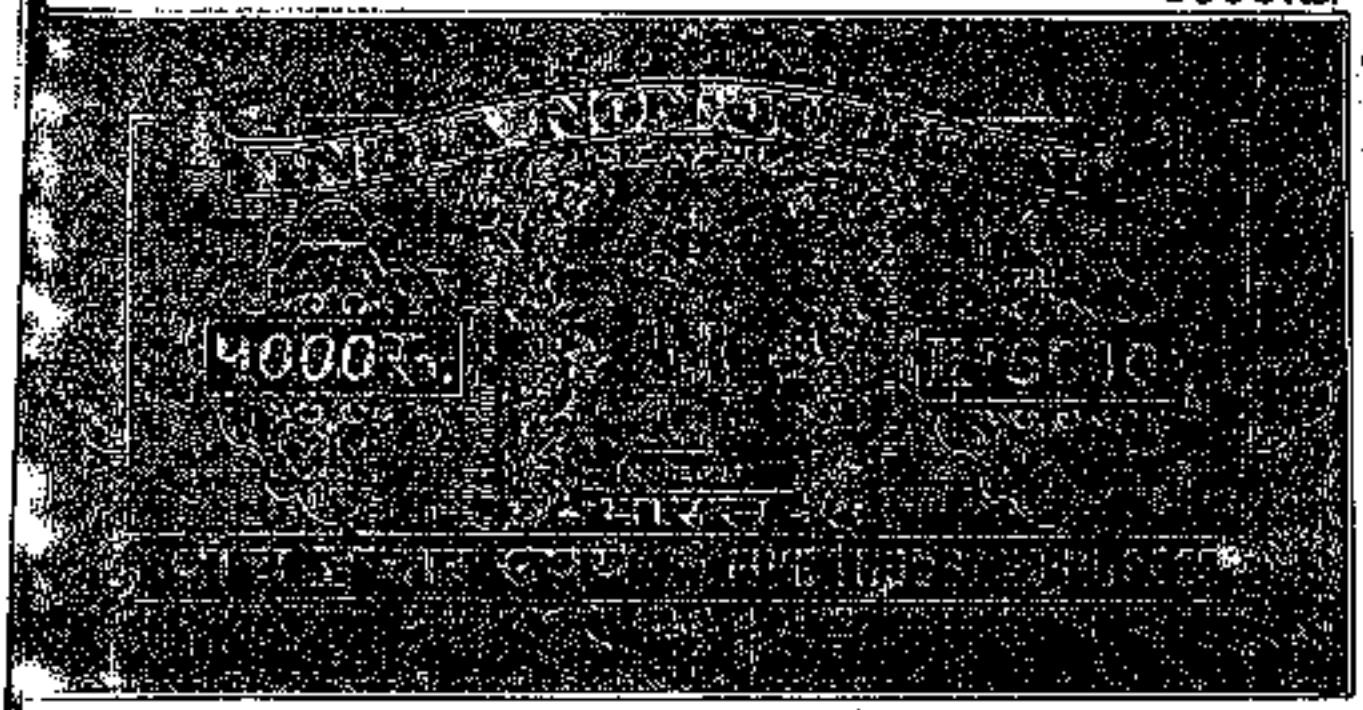
Cont...

For INDIAN METALS & FERRO ALLOYS LTD.

CONSTITUED ATTORNEY

COLLECTOR, JAIPUR

5000Rs.



account to the lessee/lessees in respect

thereof.

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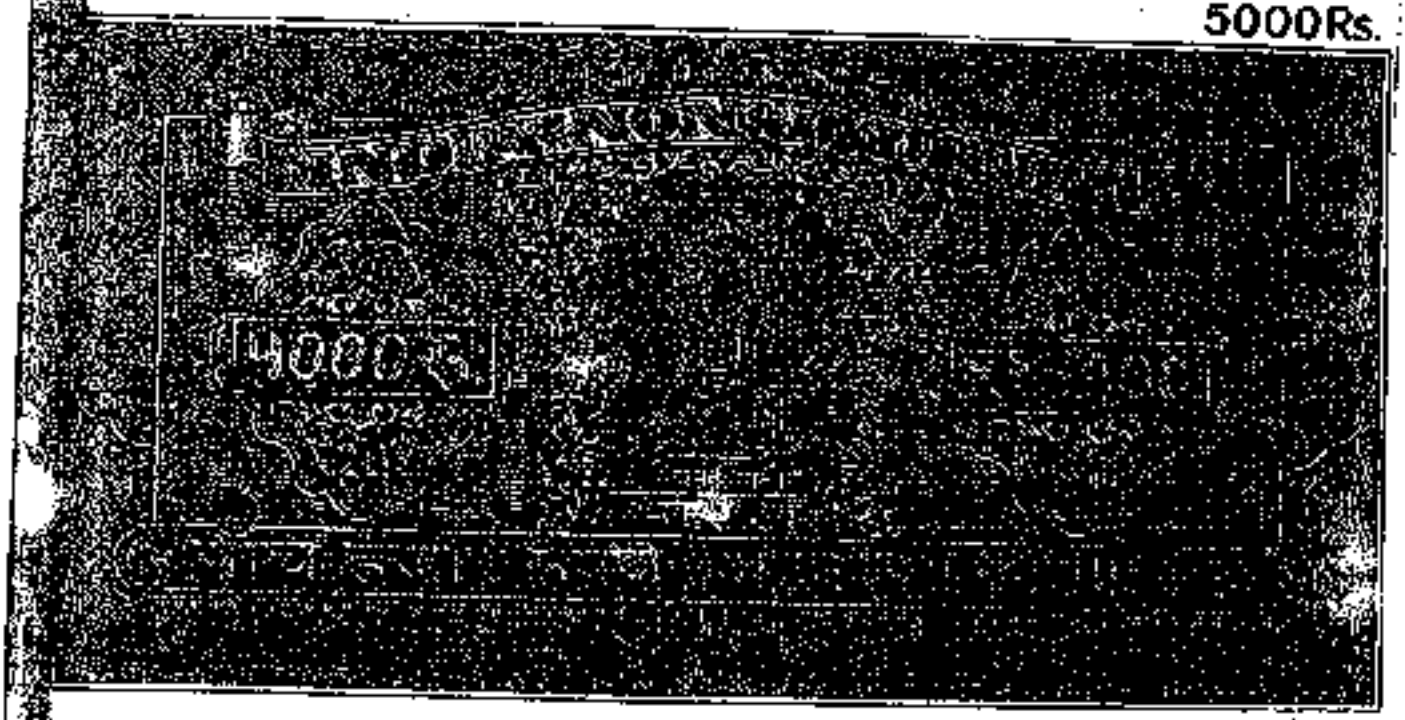
BHARAT METALS & FERRO ALLOYS LTD.

CONSTITUTED ATTORNEY

COLLECTOR, JAIPUR

5000Rs.



7. Every notice by these presents required to be given to the lessee/lessees shall be given in writing to such person resident on the said lands as the lessee/lessees

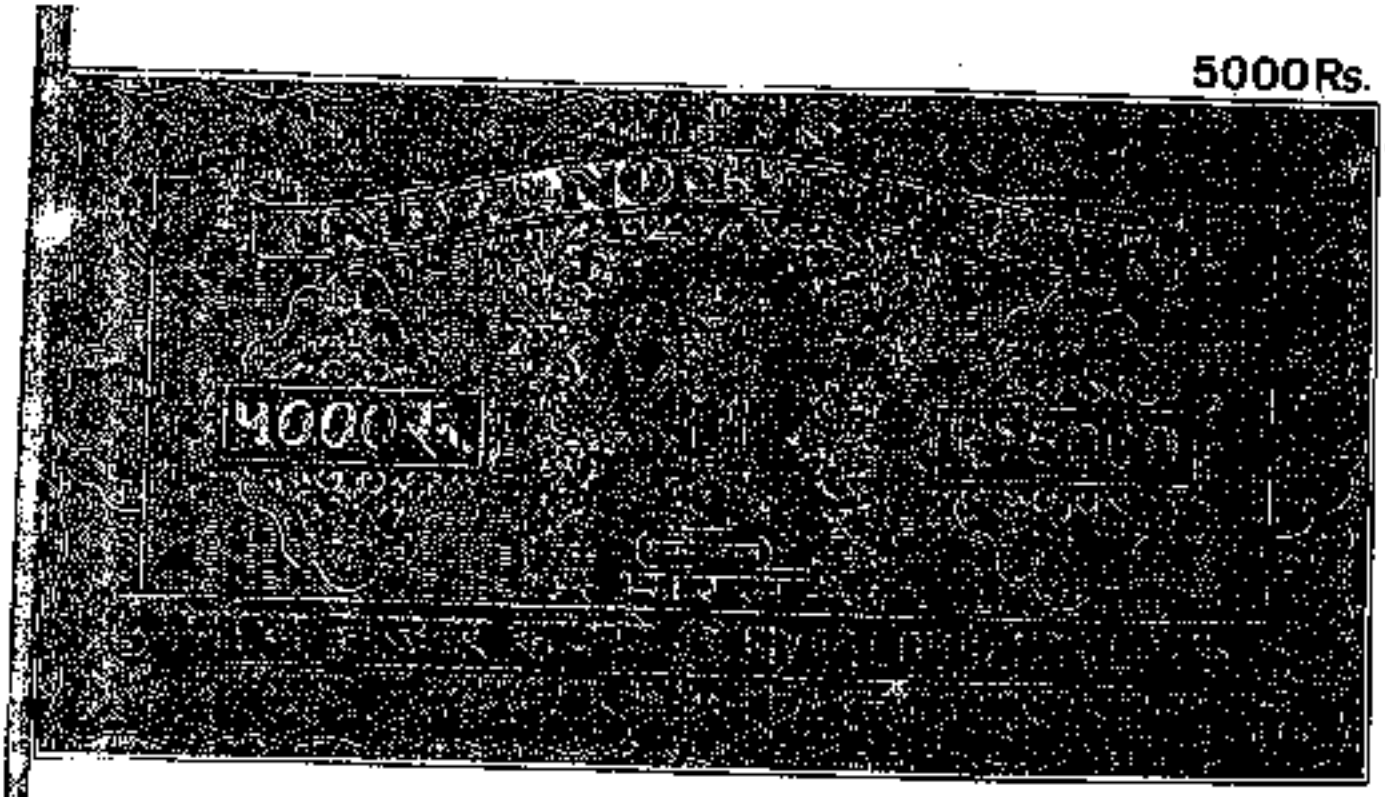
Notices.

Cont....

FOR INDIAN METALS & FERRO ALLOYS LTD.

CONSTITUED ATTORNEY

COLLECTOR, JAIPUR



may appoint for the purpose of

receiving such notices and if there

shall have been no such appointment

then every such notice shall be sent

to the lessee/lessees by registered

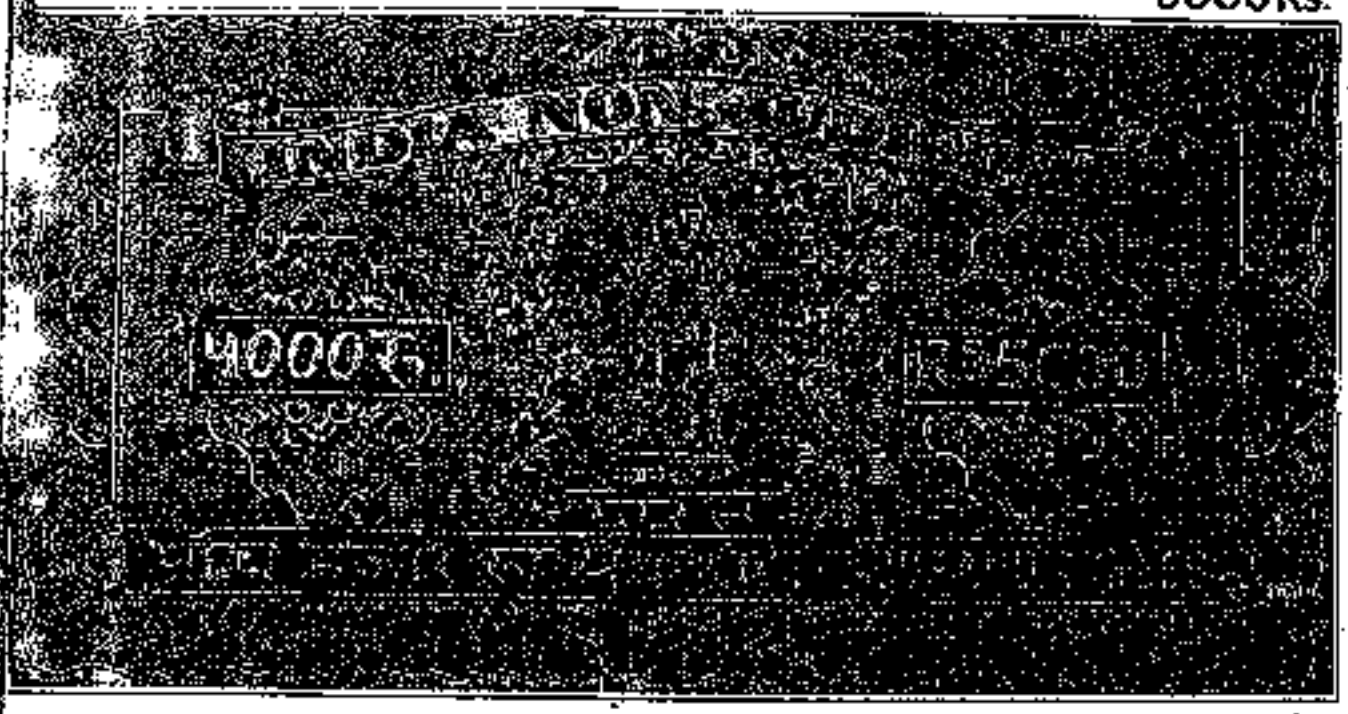
Cont....

For RHOTAS METALS & FERRO ALLOYS (P) LTD.

CONSTITUED ATTORNEY

COLLECTOR, JAIPUR

5000Rs.



post addressed to the lessee/lessees

at the address recorded in this lease

or at such other address in India as

the lessee/lessees may from time to

time in writing to the State

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CONSTITUED ATTORNEY

COLLECTOR, JAIPUR

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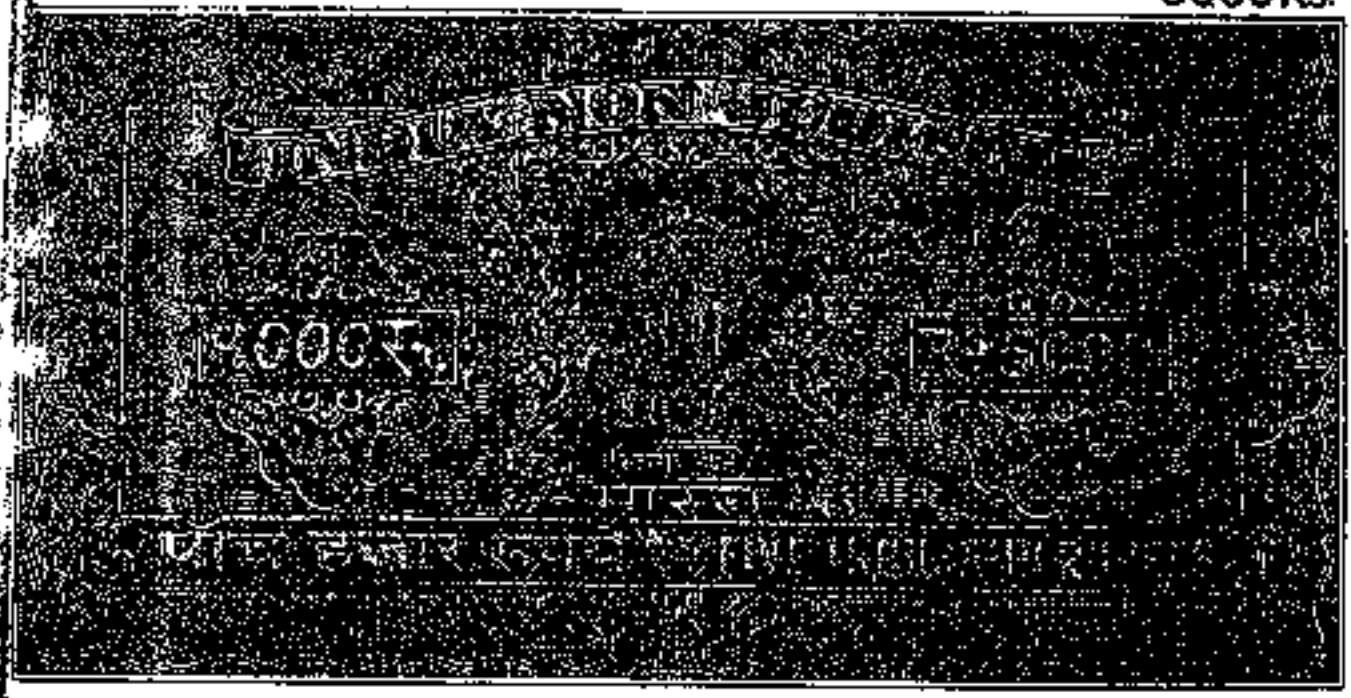

Government designate for the receipt of notices and every such service shall be deemed to be proper and valid service upon the lessee/lessees

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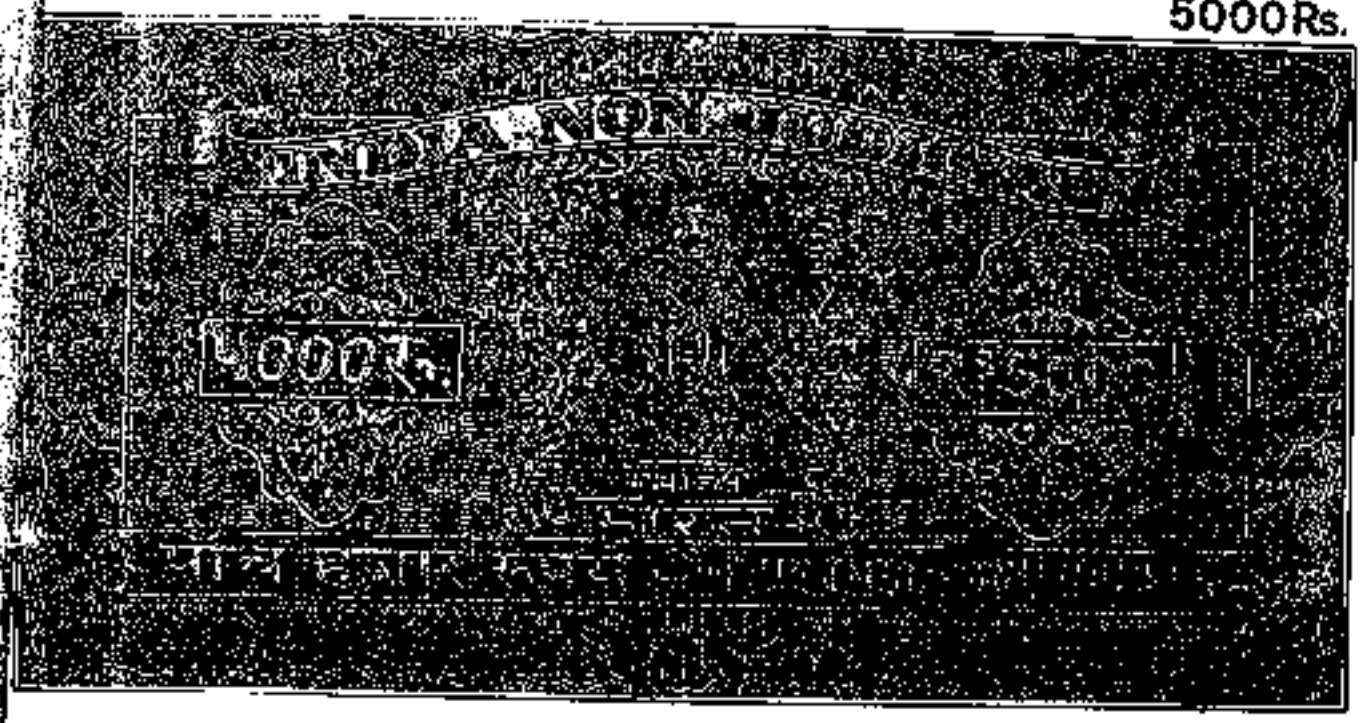
CONSTITUED ATTORNEY

COLLECTOR, JAIPUR

5000Rs.



and shall not be questioned, or challenged by him/ them.

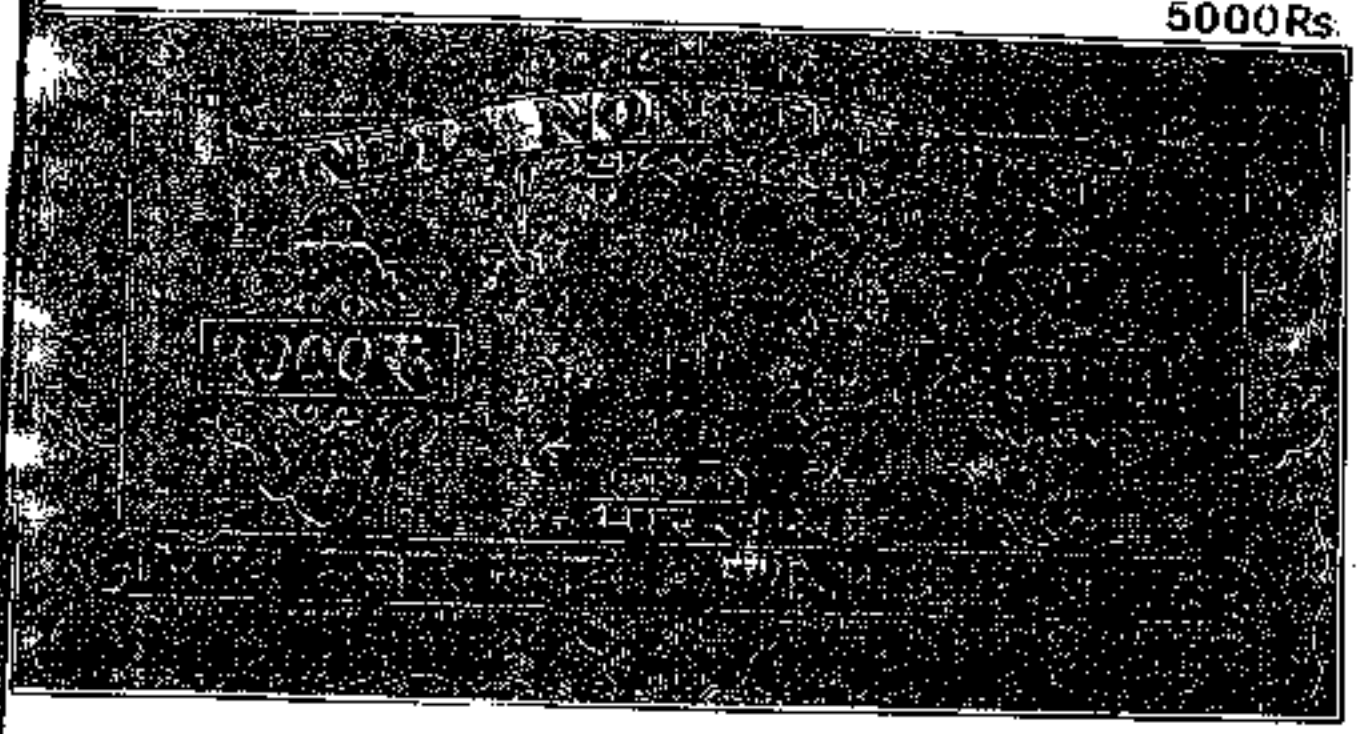
8. If in any event the orders of the State Government are revised, reviewed or cancelled by the Central Government

Immunity of State Government from liability to pay compensation.

Cont....

CONSTITUED ATTORNEY

COLLECTOR, JAIPUR



in pursuance of proceedings under Chapter VII of the Mineral Concession Rules, 1960, the lessee/ lessees shall not be entitled to compensation for any loss sustained

Cont....

CONSTITUED ATTORNEY

COLLECTOR, JAIPUR

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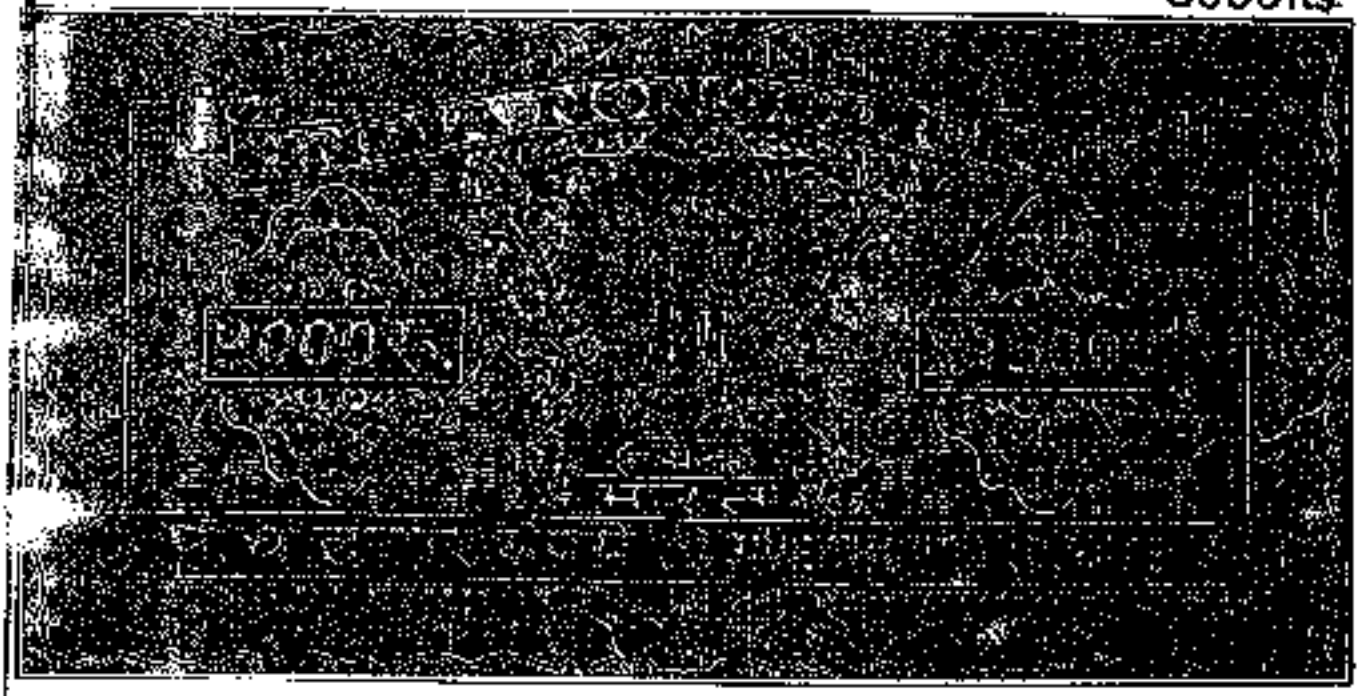

by the lessee/lessees in exercise of the powers and privileges conferred upon him/them by these presents.

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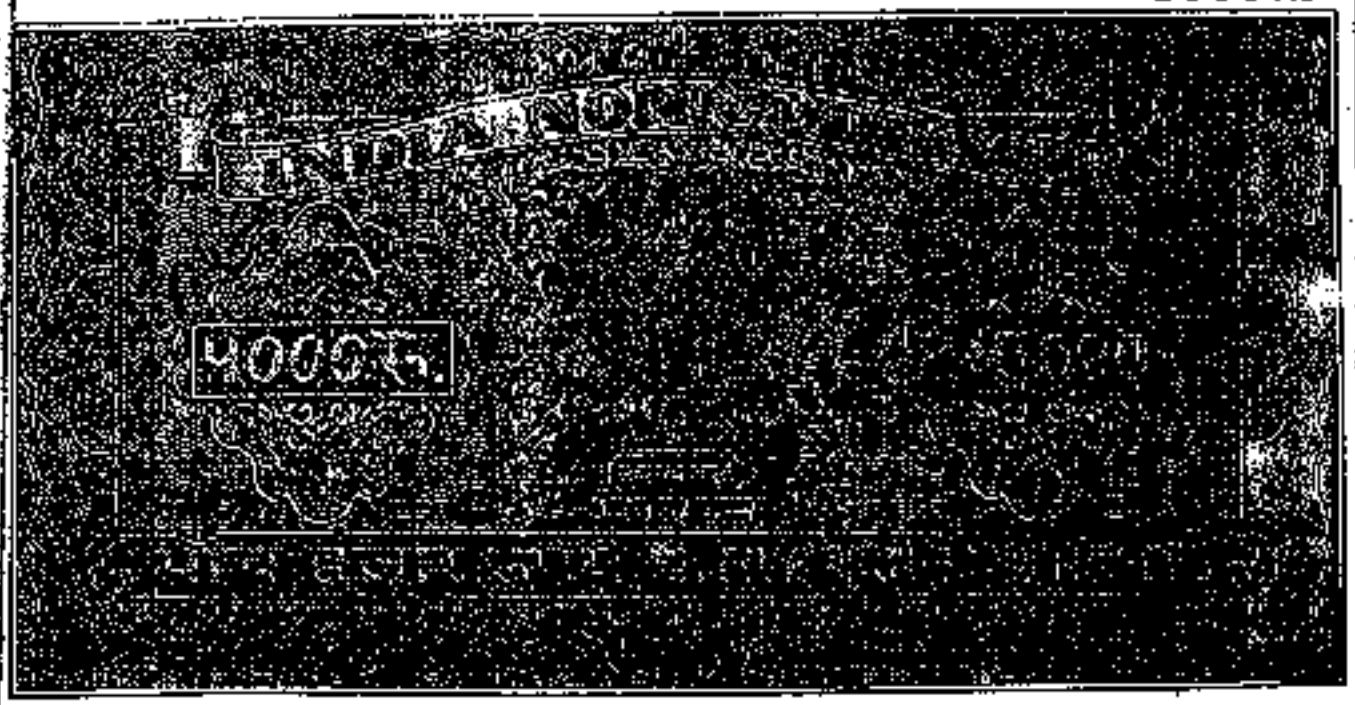
CONSTITUTED ATTORNEY

COLLECTOR, JAIPUR

5000Rs.



9. For the purpose of stamp duty the anticipated royalty from the demised land is Rs.1,09,10,700/- (Rupees One Crore Nine Lakhs Ten

Cont....

For MODAK MATTALS PVT. LTD.

CONSTITUTED ATTORNEY

COLLECTOR, JAIPUR

Thousands and Seven Hundreds

only) per year.

Present rate of dead rent.

1st year .... NIL
and to 5th year .... @ 120/- per Ha. per annum
6th to 10th year .... @ 200/- per Ha per annum
11th year onwards .... @ 300/- per Ha per annum.
Average dead rent per annum .. Rs 30,116/-

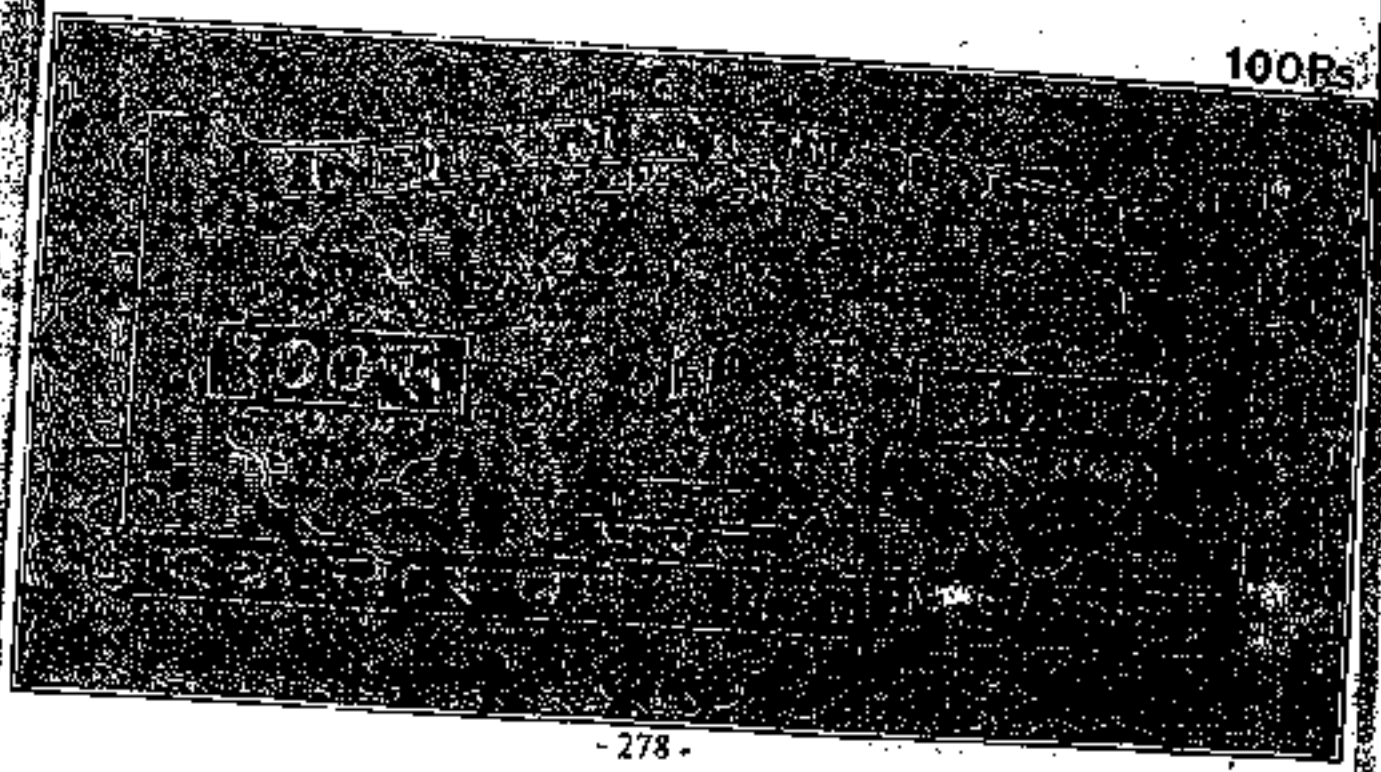
Certified that the duplicate copy of this document is a true and exact ~~copy~~ copy of the original.

Cont....

For INDIAN METALS & FERRO ALLOYS LTD.

CONSTITUED ATTORNEY

COLLECTOR, JAIPUR



IN WITNESS WHEREOF these presents have been executed in the manner hereunder appearing the day and year first above written.

In the presence of

1. 4.9.99 (B.K. Paul) Deputy Director Mines Tajpur Road

2.

Signed by the District Magistrate & Collector, Jajpur for and on behalf of the Governor of Orissa.

District Magistrate and Collector, Jajpur

The common Seal of M/s. Indian Metals & Ferro Alloys Ltd. having it's registered office at Bomikhal, Rasulgarh, Bhubaneswar- 751010 has been hereunto affixed pursuant to a resolution of the Directors passed at a meeting of the Board of Directors held on the 26th day of May, 1995 in the presence of Smruti Ranjan Ray, who has executed these presents.

In the presence of

1. Manoj Kumar Mahapatra Senior Manager (Fin) 4.9.99

2.

Signed by

FOR INDIAN METALS & FERRO ALLOYS LTD.

CONSTITUTED ATTORNEY

Enclosure III

Comparison of Mining Plan details of 23.09.2016, 14.02.2018 and 31.10.2018

Sukinda Mines Chromite, M/s IMFA Ltd.

1	Mining Plan Period		2016-17 to 2018-19		2017-18 to 2018-19		2019-20 to 2023-24	
2	Approved by IBM Letter No. & Date		MSM/FM/06-ORI/BHU/2016-17/1697 Dated – 23.09.2016		MPM/FM/25-ORI/BHU/2017-18/2815 Dated – 14.02.2018		MS/FM/27-ORI/BHU/2018-19/1796 Dated – 31.10.2018	
3	Opecast Mines Production Plan	Year	ORE (Tonne)	OB/ IB (cum)	ORE (Tonne)	OB/ IB (cum)	ORE (Tonne)	OB/ IB (cum)
		2016-17	351000	650000	--	--	--	--
		2017-18	351000	645000	351000	645000	--	--
		2018-19	351000	637200	351000	637200	--	--
		2019-20	--	--	--	--	351000	1100000
		2020-21	--	--	--	--	351000	1100000
		2021-22	--	--	--	--	351000	1100000
		2022-23	--	--	--	--	351000	1100000
		2023-24	--	--	--	--	260000	1100000
4	Underground Mines Production Plan	2021-22	25000	6700	--	--	--	--
		2022-23	200000	10000	25000	6700	--	--
		2023-24	400000	13500	200000	10000	--	--
		2024-25	600000	14700	400000	13500	--	--
		2025-26	600000	14700	600000	14700	--	--
		2026-27	600000	14700	600000	14700	--	--
		2027-28	600000	14700	600000	14700	25000	13500
		2028-29	600000	14700	600000	14700	415000	14700
		2029-30	600000	14700	600000	14700	600000	14700
		2030--31	600000	14700	600000	14700	600000	14700
5	Reasons for Modification		Change in bulk density of ore, increase in mineable reserves,		Change of chemistry of orebody due to geological disturbance in the eastern side ore body of the mines		--	

Enclosure IV
Affidavit regarding no change in Mining plan

SL NO = 14 VOL-1

04 JAN 2020

भारतीय गैर न्यायिक

दस

भारत

TEN RUPEES

Rs.10

सत्यमेव जयते

INDIA

INDIA NON JUDICIAL

ओडिशा ODISHA

NILAMANI BEHERA
NOTARY BHUBANESWAR
GOVT. OF ODISHA (INDIA)
REGD. NO.ON- 39/2003

51AA 101371

NOTARY
N. BEHERA
BHUBANESWAR
REGD. NO.ON
39/2003
GOVT. OF ODISHA (INDIA)

Before Shri N. Behera,
Notary Public, Bhubaneswar

Affidavit

I, Shri Sanjeev Das, aged about 52 Years, S/o. Shri A.K. Das Burma, residing at A/2, HIG Baramunda Colony, Bhubaneswar - 751003, District - Khordha, Odisha, at present working as Senior Vice President, Head - Mining Business Unit of M/s. Indian Metals and Ferro Alloys Limited, having its Registered Office At – IMFA Building, Bomikhal, P.O. - Rasulgarh, Bhubaneswar - 751010, District – Khordha, Odisha (in short "**IMFA**"), do hereby solemnly affirm and state as follows:

1. That Sukinda Mines (Chromite) of IMFA, is situated at Village Kaliapani under Sukinda Tahasil of Jajpur District in the State of Odisha.

2. That the Regional Controller of Mines, Indian Bureau of Mines, vide its letter No. MSM/FM/06-ORI/BHU/2016-17/1697 dated 23.09.2016, had approved the modification to the approved Mining Scheme including Progressive Mine Closure Plan of Sukinda Mines (Chromite) over an area of 116.76 ha in the Jajpur District of Odisha State submitted by said IMFA, under Rule 10 of MCDR, 1988.

For Indian Metals & Ferro Alloys Ltd.
(Sanjeev Das)
Senior Vice President
Head-Mining Business Unit

12089

18/12/19

IMA No 1264

18/12/19

DISTRICT TREASURY
KHURDA BHUBANESWAR
30 NOV 2019

Akshaya Kumar Champati
Stamp-Vender
Civil Court,Bhubaneswar

Gopali Suryjeh Dhal.

3. That the said Mining Plan was further modified and approved by IBM vide letter No. MPM/FM/25-ORI/BHU/2017-18/2815 dated 14.02.2018 for the year 2017-18 to 2018-19 and further reviewed for the period from 2019-20 to 2023-24 and approved by IBM vide letter No. MS/FM/27-ORI/BHU/2018-19/1296 dated 31.10.2018.

4. That there is no change in the area of the Mining Lease (116.76 Ha), production capacity (3.51 LTPA to 6 LTPA), mining technology involving Opencast-cum-Underground Mine, and Mineral Processing Plant (40 TPH) in the IBM approved Review Mine Plan dated 31.10.2018 as submitted to MoEF & CC along with EIA/EMP Report for appraisal and IBM approved Mining Plan dated 23.09.2016 submitted earlier for Public Hearing held on 23.06.2017.

For Indian Metals & Ferro Alloys Ltd.

(Sanjeev Das)
Senior Vice President
Head-Mining Business Unit

Place: Bhubaneswar,
Date:

Deponent

Verification

I, Shri Sanjeev Das, aged about 52 Years. S/o. Shri A.K. Das Burma, residing at A/2, HIG Baramunda Colony, Bhubaneshwar - 751003, District - Khordha, Odisha, at present working as Senior Vice President, Head-Mining Business Unit of M/s. Indian Metals and Ferro Alloys Limited, having its Registered Office At – IMFA Building, Bomikhal, P.O. - Rasulgarh, Bhubaneswar - 751 010, District – Khordha, Odisha, do hereby solemnly affirm and state that the facts stated in this Affidavit are true and correct to my knowledge and best of belief and are based on the records of the Company and no materials have been concealed and omitted therefrom.

For Indian Metals & Ferro Alloys Ltd.

(Sanjeev Das)
Senior Vice President
Head-Mining Business Unit

Verificant

NOTARY
N. BEHERA
BHUBANESWAR
REGD. NO.ON
39/2003
GOVT. OF ODISHA (INDIA)

4/1/2020

NILAMANI BEHERA
NOTARY BHUBANESWAR
GOVT. OF ODISHA (INDIA)
REGD. NO.ON- 39/2003

Enclosure V
Copy of recent mining plan dated 31.10.2018

SUKINDA MINES (CHROMITE)

(Over an area of 116.76 Ha in village Kaliapani, Jajpur District, Odisha)

REVIEW OF MINING PLAN

(For the period from 2019-20 to 2023-24)

Under Rule 17(2) of Minerals (Other than Atomic and Hydro Carbons Energy Minerals) Concession Rule, 2016,

PROGRESSIVE MINES CLOSURE PLAN

Under Rule 23 of Mineral Conservation and Development Rules, 2017

Lessee Details	M/s Indian Metals & Ferro Alloys Limited IMFA Building, Rasulgarh, Bhubaneswar District: Khurda, State: Odisha, Pin code: 751010 E-mail: mail@imfa.in Phone: (0674) 2580100/125 Fax No: (0674) 2580145/ 020
Lease Area: 116.76 Hacts Forest Area: 115.05 Hects Non Forest Area: 1.71 Hects	The entire ML area was Non Forest as per Hal records. As per Sabik records the land schedule of the ML area consists of 115.05 Ha of Forest Land and 1.71 Ha of Non Forest Land. Persuance to MoEF&CC circular No. F.No.8-78/1996-FC, dated 10.03.2015, lessee has obtained forest clearance (stage II) over 115.05 ha of forest land from Ministry of Environment, Forest & Climate, vide letter no: 8-16/2016-FC, dated 22.06.2018.
Category of Mine: Fully Mechanised Category - "A"	Date of Execution of the ML Area: 04.09.1999 Date of Expiry of the ML Area: 03.09.2049 Lease Period: 50 Years
Registration no under Rule 45 of MCDR 2017: IBM/4200/2011 Mine Code No: 11ORI19014	

TEXT

Prepared by

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INDIAN METALS & FERRO ALLOYS LIMITED

IMFA Building, Rasulgarh, Bhubaneswar – 751 010

OCTOBER, 2018

Approved vide Letter No.-
MS/IBM/27-ORI/BTW/2018-19
Dated. 31.10.18

भारत सरकार GOVERNMENT OF INDIA
खान मंत्रालय MINISTRY OF MINES
भारतीय खान ब्यूरो INDIAN BUREAU OF MINES
क्षेत्रीय खान नियंत्रक के कार्यालय
OFFICE OF THE REGIONAL CONTROLLER OF MINES

150 YEARS OF CELEBRATING THE MAHATMA

REGD. PARCEL
Phone: 0674-2352463
TeleFax: 0674-2352490
E-mail: ro.bhubaneshwar@ibm.gov.in
Plot No.149, Pokhariput
BHUBANESWAR-751020

No. MS/FM/27-ORI/BHU/2018-19 /1796 Date: 31.10.2018

To

Shri Chitta Ranjan Ray, Nominated Owner,
M/s Indian Metals & Ferro Alloys Ltd
IMFA Building, Rasulgarh,
Bhubaneswar - 751010

Sub: Approval of Review of Mining Plan of Sukinda Chromite Mine along with Progressive Mine Closure Plan (PMCP), over an area of 116.76 ha in Jajpur district of Odisha State, submitted by M/s Indian Metals & Ferro Alloys Ltd under Rule 17 of Mineral Concession Rules, 2016.

Ref: - i) Your letter No. IMFA/MPC/18/112 dated 24.09.2018.
ii) This office letter of even no. dated 27.09.2018.
iii) This office letter of even no. dated 27.09.2018 addressed to Director of Mines, Government of Odisha copy endorsed to you.
iv) This office letter of even no. dated 12.10.2018.
v) Your letter No. IMFA/MPC/18/120 dated 24.10.2018.

Sir,

In exercise of the power delegated to me vide Gazette Notification No. S.O. 1857(E) dated 18.05.2016, I hereby **Approve** the Review of Mining Plan including Progressive Mine Closure Plan of Sukinda Chromite Mine over an area of 116.76 ha of M/s Indian Metals & Ferro Alloys Ltd in Jajpur district of Odisha State submitted under Rule 17 of Mineral Concession Rules, 2016. This approval is subject to the following conditions:

I. The Review of Mining Plan is approved without prejudice to any other law applicable to the mine area from time to time whether made by the Central Government, State Government or any other authority and without prejudice to any order or direction from any court of competent jurisdiction.
II. The proposals shown on the plates and/or given in the document is based on the lease map /sketch submitted by the applicant/ lessee and is applicable from the date of approval.
III. It is clarified that the approval of aforesaid Review of Mining Plan does not in any way imply the approval of the Government in terms of any other provision of Mines & Minerals (Development & Regulation) Act, 1957, or the Mineral Concession Rules, 2016 and any other laws including Forest (Conservation) Act, 1980, Environment (Protection) Act, 1986 or the rules made there under, Mines Act, 1952 and Rule & Regulations made there under.
IV. Indian Bureau of Mines has not undertaken verification of the mining lease boundary on the ground and does not undertake any responsibility regarding correctness of the boundaries of the leasehold shown on the ground with reference to lease map & other plans furnished by the applicant / lessee.

V. At any stage, if it is observed that the information furnished, data incorporated in the document are incorrect or misrepresent facts, the approval of the document shall be revoked with immediate effect.

VI. If this approval conflicts with any other law or court order/ Direction under any statute, it shall be revoked immediately.

VII. Validity of this document shall expire on 31.03.2024.

VIII. Next Financial Assurance shall be due for submission on 31.03.2024.

भवदीय/ yours faithfully,

Encl: - One copy of Review
of Mining Plan

31/10/18

(HARKESH MEENA)
क्षेत्रीय खान नियंत्रक / Regional Controller of Mines

Copy for kind information to:-

1. The Director of Mines, Directorate of Mines, Government of Odisha, Heads of the Department Building, Bhubaneswar– 751001, Odisha along with one copy of Review of Mining Plan by REGISTERED PARCEL.
2. Shri A K Samantaray, Shri M J Raju and Shri P Behera M/s Indian Metals & Ferro Alloys Ltd, IMFA Building, Rasulgarh, Bhubaneswar - 751010 .

(HARKESH MEENA)
क्षेत्रीय खान नियंत्रक / Regional Controller of Mines

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M J Raju
Qualified Person

A K Samantray
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P Behera
Qualified Person

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LIST OF ANNEXURES

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Review of Mining Plan & Progressive Mine Closure Plan in respect of Sukinda Mines (Chromite) of M/s. Indian Metals & Ferro Alloys Limited situated in village: Kaliapani under Sukinda Tehasil of Jajpur District, Odisha, over an area of 116.760 Ha for the period from 2019-20 to 2023-24 under rule 17 (2) of Minerals (Other than Atomic and Hydro Carbons Energy Minerals) Concession Rule, 2016 and Rule 23 of Mineral Conservation and Development Rules, 2017 respectively.

SUMMARY OF PROPOSALS

Exploration: Exploration Proposal

Year	No of boreholes (Core)	Grid interval	Total Meterage	Remarks
2018-19	6	50 meters.	2915	Under progress.
2019-20	2	50 meters.	965	Proposed

Mine Excavation & Development: Summery of year wise mine development.

Particulars	2019-20	2020-21	2021-22	2022-23	2023-24
Ore Band	Band I	Band I	Band I	Band I & II	Band I & II
ROM, Tonnes (+10% Cr_2O_3)	351000	351000	351000	351000	260000
Ore, Tonnes (+30% Cr_2O_3)	326000	326000	351000	326000	200000
Mineral Reject / Sub Grade (+10% to -30% Cr_2O_3), Tonnes	25000	25000	0	25000	60000
Overburden in CuM	1100000	1100000	1100000	1100000	1100000

1. Ultimate Pit bottom of opencast mining in Band I is proposed upto (-)2mRL.
2. Trial of Opencast Mining by Grab is proposed to continue during 2018-19 & 2019-20 over 78mRL.
3. Opencast mining in Band II is proposed to commence in 2022-23 after exhaustion of Band I ore reserve by opencast method.
4. Development for underground mining is proposed from 2021-22.
5. Operation of Chrome Ore Beneficiation Plant is proposed from 2022-23.

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Area Utilisation:

Land use	At the end of Plan Period, 2023-24 (In Ha)			By the end of conceptual period (In Ha)		
	Forest	Non forest	Total	Forest	Non forest	Total
Area under Mining	36.158	0.000	36.158	42.437	0.000	42.437
Overburden Dump & Subgrade Dump	50.663	1.020	51.683	50.663	1.020	51.683
Mineral storage	7.210	0.060	7.270	0.810	0.000	0.810
Infrastructure (Workshop, Admn Building etc)	7.773	0.102	7.875	8.788	0.162	8.950
Roads	3.375	0.050	3.425	2.870	0.050	2.920
Effluent Treatment Plant, Settling Pond, Pipeline etc.	3.624	0.000	3.624	3.235	0.000	3.235
Township	1.050	0.000	1.050	1.050	0.000	1.050
Safety Zone	3.660	0.478	4.138	3.660	0.478	4.138
Chrome Ore Beneficiation Plant	1.110	0.000	1.110	1.110	0.000	1.110
Others (Magazine)	0.110	0.000	0.110	0.110	0.000	0.110
Others (Dry Talling Storage Area)	0.317	0.000	0.317	0.317	0.000	0.317
Total	115.050	1.710	116.760	115.050	1.710	116.760

Stacking: Generation & Disposal of Overburden / Waste

Year	Generation In Lakh CuM			Disposal In Lakh CuM		
1	Opencast	UG Working	Total	Dumping in Dumpyard	Backfilling in Band I mined out quarry	Total
2019-20	11	0	11	11	-	11
2020-21	11	0	11	11	-	11
2021-22	11	0.03	11.03	11.03	-	11.03
2022-23	11	0.06	11.06	6.06	5	11.06
2023-24	11	0.06	11.06	-	11.06	11.06
Total	55	0.15	55.15	39.09	16.06	55.15

1. Ultimate height of dumpyard has been proposed upto 75mtrs in four stages, i.e. maximum upto 207mRL.
2. Backfilling of mined out areas of Band I quarry has been proposed from 2022-23.

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Environmental Protection Measures: Proposals for Environmental protective measures over overburden dump yard.

Year	Protective Measures in Dump Yard					
	Plantation		Coir Matting	Retaining Wall	Garland Drain	Check Dam
	Area in Hact	No. of Plants	Sq mtr	Mtrs	Mtrs	Nos
2019-20	0.6	1500	2000	116	346	1
2020-21	1.1	2750	3600	160	Nil	Nil
2021-22	0.9	2250	2000	192	Nil	1
2022-23	0.8	2000	3000	Nil	Nil	Nil
2023-24	1.3	3250	Nil	Nil	Nil	Nil
Total	4.7	11750	10600	468	346	2

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Introduction

Sukinda Mines (Chromite) belonging to M/s Indian Metals & Ferro Alloys Limited, over an area of 116.76 Ha is situated in Kaliapani village of Jajpur District in the state of Odisha. The lease was executed on 04.09.1999 for a period of 30 years, which shall expire on 03.09.2029. Mining operations in the area commenced from 15.09.1999 and is continuing since last nineteen years by Opencast method of mining with deployment of HEMM and categorized under Category "A (FM)". As per The Mines And Minerals (Development And Regulation) Amendment Act, 2015, the lease period of the mine will be extended upto 03.09.2049.

Environmental Clearance for the project (Annexure VIII) has been obtained from MoEF & CC, New Delhi with an annual production capacity 3.51 lakh tonnes of Chromite ore (ROM) by opencast mechanized method. Environmental Clearance for Expansion in Production Capacity from 3.51 LTPA to 6.0 LTPA, Change in Technology from Opencast to Opencast and Underground and Establishment of Chrome Ore Beneficiation Plant has been applied to MoEF & CC. Public Hearing for same has been conducted on 23.06.2017. Further actions for obtaining Env Clearance are under process.

अनुमोदित
APPROVED

Both Consent to Establish & Consent to Operate have been obtained from SPCB, Odisha. (Annexure – IX).

क्षेत्रीय खान नियंत्रक
REGIONAL CONTROLLER OF MINES
INDIN BUREAU OF MINES
भुवनेश्वर/BHUBANESWAR

Surface right over the entire lease area of 116.76 hacts has been obtained. (Annexure – X).

The entire ML area was Non Forest as per Hal records. As per Sabik records the land schedule of the ML area consists of 115.05 Ha of Forest Land and 1.71 Ha of Non Forest Land. Persuance to MoEF&CC circular No. F.No.8-78/1996-FC, dated 10.03.2015, lessee has obtained forest clearance (stage II) from MoEF&CC, over 115.05 ha of forest land, vide letter no: 8-16/2016-FC, dated 22.06.2018. (Annexure XIII).

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The Scheme of Mining for the period from 2014-15 to 2018-19 has been approved by the Controller of Mines (CZ), IBM, Nagpur vide letter no 314(3)/2012-MCCM(CZ)/MS- 56/255 dated 31.07.2013 under Rule 12(4) of MCDR 1988.

Modification to the Scheme of Mining for the period from 2016-17 to 2018-19, has been approved by the Regional Controller of Mines, Bhubaneswar Region, vide letter no MSM/FM/06-ORI/BHU/2016-17/1697, dated 23.09.2016, under Rule 10 of MCDR 1988.

Further modification to the approved Scheme of Mining and PMCP for the period from 2017-18 to 2018-19 has been approved by the Indian Bureau of Mines vide letter No MPM/FM/25-ORI/BHU/2017-18/2815, dated 14.02.2018 under rule 17(3) of Minerals (Other than Atomic and Hydro Carbons Energy Minerals) Concession Rule, 2016 and Rule 23 of Mineral Conservation and Development Rules, 2017.

The Chrome ore production level of Sukinda Mines (Chromite) in the last approved modified Mining Plan was kept maximum 3.51 LTPA from opencast mine and 6.0 LTPA from underground mining. It was also proposed to start entries for underground workings and beneficiation of sub grade ore (10 to 30% Cr_2O_3) in a chrome ore beneficiation plant.

M J Raju
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1.0 GENERAL

a) **Name of applicant /lessee/Rule 45 registration no:**
M/s Indian Metals & Ferro Alloys Ltd.
Rule 45 Registration no: IBM/4200/2011

Address:
M/s Indian Metals & Ferro Alloys Limited
IMFA Building, Rasulgarh, Bhubaneswar
District: Khurda, State: Odisha, Pin code: 751010
Phone: (0674) 2580100/ 125, Fax: (0674) 2580145/ 020

Nominated Owner: Chitta Ranjan Ray
Address: M/s Indian Metals & Ferro Alloys Limited
IMFA Building, Rasulgarh, Bhubaneswar
District: Khurda, State: Odisha, Pin code: 751010
Phone: (0674) 2580100/ 125, Fax: (0674) 2580145/ 020
Email id: crray@imfa.in

b) **Status of applicant/lessee:** Public Limited Company.
List and Address of Directors is attached as Annexure IV.

c) **Mineral(s) which is / are included in the prospecting license (For Fresh grant):** Not Applicable

d) **Mineral(s) which is / are included in the letter of Intent / lease deed:** Chromite

e) **Mineral(s) which is the applicant/lessee intends to mine:** Chromite

f) Name of Qualified Person under rule 15(2) of Minerals (Other than Atomic and Hydro Carbons Energy Minerals) Concession Rule, 2016 preparing Mining Plan:

Name, Qualification & Address of Qualified Person
Sri A K Samantray, Qualification: B.E & M. Tech in Mining Engineering Address: Indian Metals & Ferro Alloys Limited, IMFA Building, Bomikhal, Rasulgarh, Bhubaneswar – 751010, Odisha Phone: (0674) 2580100/ 125, Fax: (0674) 2580145/ 020 Email: ashishsamantray@imfa.in Mobile No: 9937297144
Sri M J Raju, Qualification: M.Sc (Tech) Applied Geology Address: Indian Metals & Ferro Alloys Limited, IMFA Building, Bomikhal, Rasulgarh, Bhubaneswar – 751010, Odisha Phone: (0674) 2580100/ 125, Fax: (0674) 2580145/ 020 Email: mjraju@imfa.in Mobile No: 9777575711
Sri P Behera, Qualification: Degree in Mining Engineering from the Institution of Engineers (India) Address: Indian Metals & Ferro Alloys Limited, IMFA Building, Bomikhal, Rasulgarh, Bhubaneswar – 751010, Odisha Phone: (0674) 2580100/ 125, Fax: (0674) 2580145/ 020 Email: pbehera@imfa.in Mobile No: 9937058102

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2.0 LOCATION AND ACCESSIBILITY

a) Lease Details (Existing Mine)

Name of mine : Sukinda Mines (Chromite)

Latitude & longitude of all corner boundary point/pillar of the lease area:

Sl No	Boundary Pillar	Longitude	Latitude
1	A	85°45'35.91216"	21°02'09.82860"
2	A1	85°45'41.74812"	21°02'01.17852"
3	B	85°45'44.11116"	21°01'57.62748"
4	B1	85°45'53.18640"	21°02'02.79312"
5	C	85°46'07.86648"	21°02'11.16672"
6	C3	85°46'21.57348"	21°01'50.59524"
7	D	85°46'24.94848"	21°01'45.51492"
8	E	85°46'32.33820"	21°01'51.63456"
9	F	85°46'41.05848"	21°01'54.82488"
10	G	85°46'42.03048"	21°01'56.83512"
11	G1	85°46'36.82560"	21°02'04.50924"
12	G2	85°46'31.09764"	21°02'12.93504"
13	G4	85°46'19.52184"	21°02'29.94720"
14	H	85°46'16.99428"	21°02'33.81000"

Date of grant of lease : 04.09.1999

Period/Expiry Date : 50 years / 03.09.2049.

Name of leaseholder : M/s Indian Metals & Ferro Alloys Ltd

Postal Address : M/s Indian Metals & Ferro Alloys Limited
IMFA Building, Rasulgarh, Bhubaneswar
District: Khurda, State: Odisha,
Pin code: 751010
Phone: (0674) 2580100/ 125,
Fax: (0674) 2580145/ 020

Email id : mail@imfa.in

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b) Details of Lease area with Location Map (Mine): At the time of grant of lease entire ML area was Non Forest land as per HAL revenue records. As per the MoEF & CC circular No. F.No.8-78/1996-FC, dated 10-03-2015, the land schedule of the ML area has been considered as per land status as on 25.10.1980 (Sabik land schedule). Accordingly the details of the ML area is given below. The certified land schedule is enclosed as Annexure - XI.

Forest Land	Non Forest Land
115.05 Ha *	1.710 Ha

* Persuance to MoEF&CC circular No. F.No.8-78/1996-FC, dated 10.03.2015, lessee has obtained forest clearance (stage II) from MoEF&CC, over 115.05 ha of forest land vide letter no: 8-16/2016-FC, dated 22.06.2018. (Annexure XII).

Total lease area: 116.76 Hacts, District & State: Jajpur, Odisha
Taluka: Sukinda, Village: Kaliapani
Topo Sheet No: F45N16

Whether the area falls under Coastal Regulation Zone(CRZ): No.

Existence of public road/railway line, if any nearby and approximate distance:
The mine is situated at about 60 km from Jajpur Keonjhar railway station, 22 Kms from the Express Highway at Tomka. The Tomka & Mangalpur road is situated towards northern lease boundary of the mine.
Toposheet No: F45N16

c) General location map : The lease area marked on the Survey of India topographical map is attached as Plate No SMC/01.

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3.0 DETAILS OF APPROVED MINING PLAN / SCHEME OF MINING

3.1 Date and reference of earlier approved MP/SOM

Mining Plan / Scheme	Period		Approval Reference
	From	To	
1st MP (Grant of Lease).	1999-00	2003-04	Approved by the Indian Bureau of Mines, Nagpur under Rule 22 of Minerals Concession Rule, 1960 vide letter No 314 (3)/99-MCCM(C)/MP-4 dated 18.11.1999
1st modification to the approved Mining Plan	2002-03	2003-04	Modification of the approved Mining Plan under Rule 10 (1) of MCDR 1988 was approved by the Indian Bureau of Mines vide their letter No 314 (3)/2002-MCCM (C)/MP-10 dated 18.10.2002.
1st Scheme of Mining along with PMCP	2004-05	2008-09	First Scheme of Mining along with Progressive Mine Closure Plan under Rule 12 of MCDR 1988 was approved by the Indian Bureau of Mines vide letter No 314(3)/2003-MCCM(C)/MP/S-19 dated 25.06.2004
1st modification to the approved 1st Scheme of Mining along with PMCP	2004-05	2008-09	First modification to the approved Scheme of Mining and PMCP was approved by the Indian Bureau of Mines vide letter No 314 (3)/2003-MCCM (C)/S-19 dated 06.05.2005 under Rule 10 (1) of MCDR 1988.
2nd Modification to the approved 1st Scheme of Mining along with PMCP	2006-07	2008-09	The lessee enhanced the production of ore in the year 2005-06. The lessee also proposed to enhance the production of ore vis-à-vis removal of overburden in next 3 years (2006-07 to 2008-09) and accordingly the approved Mining Scheme was again modified under Rule 10 (1) of MCDR 1988 along with the progressive mine closure plan under Rule 23 B of MCDR 1988, which was approved vide letter No 314 (3)/2007-MCCM(C)/MP-6 dated 14.06.2007.
2nd Scheme of Mining along with PMCP	2009-10	2013-14	The Scheme of Mining for the period of 2009-10 to 2013-14 under rule 12 of MCDR 1988 was approved by the Indian Bureau of Mines vide their letter No 314 (3)/2009-MCCM (CZ)/MS-28 on 01.01.2010.
1st Modification to the approved 2nd Scheme of Mining along with PMCP	2012-13	2013-14	First modification to the approved Scheme of Mining and PMCP was approved by the Indian Bureau of Mines vide letter No 314 (3)/2012-MCCM(CZ)/MS/10 dated 14.09.2012 under Rule 10 (1) of MCDR 1988.

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Date and reference of earlier approved MP/SOM

Mining Plan / Scheme	Period		Approval Reference
	From	To	
3rd Scheme of Mining along with PMCP	2014-15	2018-19	The Scheme of Mining for the period of 2014-15 to 2018-19 under rule 12 of MCDR 1988 was approved by the Indian Bureau of Mines vide their letter No 314 (3)/2012-MCCM (CZ)/MS-56/255 on 31.07.2013.
1st Modification to the approved 3rd Scheme of Mining along with PMCP	2016-17	2018-19	First modification to the approved Scheme of Mining and PMCP was approved by the Indian Bureau of Mines vide their letter No MSM/FM/06-ORI/BHU/2016-17/1697 on 23.09.2016, under rule 10 (1) of MCDR 1988.
2nd Modification to the approved 3rd Scheme of Mining along with PMCP	2017-18	2018-19	Second modification to the approved Scheme of Mining and PMCP has been approved by the Indian Bureau of Mines vide their letter No MPM/FM/25-ORI/BHU/2017-18/2815 , dated 14.02.2018 under rule 17(3) of Minerals (Other than Atomic and Hydro Carbons Energy Minerals) Concession Rule, 2016 and Rule 23 of Mineral Conservation and Development Rules, 2017 respectively.

3.2 Details of last modifications if any (for the previous approved period):

The Mining Plan for the period from 2014-15 to 2018-19 was modified twice during the tenure of plan period.

Reasons of First Modification: *First modification to the approved Scheme of Mining and PMCP for the period from 2016-17 to 2018-19, vide letter No MSM/FM/06-ORI/BHU/2016-17/1697, dated: 23.09.2016, under rule 10 (1) of MCDR 1988.*

A. Revision of Reserves due to variation of In Situ Bulk Density (Tonnage Factor) of chrome ore and increase in life of the opencast mines: The bulk density (tonnage factor) of ore was considered as 3 tonnes/CuM for Band I opencast reserve calculation. During June 2015, In situ bulk density of different grades of chrome ore were studied by Institute of Minerals & Material

Technology (IMMT), Bhubaneswar and it was found that the weighted average of Insitu Bulk Density (tonnage factor) of chrome ore has increased to 3.85 tonnes/CuM. Increase in tonnage factor of chrome ore necessitated revision of reserves in Band I opencast & resulted increase in the Proved Mineable Reserves. Accordingly life of opencast mine in Band I also increased.

B. Safe & Scientific Mining: Increase of In Situ Bulk Density (Tonnage Factor) of different grades of chrome ore resulted decrease in average stripping ratio of the mine. Accordingly, yearwise quarry development & dumping plan for the remaining period of the approved scheme of mining necessitated modification in view of systematic development of mine.

C. Environmental Protection - Upgraded Effluent Treatment Plant: As per the conceptual plan of IIT, Kharagpur, a new upgraded ETP-4 of 360KL/Hr capacity was commissioned & operated from 25.06.2014. The surface run-off & quarry water from Sukinda Mines (Chromite) and surface run-off & water coming from underground workings of Mahagiri Mines(Chromite) were treated in this ETP-4.

D. Modification in Yearwise Plantation Programme: Due to modifications necessitated in the year wise plan of overburden dumping for the remaining scheme period, the location & availability of dead ends in overburden dump yard for plantation also changed. Accordingly, modified proposals have been made for rehabilitation of overburden dump yard by plantation on the basis of year wise availability of dead ends.

E. Facilitating Increase in yearwise production capacity: The yearwise production of chrome ore for the period from 2017-18 to 2018-19 have been revised as per plant requirement, keeping a maximum of 3.51 LTPA as per existing Environmental Clearance production limit.

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Reasons for Second modification: *Second modification to the approved Scheme of Mining and PMCP for the period from 2017-18 to 2018-19 has been approved by Indian Bureau of Mines vide letter No MPM/FM/25-ORI/BHU/2017-18/2815, dated: 14.02.2018, under rule 17(3) of Minerals (Other than Atomic and Hydro Carbons Energy Minerals) Concession Rule, 2016 and Rule 23 of Mineral Conservation and Development Rules, 2017.*

A. Revision of Reserve due to variation in grade of chrome ore and change in area of excavation: The mineable weighted average grade of ore projected for 2017-18 including the 10-40% grade ore production was 46% Cr_2O_3, where as the average grade of actual chrome ore production during the period April 2017 to November 2017 became 42% Cr_2O_3 considering the production of 10-40% Cr_2O_3 ore, which was not matching with the plant requirement during 2017-18. Minimum required average grade of Chrome ore for Ferro chrome plant was 44% Cr_2O_3. This mismatch happened for non availability of projected +52% grade chrome ore in the eastern side due to geological disturbances. In order to further ascertain the grade of ore, a detailed exploration by 58 nos of DTH drilling up to a depth of 24 mtrs with close spaced grid of 10m x 20m were done on the orebody from 89mRL. The chemical analysis of the drill hole sample revealed that, the entire ore body from section FF' to section HH' were of low and medium grade ore. There was no high grade ore present in these area.

Due to change in the quality of ore available in the eastern side area (projected +52% vs actual 42% Cr_2O_3), the lessee could not meet the specific requirement of grade wise chrome ore for it's captive ferro chrome plants, with the approved planned area of excavation. Therefore, it was necessitated to modify the area of excavation in the approved modified Scheme of Mining for the period 2017-18 & 2018-19, in order to meet the required grade of chrome ore by plants.

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B. Safe & Scientific Mining: While extending the pit towards eastern side beyond section FF', it was found that the grade of chrome ore became low & medium grade against the projected high grade. Therefore, the projected gradewise chrome ore production couldn't be achieved, to meet the requirement of the captive plants. In order to achieve gradewise requirement of chrome ore for the plants, the development of the quarry necessitated modification. Accordingly, modification in development of the quarry for the years 2017-18 and 2018-19 had been proposed.

C. Common Boundary Dumping: Vide letter BBR-JA/CH-2&12/P-111(3)/2017/235-36, dated: 15.02.2017, DGMS extended the validity period of permission under Reg. 111(3) of the Metalliferous Mines Regulations, 1961, upto 11.02.2019, for dumping of overburden within 7.5m of common boundary between Kaliapani Chromite Mine of M/s Balasore Alloys Ltd and Sukinda Mines (Chromite) of M/s IMFA Ltd. In the said permission, DGMS has accorded common boundary dumping along A-B and B-C line of M/s IMFA and IH & HG of M/s BAL, upto 3 stages of each not exceeding 20 m in height subject to total common height not exceeding 60 m from ground level. This has facilitated dumping of more overburden within the lease area. Accordingly, dumping proposal for 2017-18 and 2018-19 has been modified.

D. Reasons & Justification for modification under Rule 23 of the MCDR, 2017: Due to modifications necessitated in the year wise plan of overburden dumping for the remaining scheme period, the location & availability of dead ends in overburden dump yard for plantation were changed. Accordingly, modified proposals has been made for rehabilitation of overburden dump yard by plantation on the basis of year wise availability of dead ends.

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3.3 Review of earlier approved proposal in respect of exploration, excavation, reclamation etc.

(A) Exploration:

Commitment and compliance:

No commitment made for core drilling during 2014-15, 2015-16 & 2016-17.

Proposal during 2017-18

Year	No of boreholes (Core/RC/DTH)	Sec.	Grid Interval	Hole length (mtr)	Target
2017-18	PBH -1 (Core)	BB'	100m	671	-490mRL ore body
	PBH- 2 (Core)	HH'	100m	664	-490mRL ore body
Total 2 nos				1335mtr	
2017-18	Check BH 2 nos	DD'	150m	Each 320m	

Achivement during 2017-18

Year	No of boreholes (Core/RC/DTH)	Sec.	Grid Interval	Hole length (mtr)	Target
2017-18	BH -1 (Core)	BB'	100m	654	-465
	BH- 2 (Core)	HH'	100m	675	-486
Total 2 nos				1329	
2017-18	Check BH 1 no (Core)	DD'	150m	320	
	Check BH 1 no (Core)	DD'	150m	320	
Total 2 nos.				640	
Grand Total				1969	

Proposal during 2018-19 for DTH drilling exploration programme for non mineralised area is given below.

Year	Location	No of holes	Hole length (mtr)	Total meters
2018-19	Northern side	12 (PTDH1 to PDTH 12)	15	180
	Southern side	7 (PDTH 13 to PDTH 19)	15	105
Total :		19	Total	285

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Achivement during 2018-19 (as on 30.06.2018): The DTH drilling is in progress and shall be completed by 31.03.2019.

In addition to above proposed drilling, during 2017-18 & 2018-19, the lessee has drilled 871.5 meters of core drilling by 17 boreholes in Band-I and 836 meters of core drilling by 13 boreholes in Band II as on 30.06.2018 to know the quality of chrome ore.

(B) Mine Development (Opencast working)

Commitment and compliance: The target and achievement of mine development for opencast working from 2014-15 to 2018-19 is given below.

Development of opencast working (Excavation of overburden in CuM)

Year	Proposed	Achievement
2014-15	771352	548024
2015-16	781208	670181
2016-17	650000	649700
2017-18	645000	597295
2018 -19 (as on 30.06.2018)	637200	109019

During 2014-15, the mine was temporarily discontinued from 01.04.2014 to 30.09.2014, due to non availability of environmental clearance & valid consent to operate, for which the targeted development couldn't be achieved.

During 2015-16, the quarry floor was projected to reach 38mRL, whereas, the actual achievement was 48mRL. This mis match of quarry floor has happened due to increase of In Situ Bulk Density (Tonnage Factor) of different grades of chrome ore.

Due to increase in av tonnage factor of ore, overall stripping ratio reduced. As a result of which, it was not necessitated to develop mine upto 38mRL for achieving targeted production.

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During 2016-17, the mine development was as per proposal.

In 2017-18, the mining operations was temporarily discontinued from 11.04.2017 to 23.06.2017, due to want of valid consent to operate. Hence the development for the year 2017-18 was marginally less than the projection.

In 2018-19 (as on 30.06.2018), a quantity of 109019 CuM of overburden has been removed. It is expected that, balance quarry development shall be completed by 31.03.2019.

Mine Development (Underground working)

Commitment and compliance: The target and achievement of mine development for underground working during the Mining plan period from 2014-15 to 2018-19 is given below.

Development of underground working in meters

Year	Proposed	Achievement
2014-15	120	Nil
2015-16	273	Nil
2016-17	0	Nil
2017-18	0	Nil
2018 -19 (as on 30.06.2018)	120	Nil

Due to non availability of Environmental Clearance & Consent to Establish for underground working, the developmental activities could not be started. It is expected to get Env Clearance & Consent to Establish by 2019-20 and thereafter mine development for underground working shall be started.

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(G) Exploitation (Opencast Working)

Commitment and compliance: The target and achievement of production of chromite ore from opencast working during the Mining Plan period from 2014-15 to 2018-19 is given below.

Ore production from Opencast Working (Tonnes)

Year	Proposed	Achievement
2014-15	282467	259730
2015-16	273786	273598
2016-17	351000	350512
2017-18	351000	350112
2018 -19 (as on 30.06.2018)	351000	117283

During 2014-15, the mine was temporarily discontinued from 01.04.2014 to 30.09.2014, due to non availability of environmental clearance & valid consent to operate, for which the achievement was less than target. During the year 2015-16, 2016-17 & 2017-18, the targetted production have almost been achieved.

In 2018-19, (upto 30.06.2018), a quantity of 117283 tonnes of chrome ore has been exploited. It is expected that, balance quantity shall be exploited by 31.03.2019.

Exploitation (Underground Working)

Commitment and compliance: There was no proposal for exploitation of chrome ore from underground working during the Mining Plan period, i.e. from 2014-15 to 2018-19.

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for non availability of Environmental Clearance & Consent to Establish for underground working, the developmental activities for underground could not be started and hence no waste generated from underground for dumping. It is expectd to get EC & CtE during 2019-20.

As proposed, the common boundary dumping along A-B-C boundary line was in progress with M/s Balasore Alloys Limited.

(E) Mineral Beneficiation

Commitment and compliance: It was proposed to set up a chrome ore beneficiation plant to process 40 tonnes of chrome ore (having 10 – 30% Cr_2O_3) within the lease hold area. The proposal & achievement during the Mining Plan period from 2014-15 to 2018-19 is given below.

Achievement: Due to non availability of Environmental Clearance & Consent to Establish for establishing a COB plant, the construction of COB plant could not be started. It is expected to get EC & CtE during 2019-20.

(F) Afforestation Programme

The year wise afforestation programme proposed and achievement made during the Mining Plan period from 2014-15 to 2018-19 is given below.

Plantation target for 2014-15

Year/Location	2014-15				
	Quarry	Dump	Safety Zone	Other	Total
Area In Ha	Nil	0.509	0.046	Gap plantation as per requirement.	0.555
Nos of plants	Nil	1300	120		1420

Plantation achieved during 2014-15

Year/Location	2014-15				
	Quarry	Dump	Safety Zone	Other	Total
Area In Ha	Nil	Nil	0.046	Nil	0.046
Nos of plants	Nil	Nil	190		190

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(D) Dumping of Overburden & Waste material

The target and achievement of dumping of overburden & waste material during the Mining Plan period from 2014-15 to 2018-19 is given below.

Dumping of Overburden & Waste in CuM

Year	Proposal			Achievement		
	OB from Opencast working	Waste from Underground working	Total	OB from Opencast working	Waste from Underground working	Total
2014-15	771352	3380	774732	548024	Nil	548024
2015-16	781208	6674	787882	670181	Nil	670181
2016-17	650000	0	650000	649700	Nil	649700
2017-18	645000	0	645000	597295	Nil	597295
2018-19 (as on 30.06.18)	637200	1680	638880	109019	Nil	109019

During 2014-15, the mine was temporarily discontinued from 01.04.2014 to 30.09.2014, due to non availability of environmental clearance & valid consent to operate, for which the targeted dumping of overburden couldn't be achieved. However later on the EC & CtO were obtained.

Due to increase in av tonnage factor of different grades of ore, the av stripping ratio of the mine reduced. Therefore, during 2015-16, the targeted production was achieved by excavating & dumping less overburden.

During 2016-17, the overburden dumping was as per proposal.

During 2017-18, the mining operations were temporarily discontinued from 11.04.2017 to 23.06.2017, due to want of valid consent to operate. Hence the development for the year 2017-18 was less and accordingly dumping of over burden was less.

In 2018-19 (as on 30.06.2018), a quantity of 109019 CuM of overburden has been removed and dumped in overburden dumpyard. It is expected that, balance quanity of overburden removal and dumping shall be completed by 31.03.2019.

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During 2014-15, the mine was temporarily discontinued from 01.04.2014 to 30.09.2014, due to non availability of environmental clearance & valid consent to operate, for which the targeted dumping of overburden couldn't be achieved. Due to less overburden dumping, the designated dead ends on dump yard couldn't be made available, hence the targeted plantation over dump area couldn't be taken up. However later on the EC & CtO were received. And, plantation over an area of 0.046ha in safety zone as proposed has been completed.

Plantation target for 2015-16

Year/Location	2015-16				
	Quarry	Dump	Safety Zone	Other	Total
Area in Ha	Nil	0.22	0.71	Gap plantation as per requirement.	0.93
Nos of plants	Nil	550	1800		2350

Plantation achieved during 2015-16

Year/ Location	2015-16				
	Quarry	Dump	Safety Zone	Other	Total
Area in Ha	Nil	0.54	0.07	Nil	0.61
Nos of plants	Nil	2860	185		3045

During 2015-16 plantation done over an area of 0.54 ha in the dump area against the target of 0.22 ha, due to availability of dead ends on the dump. Safety Zone plantation during 2015-16 was proposed over 167mRL on common boundary dumping area along A-B & B-C boundary line. During 2015-16, common dumping was temporarily discontinued due to want of clearance from Govt of Odisha. Therefore, common dumping along A-B & B-C could not be completed as planned, as a result of which targeted plantation in safety zone couldn't be achieved. However, "No Objection" has been obtained from Govt of Odisha for dumping of overburden within 7.5 mtrs of common boundary between Kaliapani Chromites of M/s Balasore Alloys Ltd and Sukinda Mines (Chromite) of M/s Indian Metals & Ferro Alloys Ltd.

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Plantation target for 2016-17, 2017-18 & 2018-19

Year	Area in Hacts	Plantation in Dump Yard
2016-17	0.4	1000
2017-18	0.5	1250
2018-19	0.9	2250

Plantation Achieved for 2016-17, 2017-18 & 2018-19

Year	Area in Hacts	Plantation in Dump Yard
2016-17	0.73	2175
2017-18	0.55	1650
2018-19 (as on 30.06.2018)	Preparatory work for plantation has been done. Plantation is being carried out during rainy season and the plantation over dumpyard shall be completed as proposed.	

(G) Reclamation

There was no proposal for reclamation in the quarry during the Mining Plan period from 2014-15 to 2018-19.

(H) Scientific Study for Optimising Band I Quarry and Dumpyard.

In 2018, CIMFR, Dhanbad has reviewed and carried out the optimum slope stability studies for opencast quarry of Band I and the external dumpyard. Accordingly, CIMFR has recommended the ultimate overall pit slope angle of 30° and pit bottom of Band I as (-)2mRL. Also, CIMFR has recommended the height of dump as 75mtrs from ground level in four stages. The CIMFR report is enclosed as Annexure XII.

Mine Configuration	Optimised Parameters as per CIMFR Report
Band I Opencast Quarry	Overall Pit Slope Angle: 30 degree Ultimate Pit Bottom: (-) 2mRL
Overburden Dump	Maximum Height of Dump: 75 mtrs from ground level in four stages, i.e. maximum upto 207mRL
Distance between Quarry and dump	75mtrs

(I) Opencast Mining by Grab

In order to mine out the locked ore in the benches as well as the ore below the ultimate pit bottom, opencast mining by Grab has been proposed. Dept. of Civil Engineering, IIT Roorkee has designed the method of excavation & has submitted it's report. This report includes the geo-technical study undertaken by IIT, Roorkee, which confirms that mining can be done safely by this method. Refer Annexure XX. The basic principle is to excavate vertically downward in ore bearing zone by grab and support the side walls by series of micro piles. The excavation is done over the orebody. Such excavation are called as Panels. Each panel consists of number of sub-panels and are excavated upto a maximum depth of 60mtrs. After excavation, the panels are backfilled by overburden materials available in the mine before the adjacent panel is taken up for excavation. Based on the recommendations of the report, necessary permission from DGMS has also been obtained for opencast mining by Grab. Refer Annexure XX. As proposed, the trial for opencast mining by grab will commence in 2018-19 over 78mRL western side ore bench and continue upto 2019-20 to establish the mining method. It is estimated that approx. 56000 tonnes of ore will be mined out during this trial mining operation. On the basis of findings of the trial mining, the method shall be proposed for extraction of chrome ore deposit.

3.4 Status of compliance of violations pointed out by IBM

The violations pointed out by inspecting officials of IBM under MCDR,2017 and yearly review of the Scheme of Mining have been duly attended.

During 2014-15, the mine received two violation from .IBM vide letter no ORI/CR/JJP/MCDR-12/BBS/1949, dtd: 14.08.2014 & ORI/CR/JJP/MCDR-12/BBS/4634, dtd: 16.03.2015. The compliance to above violations have been submitted to RCOM, BBSR and are given in Annexure – XVII.

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During 2015-16 the mine received two violations vide letter no ORI/CR/JJP/MCDR-12/BBS-597, dtd: 03.06.2015 & ORI/CR/JJP/MCDR-12/BBS/2828, dtd: 16.12.2015. The compliance to above violations have been submitted to RCOM, BBSR and are given in Annexure – XVII.

During 2016-17, the mine received a violations vide letter no ORI/CR/JJP/MCDR-12/BBS/1985, dtd: 02.11.2016. The compliance to above violation has been submitted to RCOM, BBSR and are given in Annexure – XVII.

During 2017-18 & 2018-19 (till 30.06.2018), the mine has received no violation from IBM.

3.5 Details of any suspension /closure/ prohibitory order issued by any Government agency under any rule or Court of law:

During 2014-15, the mine was temporarily discontinued from 01.04.2014 to 30.09.2014, due to non availability of environmental clearance & valid consent to operate.

Odisha State Pollution Control Board has revoked the consent to operate vide letter No: 5269/IND-I-CON-2274, dated:10.04.2017, and the mine workings were stoped from 11.04.2017 to 22.06.2017. The consent to operate again issued on dated: 22.06.2017, vide letter No. 8508/Ind/Con/2274. Accordingly mine workings started from 23.06.2017. Refer Annexure - XIV.

3.6 In case the MP/SOM is submitted under rules 23 of the MCDR 2017 or under rule 17(3) of the Minerals (Other than Atomic and Hydro carbons Energy Minerals). Concession Rules, 2016 for approval of. modification, specify reason and justification for modification under these rules.

Not applicable, as the proposal is for Review of Mining Plan for next 5 years, i.e from 2019-20 to 2023-24.

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PART A

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1.0 GEOLOGY AND EXPLORATION:

a) Brief description on the topography, drainage pattern, vegetation, climate, rainfall data of the mining lease area.

Topography of Sukinda Mines (Chromite)

Mining operation at Sukinda Mines (Chromite) having a lease area of 116.760 ha. has started on 15.09.1999. The lease area is surrounded by Kaliapani chromite mines of BAL in the West, Kaliapani Chromite Mines of M/s OMC ltd in the North, area held by Govt of Odisha in the East and Mahagiri Mines (Chromite) of M/s IMFA Ltd in the South. The mining lease area, lying in the north of Mahagiri hill and covered by lateritic soil on the top followed by weathered limonites. Patches of serpentinite are noticed in the central part. The highest & lowest surface contour of the area is 160mRL & 110mRL respectively. The elevation is high in the south side and becomes gentle slope towards the northern side. Regional chromite band No I & II of Sukinda Chromite belt is lying in the lease area have a general trend of ENE-WSW dipping 75 to 80 degree towards NNW.

Drainage Pattern

The area comprises of hilly and undulating terrain. The Daitari hill range is located in the north and the Mahagiri range occupies the southern portions. The central valley portions of the area is drained by Damsal Nala flowing in westerly direction. It forms the main watershed of the study area. The entire drainage originating from Diatari hills in north and Mahagiri in the south join Damsal Nala. The drainage network present over the major portions of the study area is sub-parallel except for the drainage emanating from Diatari hills over the northern portion which is radial and dendritic in nature. The maximum elevation of the study area is 600 m above mean sea level in the northern portions (Daitari Hill) while the lowest is less than 100m above sea level in the west central parts of valley. The only surface water source in this area is perennial Damsal Nala which is situated at 1 km distance from mining lease area due North.

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The water flowing through this nala ultimately joins into the Brahmani river. The lease area, represents undulating and topography marked by linearly disposed mounds of moderate relief. The maximum elevation is 160m RL on the southern side while the minimum elevation is 110 m RL on the northern portion of the lease area.

Vegetation

In the peripheral forest area natural trees like Sal, Kendu, Bahada, Harida, Karanja, Bela are grown. In addition lessee has undertaken plantation on the dead end slopes of the overburden dump & also in the safety zone area with local species like Chankunda, Amba, Jamu, Neem, Karanja, Sisu, Krushnachuda, Radhachuda etc.

Climate :

Tropical climate prevails in the lease area. During June to October it is rainy season & during this period gets maximum rain fall in the area. During the year 2017, maximum precipitation is recorded in the month of August' 2017 (i.e 544.69mm) in the lease area. Winter is influenced from October to February. Hot summer is influenced from March to May. During summer maximum temperature ranges from 38 to 46 degree Celsius.

Rainfall data:

In this area rain falls during the period from July to October. The average rain fall in this region varies from 1300mm to 1600mm per annum. The rain fall data measured by the lessee for the year 2017 is given below.

Month	Rain fall in mm	Month	Rain fall in mm
January	0	July	313.40
February	0	August	544.69
March	46	September	379.45
April	26	October	257.41
May	183	November	31.50
June	187	December	0
Total 1968.45mm			

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b) Brief description of Regional geology with reference to location of lease.

The Sukinda Mines (Chromite) deposit (forming the Eastern Central part of the old TISCO lease hold of Sukinda Valley) forms a part of famous Chromite bearing Sukinda ultramafic complex. The Sukinda ultramafics belong to the metamorphosed rocks of Pre-Cambrian age. The rocks of the area are associated with six sedimentary sequences separated by unconformities. The Sukinda ultramafics belong to the second sequence of the succession forms a major intrusive into the older rocks and occur as intrusive. The stratigraphic succession of the region is given in table below.

STRATIGRAPHIC SUCCESSION THE REGION

Sixth Sequence	Granite Intrusive Contact Shales Carbonatites Shale lava and tuffs conqlomerates
----------Unconformity----------	
Fifth Sequence	Gabbros, Ultrabasics and dyke Swarms Ouartzites Conglomerates
----------Unconformity----------	
Fourth Sequence	Basal Granite Intrusive Contact Manqanese bearing Shales
"Iron Ore stage of Dunn"	Banded Hematite Jasper Shale
----------Unconformity----------	
Third Sequence	Gabbro and Ultrabasics (Intrusive) Lavas and Interbedded grits Conglomerates, arils. Sandstone
----------Unconformity----------	
Second Sequence	Granite and granite gneiss (Intrusive) Granophyre (Intrusive) Gabbro and Ultrabasic with chromite lodes (intrusive) Branded Hematite quartzite Banded Hematite Jasper Conglomerate, ferruginous shale and phvlilites
----------Unconformity----------	
First sequence	Metavolcanics chlorite schist Quartzite, BHQ, Banded ferruginious Quartzite, Mica Schist, Fuchsite

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The ultrabasics are distributed with two different types of metamorphic facies (a) Green Schist facies: Quartzite or Biotite hornblende-Granite in the northern part. (b) Granulites facies : Assemblages in the southern part of the region.

The ultramafic suite of rocks of Sukinda area is a layered complex of alternate bands of Chromite, Dunite, Peridotite and Orthopyroxinite. The dunite-peridotites are completely serpentinised. The presence of numerous chert bands in association with Chromite bands is the characteristic feature of the area. The lower sequence of Iron Ore Super Group of the region has been folded into syncline with gentle plunge to the WSW direction. The ultrabasics are intrusive into older sequence and subsequently co-folded.

The chrome ore mineralization is mainly restricted to the ultrabasics and occurs at six different stratigraphic levels. Band-I is the most important chromite bearing unit/member of the region. It extends for a longer distance and is the thickest among all the bands. Band – I & II occurs in Sukinda leasehold area.

c) Detailed description of geology of the lease area such as shape and size of the mineral/ore deposit, disposition various litho units indicating structural features if any etc.

Not applicable for review of mining plan. (Only applicable for MP)

d) Prospecting / Exploration Agency: Name of prospecting / exploitation agency: GSI, ACC, AOSL and Maheshwari Mining Private Limited, Drill King India Pvt Ltd.

Address: Maheswari Mining Pvt Ltd, 21, CML Lane, Raniganj-713347, Dist: Burdwan, West Bengal, E mail address: rajiv.ganeriwala@maheswaree.com, and phone no. 913412445446

Address: Drill King India Pvt Ltd, 851, 8th floor, JMD Megapolis, Sector 48, Sohna Road, Gurgaon-122018 , Haryana, E mail address: rajiv@drillking.in, and phone no. +91124 492 9580.

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e) Details of prospecting / exploration already carried out :

The Mining lease area of Sukinda Mines (Chromite) granted to M/s IMFA Ltd was a part of earlier lease area of M/s TATA Steel Ltd. Geological Survey of India carried out exploration on a regional scale in the entire TISCO lease hold area (1200 ha) including the area under reference viz. Sukinda Mines (Chromite) during 1978-81. After the area was granted, IMFA explored the area in detail by way of core drilling in the year 1999-2000 , 2000-01 ,2001-02 ,2002-03 , 2007-08, 2010-11, 2011-12 , 2012-13, 2017-18 & 2018-19. The details of exploration carried out in the area by GSI and IMFA are given in the following table.

Exploration carried out by GSI & IMFA:

Exploration Parameter	Particulars	
	GSI	IMFA
Topographical Survey	116.760 Ha	116.760 Ha
Geological Mapping	116.760 Ha	116.760 Ha
Core Drilling (Band – I)	910.40 mtr in 6 holes	8747.84 mtr in 44 holes
Core Drilling (Band – II)	174.75 mtr in one hole	5609.60 mtr. in 31 holes
Core Drilling for Proving Band III & IV	-	1197 mtr in 6 holes
DTH holes for Band I & II	-	1557 mtr in 87 holes
Sampling and Analysis	Samples were drawn at every one mtr or less for the mineralized zone from the drill cores and analyzed in in-house laboratory as well as at NABL Laboratory.	

Location of the drill holes completed are shown in the geological plan. The abstract of Year wise drill hole data is given in following table. The bore holes were drilled at a grid interval of 50 -100 mtrs.

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Year	No of Bore holes	Meters	No of DTH holes	Meters
1999-2000	3	347.35	Nil	
2000-2001	5	402.29	Nil	0
2001-2002	1	69.05	Nil	0
2002-2003	3	238.85	Nil	0
2007-2008	3	536.55	Nil	0
2010-2011	21	7419.45	Nil	0
2011-2012	5	1941.40	29	222
2012-2013	6	865.00	Nil	Nil
2017-2018	16	2662.00	58	1335
2018-2019 (till 01.09.2018)	18	1072.50	Nil	Nil
Total	**81**	**15554.44**	**87**	**1557.00**

Details of work orders to the drilling party, payment details and Form J & I submitted are attached as Annexure – XXVI.

The details of the coring and non-coring holes drilled during the period from 1999 -2000 to 2018-19 (till 01.09.2018) are given below.

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DETAILS OF BORE HOLES DONE DURING 1999-00 TO 2018-19 (till 01.09.2018)

Year	BH Number	Location (Co-ordinate)	Nature of BH (Core/ DTH)	Depth (in mtr)	Mineralized / Non-Mineralized	Inclination / Azimuth	Ore Band No.
1999-2000	SMC/IM/01	3478E /2139N	Core	112.55	Non-Mineralized	75°/N160	I
	SMC/IM/01A	3499E /2092N	Core	105.60	Mineralized	45°/N160	I
	SMC/IM/02	3364E /2009N	Core	129.20	Mineralized	60°/N160	I
Sub Total				**347.35**			
2000-01	SMC/IM/03	3319E /1984N	Core	78.59	Mineralized	50°/N160	I
	SMC/IM/04	3259E /1911N	Core	71.00	Mineralized	45°/N160	I
	SMC/IM/05	3209E /1854N	Core	82.20	Mineralized	45°/N160	I
	SMC/IM/06	3167E /1814N	Core	80.00	Mineralized	50°/N160	I
	SMC/IM/06A	3114E /1749N	Core	90.50	Mineralized	55°/N160	I
Sub Total				**402.29**			
2001-02	SMC/IM/07	3385E /1589N	Core	69.05	Mineralized	60°/N160	II
Sub Total				**69.05**			
2002-03	SMC/IM/08	3488E /1684N	Core	70.85	Mineralized	50°/N160	II
	SMC/IM/09	3590E /1763N	Core	90.00	Mineralized	50°/N160	II
	SMC/IM/10	3657E /1857N	Core	78.00	Mineralized	50°/N160	II
Sub Total				**238.85**			
2007-08	SMC/IM/11	3563E /2032N	Core	238.55	Non-Mineralized	80°/N150	I
	SMC/IM/12	3320E /2050N	Core	130.50	Non-Mineralized	75°/N150	I
	SMC/IM/13	3477E /1795N	Core	167.50	Non-Mineralized	75°/N150	I
Sub Total				**536.55**			
2010-11	SMC/IM/18	3192E /1853N	Core	574.00	Mineralized	90°/N150	I
	SMC/IM/19	3431E/2038N	Core	302.00	Mineralized	90°/N150	I
	SMC/IM/14	3133E/1946N	Core	686.00	Mineralized	90° & Directional / N150	I
	SMC/IM/15A	3328E/2209N	Core	628.15	Mineralized	84° & Directional / N150	I
	SMC/IM/15B	3328E/2209N	Core	580.00	Mineralized	65°/N150	I
	SMC/IM/16A	3255E/1749 N	Core	700.00	Non-Mineralized	76°/N150	II
	SMC/IM/16B	3306E/1673N	Core	356.00	Mineralized	70°/N150	II

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	SMC/IM/17A	3492E/1939N	Core	700.00	Mineralized	74°/N150	II
	SMC/IM/17B	3518E/1894N	Core	470.00	Mineralized	67°/N150	II
	SMC/IM/22	3734E/1544N	Core	197.00	Non-Mineralized	60°/N150	III & IV
	SMC/IM/23	3680E/1628N	Core	200.00	Non-Mineralized	60°/N150	III & IV
	SMC/IM/24	3628E/1714N	Core	200.00	Non-Mineralized	60°/N150	III & IV
	SMC/IM/25	3424E/1486N	Core	200.00	Non-Mineralized	60°/N150	III & IV
	SMC/IM/26	3478E/1401N	Core	200.00	Non-Mineralized	60°/N150	III & IV
	SMC/IM/27	3391E/1538N	Core	200.00	Non-Mineralized	60°/N150	III & IV
	SMC/IM/28	3131E/1813N	Core	150.00	Mineralized	56°/N150	I
	SMC/IM/29	3231E/1939N	Core	164.00	Mineralized	58°/N150	I
2010-11	SMC/IM/30	3353E/2026N	Core	144.00	Mineralized	73°/N150	I
	SMC/IM/31	3498E/2072N	Core	150.00	Mineralized	74°/N150	I
	SMC/IM/32	3183E/1868N	Core	153.00	Mineralized	65°/N150	I
	SMC/IM/20	3362E / 1868N	Core	465.30	Mineralized	72°/N150	I
Sub Total				**7419.45**			
2011-12	SMC/IM/20	3362E/1868N	Core	94.70	Mineralized	72°/N150	I
	SMC/IM/21	3514E/1612N	Core	398.50	Non-Mineralized	79°/N330	II
	SMC/IM/33	3466E/1842N	Core	428.20	Mineralized	66°/N150	II
	SMC/IM/34	3327E/1806N	Core	490.00	Mineralized	67°/N150	II
	SMC/IM/35	3196E/2094N	Core	530.00	Mineralized	70°/N150	I
	DTH-2	E3322/N1503	DTH	9.00	Mineralized	90°	II
	DTH-2A	E3325/N1499	DTH	9.00	Mineralized	90°	II
	DTH-2B	E3328/N1493	DTH	9.00	Mineralized	90°	II
	DTH-2C	E3331/N1487	DTH	8.00	Mineralized	90°	II
	DTH-2D	E3334/N1482	DTH	8.00	Mineralized	90°	II
	DTH-3	E3366/N1528	DTH	9.00	Mineralized	90°	II
	DTH-4	E3406/N1560	DTH	9.00	Mineralized	90°	II
	DTH-4A	E3402/N1565	DTH	9.00	Mineralized	90°	II
	DTH-4B	E3399/N1570	DTH	9.00	Non-Mineralized	90°	II
	DTH-5	E3437/N1603	DTH	9.00	Mineralized	90°	II
	DTH-5A	E3435/N1607	DTH	9.00	Mineralized	90°	II
	DTH-5B	E3441/N1609	DTH	9.00	Non-Mineralized	90°	II
	DTH-6	E3472/N1641	DTH	8.00	Mineralized	90°	II

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	DTH-07	E3517/N1669	DTH	6.00	Mineralized		
	DTH-7A	E3512/N1677	DTH	6.00	Mineralized		
	DTH-08	E3538/N1687	DTH	6.00	Mineralized	90°	II
	DTH-8A	E3532/N1698	DTH	6.00	Mineralized	90°	II
	DTH-09	E3561/N1707	DTH	9.00	Mineralized	90°	II
	DTH-9A	E3558/N1712	DTH	8.00	Mineralized	90°	II
	DTH-9B	E3556/N1715	DTH	8.00	Mineralized	90°	II
	DTH-9C	E3554/N1718	DTH	9.00	Non-Mineralized	90°	II
	DTH-10	E3603/N1753	DTH	6.00	Mineralized	90°	II
	DTH-10A	E3618/N1730	DTH	6.00	Non-Mineralized	90°	II
	DTH-11	E3640/N1789	DTH	6.00	Non-Mineralized	90°	II
	DTH-11A	E3643/N1784	DTH	6.00	Non-Mineralized	90°	II
	DTH-11B	E3656/N1762	DTH	6.00	Non-Mineralized	90°	II
	DTH-11C	E3649/N1774	DTH	6.00	Non-Mineralized	90°	II
	DTH-11D	E3653/N1768	DTH	6.00	Non-Mineralized	90°	II
	DTH-12	E3682/N1816	DTH	8.00	Mineralized	90°	II
Sub Total				**2163.40**			
2012-13	SMC/IM/36	3320.39E/1542.31N	Core	150.00	Mineralized	63°/N150	II
	SMC/IM/37	3396.75E/1619.88N	Core	150.00	Mineralized	64°/N150	II
	SMC/IM/38	3444.04E/1691.71N	Core	150.00	Mineralized	66°/N150	II
	SMC/IM/39	3541.61E/1755.00N	Core	140.00	Mineralized	52°/N150	II
	SMC/IM/40	3619.44E/1828.72N	Core	150.00	Mineralized	65°/N150	II
	SMC/IM/41	3583.33E/1797.92N	Core	125.00	Mineralized	52°/N150	II
Sub-Total				**865.00**			
	SMC/IM/42	3025.8641E/1996.0676N	Core	654.00	Mineralized	72°/N150	I
	SMC/IM/43	3393.9911E/2238.4594N	Core	675.00	Mineralized	75°/N150	I
	SMC/IM/44	3103.8534E/2230.3546N	Core	320.00	Non-Mineralized	60°/N330	I
	SMC/IM/45	E 3316.913 / 2207.510 N	Core	320.00	Non-Mineralized	60°/N330	I
	SMC/IM/46	E 3520.928 & N 2037.924	Core	17.00	Mineralized	80°/N330	I
	SMC/IM/47	E 3523.702 & N 2028.204	Core	78.00	Mineralized	80°/N330	I

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2017-18	SMC/IM/48	E 3479.286 & N 2011.119	Core	104.00	Mineralized	80°/N330	I
	SMC/IM/49	E 3486.705 & N 1998.773	Core	37.00	Mineralized	80°/N330	I
	SMC/IM/50	E 3379.022 & N 1960.469	Core	26.00	Mineralized	80°/N330	I
	SMC/IM/51	E 3373.436 & N 1969.766	Core	26.00	Mineralized	80°/N330	I
	SMC/IM/52	E 3463.925 & N 2014.750	Core	37.00	Mineralized	80°/N330	I
	SMC/IM/53	E 3434.239 & N 1988.954	Core	30.00	Mineralized	80°/N330	I
	SMC/IM/54	E 3442.680 & N 1974.907	Core	115.00	Mineralized	80°/N330	I
	SMC/IM/55	E 3242.393 & N 1843.520	Core	77.00	Mineralized	80°/N330	I
	SMC/IM/56	E 3168.837 & N 1779.106	Core	77.00	Mineralized	80°/N330	I
	SMC/IM/57	E 3286.127 & N 1881.643	Core	69.00	Mineralized	90°/N330	I
	DTH 1	E3408.216/N2005.761	DTH	24.00	Mineralized	90°	I
	DTH 2	E3412.336/N1998.903	DTH	24.00	Mineralized	90°	I
	DTH 3	E3416.456/N1992.046	DTH	24.00	Mineralized	90°	I
	DTH 4	E3420.758/N1984.887	DTH	15.00	Mineralized	90°	I
	DTH 5	E3418.479/N2008.095	DTH	24.00	Mineralized	90°	I
	DTH 6	E3423.629/N1999.524	DTH	24.00	Mineralized	90°	I
	DTH 7	E3428.780/N1990.952	DTH	12.00	Non-Mineralized	90°	I
	DTH 8	E3433.930/N1982.380	DTH	22.00	Mineralized	90°	I
	DTH 9	E3439.080/N1973.809	DTH	24.00	Mineralized	90°	I
	DTH 10	E3428.502/N2010.831	DTH	22.00	Mineralized	90°	I
	DTH 11	E3433.652/N2002.259	DTH	20.00	Mineralized	90°	I
	DTH 12	E3438.803/N1993.687	DTH	22.00	Mineralized	90°	I
	DTH 13	E3445.507/N1987.059	DTH	24.00	Mineralized	90°	I
	DTH 14	E3449.103/N1976.544	DTH	24.00	Mineralized	90°	I
	DTH 15	E3445.305/N2017.230	DTH	24.00	Mineralized	90°	I
	DTH 16	E3449.095/N2008.810	DTH	24.00	Mineralized	90°	I
	DTH 17	E3453.870/N1997.735	DTH	24.00	Mineralized	90°	I
	DTH 18	E3459.021/N1989.163	DTH	24.00	Mineralized	90°	I
	DTH 19	E3463.833/N1981.154	DTH	24.00	Mineralized	90°	I
	DTH 20	E3458.624/N2018.947	DTH	20.00	Mineralized	90°	I
	DTH 21	E3463.774/N2010.376	DTH	24.00	Mineralized	90°	I
	DTH 22	E3468.925/N2001.804	DTH	8.00	Mineralized	90°	I

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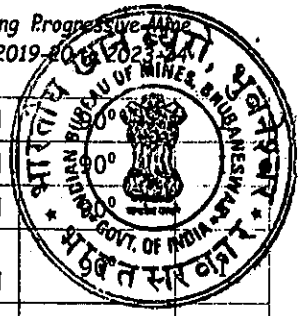

	DTH 23	E3474.075/N1993.232	DTH	24.00	Mineralized	90°	
	DTH 24	E3480.254/N1986.649	DTH	24.00	Mineralized	90°	
	DTH 25	E3442.686/N1967.809	DTH	24.00	Mineralized	90°	
	DTH 26	E3451.081/N1958.223	DTH	24.00	Non-Mineralized		
	DTH 27	E3459.073/E1963.558	DTH	24.00	Non-Mineralized	90°	I
	DTH 31	E3494.286/N1988.719	DTH	24.00	Non-Mineralized	90°	I
	DTH 32	E3489.136/N1997.290	DTH	24.00	Non-Mineralized	90°	I
2017-18	DTH 33	E3483.986/N2005.862	DTH	24.00	Non-Mineralized	90°	I
	DTH 35	E3473.685/N2023.006	DTH	24.00	Mineralized	90°	I
	DTH 37	E3493.896/N2018.492	DTH	24.00	Mineralized	90°	I
	DTH 38	E3499.065/N2009.925	DTH	24.00	Mineralized	90°	I
	DTH 39	E3504.197/N2001.349	DTH	24.00	Mineralized	90°	I
	DTH 41	E3519.078/N2005.358	DTH	24.00	Mineralized	90°	I
	DTH 42	E3514.108/N2013.979	DTH	24.00	Mineralized	90°	I
	DTH 43	E3508.957/N2022.550	DTH	24.00	Mineralized	90°	I
	DTH 47	E3461.025/N1971.265	DTH	24.00	Mineralized	90°	I
	DTH 48	E3421.608/N1974.977	DTH	24.00	Mineralized	90°	I
	DTH 49	E3424.673/N1965.152	DTH	24.00	Mineralized	90°	I
	DTH 50	E3416.753/N1960.393	DTH	22.00	Non-Mineralized	90°	I
	DTH 51	E3411.603/N1968.965	DTH	24.00	Non-Mineralized	90°	I
	DTH 52	E3407.002/N1976.622	DTH	22.00	Mineralized	90°	I
	DTH 53	E3401.336/N1986.051	DTH	24.00	Mineralized	90°	I
	DTH 54	E3382.435/N1988.571	DTH	22.00	Non-Mineralized	90°	I
	DTH 55	E3378.267/N1971.704	DTH	24.00	Mineralized	90°	I
	DTH 56	E3383.857/N1966.946	DTH	24.00	Mineralized	90°	I
	DTH 57	E3388.084/N1959.865	DTH	24.00	Mineralized	90°	I
	DTH 58	E3371.248/N1958.108	DTH	24.00	Mineralized	90°	I
	DTH 59	E3366.098/N1966.680	DTH	24.00	Mineralized	90°	I
	DTH 62	E3359.882/N1980.252	DTH	24.00	Non-Mineralized	90°	I
	DTH 63	E3372.842/N1992.407	DTH	24.00	Non-Mineralized	90°	I
	DTH 64	E3371.345/N1978.679	DTH	24.00	Mineralized	90°	I
	DTH 65	E3333.109/N1959.418	DTH	24.00	Mineralized	90°	I

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	DTH 66	E3351.831/N1965.387	DTH	24.00	Mineralized	90	
	DTH 67	E3400.436/N2018.586	DTH	24.00	Mineralized	90	
	DTH 68	E3358.173/N1943.875	DTH	24.00	Mineralized	90	
	DTH 69	E3344.930/N1952.607	DTH	24.00	Mineralized	90	
Sub-Total				3997.00			
2018-19	SMC/IM/58	E 3425.799 & N 2002.859	Core	27.00	Mineralized	80°/N330	I
	SMC/IM/59	E 3447.830 & N 1966.335	Core	53.00	Mineralized	80°/N330	I
	SMC/IM/60	E 3247.53 & N 1852.50	Core	40.00	Mineralized	90°/N330	I
	SMC/IM/61	E 3346.21 & N 1955.15	Core	58.50	Mineralized	90°/N330	I
	SMC/IM/62	E 3422.57 & N 1639.22	Core	100.5	Mineralized	50°/N150	II
	SMC/IM/63	E 3440.69 & N 1615.11	Core	70.00	Mineralized	50°/N150	II
	SMC/IM/64	E 3505.01 & N 1701.20	Core	63.00	Mineralized	50°/N150	II
	SMC/IM/65	E 3505.01 & N 1701.20	Core	88.00	Mineralized	72°/N150	II
	SMC/IM/66	E 3337.03 & N 1517.12	Core	62.00	Mineralized	55°/N150	II
	SMC/IM/67	E 3393.77 & N 1552.29	Core	52.00	Mineralized	50°/N150	II
	SMC/IM/68	E 3369.90 & N 1538.38	Core	17.00	Mineralized	90°/N150	II
	SMC/IM/69	E 3295.32 & N 1482.30	Core	54.00	Mineralized	50°/N150	II
	SMC/IM/70	E 3295.32 & N 1482.30	Core	103.00	Mineralized	80°/N150	II
	SMC/IM/71	E 3582.513 & N 1771.748	Core	58.50	Mineralized	50°/N150	II
	SMC/IM/72	E 3628.336 & N 1812.622	Core	52.00	Mineralized	50°/N150	II
	SMC/IM/73	E 3640.973 & N 1792.567	Core	67.00	Mineralized	50°/N150	II
	SMC/IM/74	E 3665.396 & N 1841.814	Core	49.00	Mineralized	50°/N150	II
	SMC/IM/75	E 3489.520 & N 1631.825	Core	58.00	Mineralized	50°/N150	II
Sub-Total(till 01-09-18)				1072.5			
GRAND TOTAL				**17111.44**			

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Summary of the exploration carried so far within the lease area is given below:

Item of information	Lease area explored as per UNFC norms (In Ha) as on date: 01.12.2017. **Total Lease area A+B+C+D+E**	Remarks/Comments including reasons for Not carrying out the exploration as per UNFC norms.			
	G1 Level	G2 Level	G3 Level	Explored and found non-mineralized with level of exploration (Remarks)	Unexplored lease area
	A	B	C	D	E
Area as per level of exploration	46.76 Ha	-	-	70 Ha (G2)	Nil
No. of BH Drilled	73	-	-	8 nos Borehole and 5 nos tubewell	
No. of BH considered for Resource Estimation.	60	-	-	-	
Meterage Drilled	**15554.44**	-	-	1837	
Grid Interval	50- 100 Mtr	-	-	100-200 Mtr	
Scale of Mapping	1 : 1000	-	-		
Reserve estimated after above exploration as on dated 01.07.2018					119.11
Remaining Resource after above exploration as on dated 01.07.2018					225.88
Total Reserver/Resource after above exploration as on dated 01.07.2018					344.99

The exploratory bore hole core samples are analysed both in the in-house laboratory and in a NABL accredited laboratory. Out of 81 bore holes done in Band I & II, 31 boreholes were analysed in NABL accredited laboratory. The analysis data given in the exploration report is derived out of the average of the analysis done in NABL accredited laboratory. The analysis report of NABL laboratory is enclosed as Annexure XXIV and the accreditation certificate of the laboratory from where the analysis carried out is enclosed as Annexure XXV. 10% of the total samples generated during the proposed exploration shall also be done in NABL accredited laboratory.

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f) The Surface Plan of the lease area on a scale of 1:1000 or 1:2000 with contour interval of maximum of 10m depending upon the topograpphy and size of the area duly marked by grid lines showing all features indicated under rule 32(1)(a) of MCDR 2017.

The surface plan of the lease area has been prepared on a scale of 1:2000 with contour interval of 5m duly marked by grid lines showing all features indicated under rule 32(1)(a) of MCDR 2017. The same is shown as Plate No SMC/03.

g) The Geological Plan showing details of exploration already carried out along with supporting data for existence of mineral, locations proposed exploration, various litho units along with structural features, mineralized/ ore zone .

Geological plan has been prepared taking the surface plan prepared on a scale of 1:2000. The details of exploration already carried out along with supporting data for existence of mineral, locations proposed exploration, various litho units along with structural features, mineralized / ore zone with grade variation have been marked on the geological plan along with other features indicated under Rule 32 (1)(b) of MCDR 2017. Refer plate no SMC/04.

h) Geological Sections on natural scale of geological plan at suitable interval across the lease area from boundary to boundary.

Geological sections has been prepared on 1:2000 scale of geological plan at suitable interval across the lease area. Refer plate no SMC/05A, SMC/05B, SMC/05C, SMC/05D, SMC/05E & SMC/05E.

i) Future programme of exploration with due justification (duly marked on Geological plan year wise location in different colours) taking into consideration the future tentative excavation programme planned in next five years.

The Mining lease area of Sukinda Mines (Chromite) granted to M/s IMFA Ltd is a part of earlier lease area of M/s TATA Steel Ltd.

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Geological Survey of India carried out exploration on a regional scale in the entire TISCO lease hold area (1271 ha) including the area under reference viz. Sukinda Mines (Chromite) during 1978-81. After the area was granted, IMFA explored the area in detail by way of core drilling in the year 1999-2000, 2000-01, 2001-02, 2002-03, 2007-08, 2010-11, 2011-12, 2012-13 ,2017-18 & 2018-19.

In the total mining lease area of 116.760 ha, G1 category of exploration has been done over the potentially mineralised area by bore holes at a grid interval of 50 - 100mtrs.

Regarding non mineralised area, the entire northern part of the lease area was utilised for over burden dump by the earlier lessee at the time of grant of Mining lease. The Southern & Northern lease area beyond potential mineralised area has already been proved non mineralised by doing bore holes. 19 No's DTH holes of 15 meters depth are proposed during the year 2018-19 and are in progress & shall be completed during year and same BH's are depicted on the Geological plan & sections.

Proposal for exploration by way of Core drilling & DTH drilling during the review of Mining Plan Period (2019-20 to 2023-24)

The continuation of ore body over the total strike length available within the mining lease area in greater depths has been established by means of core drilling for both the ore bands Band I & Band II. Band I ore body has already been exposed over the total strike length in the opencast mine . Thus, it may be concluded that present level of exploration (diamond drilling carried out from surface) is capable enough to establish the profile of the ore body and based on that the underground development has been proposed.

However, it is proposed 8 Nos deep bore holes at a grid interval of 50 meters along the strike with 3880 meters to know the detailed chemical composition of chrome ore between -250mRL & -300mRL, accordingly Form I has been submitted (Refer Annexure XXVI). The proposed drilling has already been started in the FY 2018-19 and is expected to complete during 2019-20.

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Future programme of exploration by core drilling in the review of Mining Plan Period (2019-20 to 2023-24) is given below.

Details of core drilling programme:

Details of proposed exploratory bore holes.

Sl No	Year	BH No.	Northing	Easting	Collar RL	Core/RC/ DTH	Depth In Mtr	Inclination	Forest/ Non Forest	Surface right/ Non surface right	Purpose
1	2018-19	PBH3	2037.75	3137.16	136	Core	485	67	Diverted Forest	Surface right	To assess the geometry and quality of the deposit up to -300mRL
2	2018-19	PBH4	2072.89	3172.88	136	Core	495	67	do	do	
3	2018-19	PBH5	2126.06	3254.63	135.2	Core	485	70	do	do	
4	2018-19	PBH6	2153.27	3296.09	135.3	Core	490	70	do	do	
5	2018-19	PBH7	2202.31	3382.79	135.3	Core	490	69	do	do	
6	2018-19	PBH8	2208.37	3437.26	135	Core	470	72	do	do	
7	2019-20	PBH1	1927.22	3033.02	137	Core	480	68	do	do	
8	2019-20	PBH2	1961.30	3069.40	136.5	Core	485	68	do	do	
	Total	**8 No's**					**3880**		**Diverted forest area**	**Surface right area**	

The above exploratory proposed bore holes are depicted on the geological plan & sections. Refer plate no SMC/04, SMC/05A, SMC/05B, SMC/05C, SMC/05D & SMC/05E.

j) Reserve and resources as per UNFC with respect to the threshold value notified by IBM. Area explored under different level of exploration marked on the geological plan and UNFC code for area considered for different categories of reserve/ resources estimation marked on the geological cross sections.

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Lease area explored as per UNFC norms is given below in the table

Name of the mineral : Chromite

Sl No	Name of the Lease & owner	Total lease area (in Ha)	Lease area explored as per UNFC norms (in Ha)					Remarks/ Comments including reasons for not carrying out the exploration as per UNFC norms
			C= D+E+F+G					
			G1 level	G2 level	G3 level	Explored and found non mineralised with level of exploration.	Un explored area	
A	B	C	D	E	F	G	H	I
1	Sukinda Mines (Chromite) Owner- M/s IMFA LTD	116.76	46.76	0	0	70Ha (G2)	0	Exploration has been carried out over the entire ML area 116.760

The threshold grade has been kept as 10% Cr_2O_3 as per IBM guidelines and based on the usability of ore at captive plants, the cut off grade has been fixed at 30% Cr_2O_3. Area explored under different level of exploration marked on the geological plan & sections as per UNFC. A feasibility study report along with financial analysis for economic viability of the deposit as specified under the UNFC field guidelines is given in Annexure XXIX.

k) Detailed calculations of Reserves.

In the regional set up, there are two lodes namely, Band-I and Band-II existing within the lease area of Sukinda Mines (Chromite). The Band-I ore body is the thickest chromite band of Sukinda region and extends for about 600m in strike length in the mining lease hold area. Based on the detailed exploration (G1 category) and exposed orebody in the opencast mine, the width varies from 20 to 47 m up to -2 mRL (UPL for opencast working) and 18 to 21 m width from -2 mRL to -445 mRL. The dip of the ore body is sub-vertical to vertical, north – westernly dipping in average 75° to 80°.

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The grade of the ore band-I is varying mostly from 10% to 57% Cr_2O_3. Chromite ore having +30 % Cr_2O_3 is occurring within the exposed width of the ore body in the quarry floor on the eastern sector from section E to section H. The Band-II ore body is nearly parallel to Band-I ore body and the strike of the ore body is also N-E and S-W with dipping in average 75^0 to 84^0 in north westernly direction. The detailed G1 category of exploration (as per UNFC) has been carried out for Band II and established the strike length of the ore body 600 m having average width of 4 – 17 m from +150 mRL (Surface) to +46 mRL (UPL). The grade range of band-II ore is 10% to 52% Cr2O3.

Calculation of reserves has been done by conventional slice plan method (Longitudinal sectional method). The longitudinal sectional area is multiplied by the average width of the ore body to obtain the in-situ volume of the total ore, based on the exposed ore body in opencast for Band-I. The volume of ore has been converted into tonnes by multiplying with bulk density as per grade of the ore. Bore hole intersections in 7 nos of updated cross sections B-B' to H-H' for entire strike length (600m) considered. Exposed ore body geometry & assay, chemical analysis of core samples and channel samples have been considered for estimation of the reserves, as per the UNFC guidelines. The reserve in opencast for Band-I & Band-II has been calculated upto (-)2 mRL and +46 mRL respectively. Beyond the conventional opencast limit of -2mRL, the opencast mining by grab shall be done up to a depth of 60m as per the method established by IIT Roorkee. Hence total opencast reserves has been calculated up to a depth of – 62mRL for Band I.

The bulk density considered (study made by IMMT refer Annexure XXIII) for different grades of chrome ore for reserve calculation in Band I & Band II are as below:

Grade of Chrome Ore Cr_2O_3 % (average)	Average In Situ Bulk Density (Tonnes/CuM)
Above 52% Cr_2O_3	4.2
47 to 52% Cr_2O_3	3.7
40 to 47 % Cr2O3	3.5
30 to 40% Cr_2O_3	3.0
<30 % Cr2O3	2.7

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The Basis of Conventional Opencast Ultimate Pit Limit & Opencast Mining by Grab:

The ultimate pit limit has been decided as (-)2mRL for Band I and 46mRL for Band II. Two aspects have been taken into consideration while fixing the conventional opencast mining ultimate pit limit for Band I.

The northern side quarry limit has been fixed keeping the top of quarry upto 75mtrs from the bottom edge of conceptual limit of dump. This is as per the August 2018 study report of CIMFR (Copy enclosed as Annexure XII).

The overall pit slope angle has been taken as 30^0 for Band I, as per the recommendations of CIMFR in their study report. Accordingly, the ultimate pit bottom has been planned at (-)2mRL in Band I. Beyond the conceptual limit of the conventional opencast mining, i.e. upto (-)2mRL, the opencast mining by grab shall be carried out as per the study report of IIT, Roorkee up to a maximum vertical depth of 60meters, i.e up to (-)62mRL.

Threshold & Cut off grade:

The threshold grade has been kept as 10% Cr_2O_3 as per IBM guidelines and based on the usability of ore at captive plants, the cut off grade has been fixed at 30% Cr_2O_3. For estimation of geological reserve up to opencast pit limit in Band-I and Band II, calculation has been done taking into consideration the longitudinal section. The average width of the ore body is taken as per the seen & exposed ore body at present in the quarry and boreholes data. The strike influence of the ore body is considered 600 m.

For estimation of geological reserve below opencast pit limit both in Band I and Band-II, the average width of the ore body is taken as per boreholes drilled in different sections. The strike influence of the ore body is considered 600 m. Volumes of ore have been converted into tonnes by multiplying with the applicable tonnage factor of 3.88 tonnes/CuM. The tonnage factor of 3.88 has been considered based upon the borehole core analysis done by NIRM (Refer Page No.13 of Annexure -XXI).

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The parameters considered for calculation of reserve for both Opencast & below opencast are described below in table.

Table: Parameters considered for Reserve Estimation

Category	Parameters considered	Band-I		Band-II	
		Opencast & Opencast by Grab	Below Opencast by Grab	Opencast	Below Opencast
G1	Level	94 to -62 mRL	-62 to -445 mRL	150 to 46 mRL	Nil
	Bore Holes considered	1,1A,2,3,28,29,30 ,31,32,46,47,48,4 9,50,51,52,53,54, 55,56,57,58,59,6 0,61 and 58 nos of DTH Holes	14,15A,15B,18,1 9, 20, 32 , 35,42 & 43.	7,8,9,10,33,34,36,3 7,38,39,40 , 41,62,63,64,65,66, 67,69,70,71,72,73, 74 & 75 and non coring DTH holes No.4,4A, 4B,5,5A,5B,6,9,9A, 9B,9C,10,10A &12.	
	Influence in strike direction	The strike influence has been considered 50m for total strike length of 600m based on the BH intersection, exposed ore bench of O/C working, referring 7 nos of cross sections i.e. B-B' to H-H'.	The strike influence has been considered 50m for total strike length of 600m based on the BH intersection, referring L-section along XYZ.	The strike influence has been considered 50m for total strike length of 600m based on the BH intersection, referring 7 nos of cross sections i.e. B-B' to H-H'.	
	Influence in Dip direction	50m	50m	50m upto UPL of +46 mRL	
	Dip of the Ore body	75° to 82° towards N-W	75° to 82°	75° to 84°	
	Width of Ore body	20 to 47m for Opencast & 20 to 30 m for Opencast by Grab.	18 to 21m	4 to 17m	
	Grade of the deposit	10 to 57 %	30 to 57 %	10 to 52%	
	Bulk density	4.20 for +52% Cr2O3, 3.50 for 40 to 52% Cr2O3 & 2.70 for 10 to 40% Cr2O3.	3.88	4.20 for +52% Cr2O3, 3.50 for 40 to 52% Cr2O3 & 2.70 for 10 to 40% Cr2O3.	

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Category	Parameters considered	Band I		Band II	
		Opencast	Below Opencast	Opencast	Below Opencast
G2	Level	--	-250 to -495 mRL	--	46 to -301 mRL
	Drill Holes considered	--	14, 15A, 18, 35, 42 and 43	--	16B, 17B, 33, 34 & 36
	Influence in strike direction	--	The strike influence has been considered 100m from bore hole intersections .	--	The strike influence has been considered 100m from bore hole intersections .
	Influence in Dip direction	--	100m up dip & down dip from bore hole intersection.	--	100m up dip & down dip from bore hole intersection.
	Dip of the Ore body	--	75° to 82°		75° to 84°
	Width of Ore body	--	18 to 21 m	--	4 to 6 m
	Grade of the deposit	--	30 to 57 %	--	10 to 52%
	Tonnage Factor	--	3.88	--	3.88
G3	Level	--	--	--	- 301 to - 459
	Drill Holes considered	--	--		34 & 17A
	Influence in strike direction	--	--		The strike influence has been considered 200m from bore hole intersections .
	Influence in Dip direction	--	--	--	200m up dip & down dip from bore hole intersection.
	Dip of the Ore body	--	--		84°
	Width of Ore body	--	--		3m
	Grade of the deposit	--	--	--	10 to 57%
	Tonnage Factor	--	--	--	3.88

This is a working opencast mine with annual capacity of 3.51 Lakh tonnes of chrome ore. The measured resources has been considered for Opencast Mining and Opencast Mining by Grab upto -62 mRL for band I and 46 mRL for Band II. Underground proposal for Band I mining considered from -250 mRL. Feasibility report (NIRM) has been appended at Annexure-XXIX. Accordingly proved Reserve and remaining resources have been estimated out of Measured chromite resources.

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Detailed calculation of Reserves for Band I

Details of Reserve/resource estimated as on 01.12.2017 in the approved modified Mining Plan for the period 2017-18 to 2018-19 is given below.

Reserve/ Resources as on 01.12.2017 As per approved Modified Mining Plan (UNFC classification)

Reserve/ Resources as on 01.12.2017 As per UNFC classification

Reserve / Resources as on 01.12.2017 (In Lakh Tonnes)					
Classification	**UNFC Code**	**Band-I**	**Band-II**	**Grand Total**	**Grade Cr_2O_3**
A. Total Mineral Reserves					
1. Proved mineral reserves	111	**54.44**	**13.56**	**68.00**	+10%
2. Probable mineral reserves Probable mineral reserves	121 122	**Nil** **17.30**	**Nil** **Nil**	**Nil** **17.30**	+10%
Sub - TOTAL		**71.74**	**13.56**	**85.30**	+10%
B. Total Remaining Resources					
1. Feasibility Mineral Resources	211	**196.74**	**4.87**	**201.61**	+10%
2. Prefeasibility Mineral Resources	221 222	Nil 9.68	Nil Nil	Nil 9.68	+10%
3. Measured Mineral Resources	331	Nil	Nil	Nil	
4. Indicated Mineral Resources	332	Nil	Nil	Nil	
5. Inferred Mineral Resources	333	Nil	**50.29**	50.29	+10%
6. Reconnaissance Mineral Resources	334	Nil	Nil	Nil	
Sub - Total		206.42	55.16	261.58	+10%
Total Reserves+Resources (A+B)		**278.16**	**68.72**	**346.88**	+10%

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Category-wise Updated Reserves with grade in Tonnes (As on 01.07.2018) for Conventional Opencast Mining in Band I upto (-)2 mRL.

(a) Measured Mineral Resource of Band-I between Surface & (-)2 mRL

BAND 1 RESERVE FROM SURFACE TO (-)2 mRL							
Section	Area	Avg. Width	Volume	Bulk density	Quantity	Grade	Mineable
	Sq.M	Mtr	Cum		MT	Cr2O%	
BB'	196	20	3920	4.2	16464	>30%	M
CC'	1835	20	36700	4.2	154140	>30%	M
DD'	2470	20	49400	4.2	207480	>30%	M
EE'	2650	20	53000	4.2	222600	>30%	M
FF'	822	20	16440	4.2	69048	>30%	M
FF'	282	32	9024	4.2	37901	>30%	M
	1028		32896	3.7	121715	>30%	
	171		5472	3.5	19152	>30%	
	631		20192	3	60576	>30%	
	38		1216	2.7	3283	**<30%**	
GG'	494	47	23218	4.2	97516	>30%	M
	251		11797	3.7	43649	>30%	
	260		12220	3.5	42770	>30%	
	476		22372	3	67116	>30%	
	403		18941	2.7	51141	**<30%**	
HH'	171	25	4275	3.7	15818	>30%	M
	171		4275	3.5	14963	>30%	
	248		6200	3	18600	>30%	
	230		5750	2.7	15525	**<30%**	
Total					1279455		

M (111) – Mineable, Upto UPL (-)2mRL

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(b) Proved Mineable reserves of Band-I between (-)2 mRL Conventional Opencast limit & -62 mRL Opencast Mining by Grab limit.

BAND 1 RESERVE FROM (-) 2mRL to (-) 62mRL.

Section	Area	Avg. Width	Volume	Bulk density	Quantity	Grade Cr_2O_3%	UNFC
	Sq.M	Mtr	Cum		MT		
BB'	6553	20	13160	4.2	550452		
CC'	4638	20	92760	4.2	389592		
DD'	4628	20	92560	4.2	388752		
EE'	4608	20	92160	4.2	387072		
FF'	1324	20	26480	4.2	111216		
FF'	2548	30	76440	4.2	321048		
	110		3300	3.7	12210		
	334		10020	3.5	35070		
GG'	1365	30	40950	4.2	171990	> 30%	121
	1540		46200	3.7	170940		
	509		15270	3.5	53445		
	164		4920	2.7	14760		
HH'	1858	25	46450	4.2	195090		
	708		17700	3.7	65490		
	1266		31650	3.5	110775		
	2024		50600	3	151800		
Total					3129702		

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Section wise and Grade wise updated reserve below Opencast Mining by Grab limit, i.e -62 mRL to -495 mRL for Underground Workings.

The Underground Opening, Stope Block Design & Support System study of Sukinda Mines (Chromite) has been carried out by the National Institute of Rock Mechanics, Karnataka, India (Annexure-XXI). The recommendation of the study are as follows.

The first opening of underground level shall be -250 mRL, the ultimate pit limit of surface working by conventional opencast mining and opencast mining by grab shall be -62 mRL and the crown pillar shall be kept between -62 mRL to -250 mRL, as parting between opencast & underground workings. The maximum stope height shall be 50 m, the stope width shall be within 20 m (or the maximum ore body width). The recommended rib pillar thickness (within the ore body) is 6m and length of the stope (along the strike) shall be 20m and crown pillar thickness between the stope blocks to be 15m.

Based on the detailed exploration, physio-chemical analysis of core and considering the above recommendation, the reserve estimation has been estimated for underground mining by level plan method.

(a) Feasibility Mineral Resources (211) of Band -I between -62 mRL (below Opencast Mining by Grab limit) to -250 mRL (Sill Pillar)

Bore Hole Considered	BH No – 14,18,32,20,35,29,15A,15B
Sectional Area(L-Section) in square meters	133564
Average width of the ore body in m	21.33
Tonnage Factor	3.88
Total Reserve in Tonnes	11053810(10-30%=0,30-40%=552691,40-52%=331614,+ 52%= 10169505)

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Reserve available for underground mining of Band-I is as below:

(b) Measured Mineral Resource (331) of Band -I between -250mRL to -300 mRL (1st Stope Block)

Bore Hole Considered	BH No – 14,18,32,20,35,19,15A,15B	
Strike Length of the ore body in m	608	
Vertical Depth in m	50	
Average width of the ore body in m	18.75	
Tonnage Factor	3.88	
Total Reserve in Tonnes	2211600	
Gradewise Reserve in MT	10-30% Cr2O3	0
	30-40 % Cr2O3	132696
	40-52 % Cr2O3	265392
	52% & Above Cr2O3	1813512

(c) Proved Mineable Reserve (111) of Band -I between -250 mRL to -300 mRL(1st Stope Block). Considered the strike influence distance from the bore hole intersection as 50 m on either side for 111 category and beyond 50m for 122 category.

Bore Hole Considered		BH No – 14,18,32,20,35,19,15A,15B	
Category		111	122
Strike Length of the ore body in m		276	154
Vertical Depth in m		50	50
Average width of the ore body in m		18.75	18.75
Tonnage Factor		3.88	3.88
Total Reserve in Tonnes		1003950	560175
Grade wise Reserve in MT	10-30% Cr2O3	0	0
	30-40 % Cr2O3	60237	33610
	40-52 % Cr2O3	120474	67221
	52% & Above Cr2O3	823239	459344

Hence, the category of reserve (211) between -250 mRL to -300 mRL = 647475 MT

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(d) Feasibility Mineral Resources (211) of Band -I between -300mRL to -315 mRL (Crown Pillar)

Bore Hole Considered	BH No – 14,18,32,20,35,19,15A,15B
Strike Length of the ore body in m	608
Vertical Depth in m	15
Average width of the ore body in m	20.94
Tonnage Factor	3.88
Total Reserve in Tonnes	740974

(e) Measured Mineral Resource (331) of Band -I between -315 mRL to -365 mRL (2nd Stope Block)

Bore Hole Considered	BH No – 14,18,32,20,35,19,15A,15B	
Strike Length of the ore body in m	608	
Vertical Depth in m	50	
Average width of the ore body in m	20.94	
Tonnage Factor	3.88	
Total Reserve in Tonnes	2469915	
Grade wise Reserve in MT	10-30% Cr2O3	0
	30-40 % Cr2O3	172894
	40-52 % Cr2O3	296390
	52% & Above Cr2O3	2000631

(f) Proved Mineble Reserve (111) of Band -I between -315 mRL to -365 mRL(2nd Stope Block)

Bore hole Considered		BH No 14,18,32,20,35,19,15A.15B	
Category		**111**	**122**
Strike Length of the ore body in m		276	154
Vertical Depth in m		50	50
Average width of the ore body in m		20.94	20.94
Tonnage Factor		3.88	3.88
Total Reserve in Tonnes		1121211	625603
Gradewise Reserve in MT	10-30% Cr2O3	0	0
	30-40 % Cr2O3	78485	43792
	40-52 % Cr2O3	134545	75072
	52% & Above Cr2O3	908181	506739

Hence, the category of reserve (211) between -315 mRL to -365 mRL =723100 MT.

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(g) Feasibility Mineral Resources (211) of Band -I between -365 mRL to -380 mRL (Crown Pillar)

Bore hole Considered	BH No – 14,18,32,20,35,19,15A.15B
Strike Length of the ore body in m	608
Vertical Depth in m	15
Average width of the ore body in m	20.94
Tonnage Factor	3.88
Total Reserve in Tonnes	740974

(h) Measured Mineral Resources (331) of Band -I between -380 mRL to -430 mRL (3rd Stope Block)

Bore hole Considered	BH No – 14,18,32,20,35,19,15A.15B	
Strike Length of the ore body in m	608	
Vertical Depth in m	50	
Average width of the ore body in m	20.94	
Tonnage Factor	3.88	
Total Reserve in Tonnes	2469915	
Gradewise Reservein MT	10-30% Cr2O3	0
	30-40 % Cr2O3	172894
	40-52 % Cr2O3	271691
	52% & Above Cr2O3	2025330

(I) Proved Mineble Reserve (111) of Band -I between -380 mRL to -430 mRL (3rd Stope Block)

Bore hole Considered		BH No 14,18,32,20,35,19,15A.15B	
Category		111	122
Strike Length of the ore body in m		296	134
Vertical Depth in m		50	50
Average width of the ore body in m		20.94	20.94
Tonnage Factor		3.88	3.88
Total Reserve in Tonnes		1202459(111)	544356(122)
Grade wise Reserve in MT	10-30% Cr2O3	0	0
	30-40 % Cr2O3	84172	38105
	40-52 % Cr2O3	132270	59879
	52% & Above Cr2O3	986016	446372

Hence, the category of reserve (211) between -380 mRL to -430 mRL =723100 MT.

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(j) Feasibility Mineral Resources (211) of Band -I between -430 mRL to -445 mRL(Crown Pillar)

Strike Length of the ore body in m	608
Vertical Depth in m	15
Average width of the ore body in m	20.94
Tonnage Factor	3.88
Total Reserve in Tonnes	740974

(k) Measured Mineral Resources (331) between -445 mRL to -495 mRL

Bore hole Considered	BH No.14, 15A,18 & 35	
Strike Length of the ore body in m	608	
Vertical Depth in m	50	
Average width of the ore body in m	18.08	
Tonnage Factor	3.88	
Total Reserve in Tonnes	2132572	
Gradewise Reservein MT	10-30% Cr2O3	0
	+30 to 52% Cr2O3	2132572

(l) Proved Mineble Reserve (111) of Band -I between -445 mRL to -495 mRL (4th Stope Block)

Bore hole Considered	BH No.14, 15A,18 & 35		
Category	111	222	211
Strike Length of the ore body in m	240	276	92
Vertical Depth in m	50	50	50
Average width of the ore body in m	18.08	18.08	18.08
Tonnage Factor	3.88	3.88	3.88
Total Resource in Tonnes	841805(10-30%=0, +30 to 52%)	968076(10-30%=0, +30 to 52%)	322692(10-30%=0,+30to 52%)

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Detailed calculation of Reserves for Band II

(a) Measured Mineral Resource (331) of Band-II between Surface and +46 mRL

BAND II RESERVE FROM SURFACE TO +46 mRL

Section	Area	Avg.Width	Volume	Bulk Density	Quantity	Grade	Mineable/ Non Mineable
	Sq.M	Mtr	Cum		MT	Cr2O3%	
1-1'	920	12	11040	4.2	8810	+10%	M
				3.7	12254	10.00%	
				3.5	11978	10.00%	
				3	994	10.00%	
				2.7	5067	10.00%	
	6440	12	77280	4.2	61669	10.00%	NM
				3.7	85781	10.00%	
				3.5	83849	10.00%	
				3	6955	10.00%	
				2.7	35472	10.00%	
2-2'	2418	8.5	20553	4.2	40572	10.00%	M
				3.7	6084	10.00%	
				3.5	5035	10.00%	
				3	11099	10.00%	
				2.7	11099	10.00%	
	2930	8.5	24905	4.2	49162	10.00%	NM
				3.7	7372	10.00%	
				3.5	6102	10.00%	
				3	13449	10.00%	
				2.7	13449	10.00%	
3-3'	2431	7.5	18233	3.5	63814	10.00%	M
	1101	7.5	8258	3.5	28901	10.00%	NM
4-4'	1269	6.5	8249	3.7	6104	10.00%	M
				3.5	17322	10.00%	
				2.7	4454	10.00%	
	277	6.5	1801	3.7	1332	10.00%	NM
				3.5	3781	10.00%	
				2.7	972	10.00%	

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5-5'	1766	15	26490	3	20662	10.00%	M
				2.7	52927	10.00%	
	176		2640	3	2059	10.00%	
				2.7	5275	10.00%	
6-6'	3146	5	15730	4.2	52853	10.00%	M
				3.5	11011	10.00%	
7-7'	4345	8	34760	4.2	23359	10.00%	M
				3.7	38584	10.00%	
				3.5	19466	10.00%	
				3	18770	10.00%	
				2.7	18770	10.00%	
8-8'	4486	17	76262	4.2	12812	10.00%	M
				3.7	53612	10.00%	
				3.5	112105	10.00%	
				2.7	72068	10.00%	
9-9'	3267	29	94743	4.2	171106	10.00%	M
				3.5	6632	10.00%	
				3	36950	10.00%	
				2.7	107439	10.00%	
10-10'	3565	7	24955	4.2	64983	10.00%	M
				3.5	3494	10.00%	
				3	3743	10.00%	
				2.7	19540	10.00%	
11-11'	3265	9	29385	4.2	90094	10.00%	M
				2.7	21422	10.00%	
12-12'	3300	16	52800	4.2	157450	10.00%	M
				2.7	41342	10.00%	
13-13'	2836	9	25524	4.2	62176	10.00%	M
				3.5	2680	10.00%	
				3	3829	10.00%	
				2.7	23431	10.00%	
13-13'	163	9	1467	4.2	3574	10.00%	NM
				3.5	154	10.00%	
				3	220	10.00%	
				2.7	1347	10.00%	
14-14'	2430	4	9720	3	29160	10.00%	M

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	724	4	2896	3	8688	10.00%	
15-15'	2645	5	13225	4.2	34993	10.00%	
				3.5	11572	10.00%	
				3	1587	10.00%	
				2.7	2857	10.00%	
15-15'	2204	5	11020	4.2	29159	10.00%	NM
				3.5	9643	10.00%	
				3	1322	10.00%	
				2.7	2380	10.00%	
16-16'	1435	9	12915	4.2	18985	10.00%	M
				3.7	4301	10.00%	
				3	11624	10.00%	
				2.7	9066	10.00%	
	6435	9	57915	4.2	85135	10.00%	NM
				3.7	19286	10.00%	
				3	52124	10.00%	
				2.7	40656	10.00%	
Total					2311406		

NM (211) – Non-mineable reserve, M (111) – Mineable Reserve.

(b) Proved Mineable reserves (111) of Band-II between Surface and +46 mRL

BAND II RESERVE FROM SURFACE TO +46 mRL							
Section	Area	Avg.Width	Volume	Bulk Density	Quantity	Grade	Mineable/ Non Mineable
	Sq.M	Mtr	Cum		MT	Cr2O3%	
1-1'	920	12	11040	4.2	8810	+10%	M
				3.7	12254	10.00%	
				3.5	11978	10.00%	
				3	994	10.00%	
				2.7	5067	10.00%	
2-2'	2418	8.5	20553	4.2	40572	10.00%	M
				3.7	6084	10.00%	
				3.5	5035	10.00%	
				3	11099	10.00%	
				2.7	11099	10.00%	

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3-3'	2431	7.5	18233	3.5	63814	10.00%	
4-4'	1269	6.5	8249	3.7	6104	10.00%	
				3.5	17322	10.00%	
				2.7	4454	10.00%	
5-5'	1766	15	26490	3	20662	10.00%	M
				2.7	52927	10.00%	
6-6'	3146	5	15730	4.2	52853	10.00%	M
				3.5	11011	10.00%	
7-7'	4345	8	34760	4.2	23359	10.00%	M
				3.7	38584	10.00%	
				3.5	19466	10.00%	
				3	18770	10.00%	
				2.7	18770	10.00%	
8-8'	4486	17	76262	4.2	12812	10.00%	M
				3.7	53612	10.00%	
				3.5	112105	10.00%	
				2.7	72068	10.00%	
9-9'	3267	29	94743	4.2	171106	10.00%	M
				3.5	6632	10.00%	
				3	36950	10.00%	
				2.7	107439	10.00%	
10-10'	3565	7	24955	4.2	64983	10.00%	M
				3.5	3494	10.00%	
				3	3743	10.00%	
				2.7	19540	10.00%	
11-11'	3265	9	29385	4.2	90094	10.00%	M
				2.7	21422	10.00%	
12-12'	3300	16	52800	4.2	157450	10.00%	M
				2.7	41342	10.00%	
13-13'	2836	9	25524	4.2	62176	10.00%	M
				3.5	2680	10.00%	
				3	3829	10.00%	
				2.7	23431	10.00%	
14-14'	2430	4	9720	3	29160	10.00%	M
15-15'	2645	5	13225	4.2	34993	10.00%	M
				3.5	11572	10.00%	

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				3	1587	10.00%	
				2.7	2857	10.00%	
16-16'	1435	9	12915	4.2	18985	10.00%	
				3.7	4301	10.00%	
				3	11624	10.00%	
				2.7	9066	10.00%	
Total					1652138		

Reserve available for Underground Mining of Band-II is as below.

(a) Measured Mineral Resource (332) of Band- II between +46 to -151 mRL.

Bore hole Considered	BH No. 16B,33,17B,36,38
Strike Length of the ore body in m	600
Vertical Depth in m	197
Average width of the ore body in m	6
Tonnage Factor	3.88
Total Reserve in Tonnes	2751696 (+10 % Cr2O3)

b) Indicated Mineral Resource (332) of Band- II between -151 to -301 mRL.

Bore hole Considered	BH No. 16B,34,33,17B
Strike Length of the ore body in m	600
Vertical Depth in m	150
Average width of the ore body in m	4
Tonnage Factor	3.88
Total Reserve in Tonnes	1396800 (+10 %Cr2O3)

c) Inferred Mineral Resource (333) of Band- II between -301 to -459 mRL.

Bore hole Considered	BH No.17A, 33,
Strike Length of the ore body in m	600
Vertical Depth in m	158
Average width of the ore body in m	3
Tonnage Factor	3.88
Total Reserve in Tonnes	1103472 (+10% Cr2O3)

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ABSTRACT OF RESERVES:

(A) Band I, Measured Mineral Resources (331)

Category	mRL considered	Measured Mineral Resources (331) in Tonnes	Proved Mineral Reserve (111) inTonnes	Probable Mineral Reserve (121) in Tonnes	Feasibility Mineral Resources (211) in Tonnes
Opencast	Surface to -2mRL	1279455	1279455	-	-
Opencast by Grab	-2mRL to -62mRL	3129702	-	3129702	-
Under Ground					
Sill Pillar	Below Opencast Mining by Grab to -250 RL	11053810	-	-	11053810
Block 1	-250 to -300 RL	2211600	1003950	560175-	647475
Sill Pillar	-300 to -315 RL	740974	-	-	740974
Block 2	-315 to -365 RL	2469915	1121211	625603	723100
Sill Pillar	-365 to -380 RL	740974	-	-	740974
Block 3	-380 to -430 RL	2469915	1202459	544356	723100
Sill Pillar	-430 to -445 RL	740974	-	-	740974

(B) Band I, Measured Mineral Resources (331)

Category	mRL considered	Indicated Mineral Resources (332) in Tonnes	111	Probable Mineral Reserve (122) inTonnes	Prefeasiblity Mineral Resources (222) in Tonnes	Feasiblity Mineral Resources (211) in Tonnes
Opencast	Nil	-		-	-	
Underground						
Block 4	-445 to -495	2132572	841805	-	968076	322692

(C) Band II, total Measured Mineral Resources (331)

Category	mRL considered	Measured Mineral Resources (331) in Tonnes	Proved Mineral Reserve (111) inTonnes	Feasiblity Mineral Resources (211) in Tonnes
Opencast	Surface to 46 RL	2311406	1652138	659268

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(D) Band II, total Indicated Mineral Resources (332)

Category	mRL considered	Indicated Mineral Resources (332) in Tonnes	Probable Mineral Reserve(122) inTonnes	Prefeasibility Mineral Resources (222) in Tonnes
Underground				
Block 1	+46 to -151	2751696	-	-
Block 2	-151 to -301	1396800	-	-

(E) Band II, total Inferred Mineral Resources (333)

Category	mRL considered	Inferred Mineral Resources (333) in Tonnes	Probable Mineral Reserve(122) inTonnes	Prefeasibility Mineral Resources (222) in Tonnes
Underground				
Block 3	-301 to -459	1103472	-	-

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The following tables shows the total reserves/ resources as per the UNFC code of Sukinda Mines (Chromite) of M/s IMFA Ltd **as on 01.07.2018.**

Reserve / Resources as on 01.07.2018 (in Lakh Tonnes)					
Classification	**UNFC Code**	**Band-I**	**Band-II**	**Grand Total**	**Grade Cr_2O_3**
A. Total Mineral Reserves					
1. Proved mineral reserves	111	54.49	16.52	71.01	+10%
2. Probable mineral reserves Probable mineral reserves	121 122	31.30 17.30	Nil Nil	31.30 17.30	+10%
Sub - Total		103.09	16.52	119.61	+10%
B. Total Remaining Resources					
1. Feasibility Mineral Resources	211	156.93	6.59	163.52	+10%
2. Prefeasibility Mineral Resources	221 222	Nil 9.68	Nil Nil	Nil 9.68	+10%
3. Measured Mineral Resources	331	Nil	Nil	Nil	
4. Indicated Mineral Resources	332	Nil	41.49	41.49	+10%
5. Inferred Mineral Resources	333	Nil	11.03	11.03	+10%
6. Reconnaissance Mineral Resources	334	Nil	Nil	Nil	
Sub - Total		166.61	59.11	225.72	+10%
Total Reserves+Resources (A+B)		**269.7**	**75.63**	**345.33**	+10%

Note: It is not be possible to quantify grade wise reserve, as normally there is considerable variation in size and grade distribution within the ore zone, which results variable recovery factor and bulk density. Thus tonnages arrived are tentative.

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Proved Mineral Reserve (111): Economically mineable part of measured mineral resources. Explored by core drilling of 50-100m grid spacing (exposed ore body in opencast working) with detailed mapping on 1 : 2000 scale. Measurement on thickness, mineralogical composition, etc are estimated from different geological sections prepared basing on the core drilling. Total 600 m strike length has already been proved and continuity of ore body extention in dip direction established up to -495 mRL. The feasibility study has been carried out and the assessment demonstrates with high degree of confidence.

Feasibility Mineral Resource (211): Feasibility mineral resources considered on the basis of G1 level of exploration over 600m strike length. The blocked ore in opencast working due to statutory bindings, sill pillar, crown & rib pillars for underground working has been taken into consideration in this category.

Probable Mineral Reserves (122): Area considered for Probable Mineral Reserves category is taken beyond the strike limit of 50 meters from the borehole intersections. Out of total 600 m strike length from -250mRL to -495 mRL part strike length has been considered for 111 category and part considered as 122 category. Other parameters for resources quantity estimate has been taken same as for 111 category.

Measured Mineral Resource (331): Mineral resources for which quantity, grade or quality, densities, shape, and physical properties are estimeted with high degree of confidence.

Indicated Mineral Resource (332): Indicated mineral resources considered for which tonnage, density, shape, physical content can be estimated with a reasonable rate of confidence. Based on the general exploration, sampling & analysis information, the reserve estimation has been carried out.

Inferred Mineral Resource (333): Inferred mineral resources considered for which tonnage, grade & mineral content can be estimated with low level of confidence. Based on the preliminary exploration data, the reserve estimation has been carried out.

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Parameters considered for classification of Resources estimation:

Economic Axis	Feasibility Axis	Geological Axis
1. Detailed exploration carried out by the lessee by way of core drilling since 1999-2000 from surface. Total 81 nos of bore holes have been drilled to delineate the ore body. 2. Mining plan has been prepared time to time and approved by the Indian Bureau of Mines. 3. Knowledge of forest & non forest & other land use data are available.	Geology : 1.Detailed exploration carried out. 2. Mining: Opencast fully mechanised method of mining is being carried out & the production , development is being done as per the plan. Feasibility of underground mining has been established by NIRM. 3. Environmental: Base line data on environment has been collected. Environmental Clearance has been obtained from MoEFCC, New Delhi. 4. Processing : The chrome ore raised from mines is stacked, analysed and transported to captive plants for use. 5. Infrastructure and Services and construction activities: Infrastructural facilities are available . 6. Costing: The cost of mining is economical.Feasibility study report attached. 7. Economic viability: The mining project shall be economically viable since the ore shall be supplied for charge chrome/ ferro chrome plants of the company.	1. Geological Survey : Mapping has been done in 1:2000 Scale. 2.Geochemical Survey : Samples collected from bore holes, ore faces & benches from O/C workings have been analyzed for different constituents. 3. Geophysical Survey: Not required, because total nos of 81 bore holes have been drilled in the lease area. 4. Technological: i) Pitting/Trenching- Not required at present. ii) Drilling- A total of 81 nos of drill holes have been drilled at 50 to 100m spacing. iii) Sampling- Sampling of stacked ore, drill core from boreholes and drill hole cuttings are being carried out. 5. Assay data : Analysis of samples generated are being for all radical pertaining to chromite. 6. Petrography : Wall rocks and its chemical analysis done. 7. Bulk density : Bulk density study was done at CSIR-IMMT. 8. Environmental setting: Monitoring of all environmental parameters are studied by authorised approved external agency.

A feasibility study report along with financial analysis for economic viability of the deposit as specified under the UNFC field guideline is given as Annexure -XXIX.

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(L) Mineral Reserves/Resources :

Mineral Resources has been estimated purely based on level of exploration with reference to the threshold value of minerals declared by IBM.

Level of Exploration	Resources in Lakh tons (Band I+BandII)	Grade
G1- Detailed exploration	265.49	+10% Cr2O3
G2- General exploration	68.47	+10% Cr2O3
G3- Prospecting	11.03	+10% Cr2O3
G4- Reconnaissance	-	

Reserve/ Resources as on 01.07.2018 As per UNFC classification

Reserve / Resources as on 01.07.2018 (in Lakh Tonnes)					
Classification	**UNFC Code**	**Band-I**	**Band-II**	**Grand Total**	**Grade Cr_2O_3**
A. Total Mineral Reserves					
1. Proved mineral reserves	111	54.49	16.52	71.01	+10%
2. Probable mineral reserves Probable mineral reserves	121 122	31.30 17.30	Nil Nil	31.30 17.30	+10%
Sub - Total		103.09	16.52	119.61	+10%
B. Total Remaining Resources					
1. Feasibility Mineral Resources	211	156.93	6.59	163.52	+10%
2. Prefeasibility Mineral Resources	221 222	Nil 9.68	Nil Nil	Nil 9.68	+10%
3. Measured Mineral Resources	331	Nil	Nil	Nil	
4. Indicated Mineral Resources	332	Nil	41.49	41.49	10.00%
5. Inferred Mineral Resources	333	Nil	11.03	11.03	+10%
6. Reconnaissance Mineral Resources	334	Nil	Nil	Nil	
Sub - Total		166.61	59.11	225.72	+10%
Total Reserves + Resources (A+B)		**269.7**	**75.63**	**345.33**	

Note: It is not possible to quantify grade wise reserve, as normally there is considerable variation in size and grade distribution within the ore zone, which results variable recovery factor and bulk density. Thus tonnages arrived are tentative.

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2.0 MINING

A. OPENCAST MINING:

a) Description on the existing as well as proposed method for excavation with all design parameters.

Present mining method: At present the mine is fully mechanized mine where opencast mining has been adopted. Opencast mining is concentrated in Band I orebody. In opencast mine the ore and overburden is being excavated by using HEMM in conjunction with Deep hole drilling and blasting where ever required. Till date the overall slope of the mines is being maintained at less than 30°, with individual bench adequately sloped.

Extent of Open Pit development as on 30.06.2018

Pit size in mtrs (Length x Width x Depth)	No. of benches	Bench Height (m)	Bench Width (m)	Pit Depth (m)	Top RL (m)	Bottom RL (m)	Overall pit Slope Angle
595 x 537 x 98	F/W: 19 H/W: 14	Max 8mtrs	Min 12mtrs	98	136mRL in H/W	38mRL	F/W: 22° H/W: 26°

Extent of Dump development as on 30.06.2018

Dump type	Area in Ha.	Height in Mtr	No of terraces	Overall Angle
Overburden	43.18	60 mtr	3	23°
Sub Grade	6.6	23 mtr	2	23°

Design Parameters: Opencast Mining

Top RL of opencast mine: 136mRL (H/W) & 158mRL (F/W)

UPL of opencast mine: (-)2mRL for Band I & 46mRL for Band II.

Bench Height: Maximum 8 mtrs

Bench Width: 8 to 12 mtrs

Gradient of Haul Roads: Maximum 1 in 16

Gradient of Short Ramp: Maximum 1 in 10

Width of Haul Roads: 13 to 15 mtrs

Overall Pit Slope Angle: Less than 30 degree from horizontal.

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Proposed Mining Methods: The present method of opencast mining in Band I shall continue till ultimate pit limit of Band I is reached. During 2018, Central Institute of Mining & Fuel Research (CIMFR), Dhanbad has reviewed and carried out the slope stability studies for opencast quarry of Band I and the waste dumpyard. CIMFR has recommended the overall pit slope angle of 30° with pit bottom of Band I at (-)2mRL alongwith increase in dump height from 60mtrs to 75mtrs (maximum upto 207mRL). Refer Annexure XII. Based on recommendations of CIMFR, opencast mining in Band I is proposed to be continued upto ultimate pit bottom of (-)2mRL and increase in height of overburden dump upto 75mtrs from ground level in four stages (maximum upto 207mRL). Opencast mining in Band II shall commence after exhaustion of opencast mining in Band I.

To mine out the locked ore in the benches as well as the ore below the ultimate pit bottom of Band I quarry, Dept. Of Civil Engineering, IIT Roorkee has designed a mining method using grab & has submitted it's report (Annexure XX). This report includes the geo-technical study undertaken by IIT, Roorkee, which confirms that mining can be done safely by this method. The basic principle is to excavate vertically downward in ore bearing zone by grab and support the side walls by series of micropiles of steel casings. The excavation is done over the orebody called as Panels. Each panel consisting of number of sub-panels having maximum size of 6 m x 4 m and 60 m deep. After excavation, the panels are backfilled by overburden materials available in the mine before the adjacent panel is taken up for excavation. After backfilling is completed, the casings from micropiles are withdrawn. In order to establish the method, a trial of opencast mining by grab is proposed over a panel size of 24m x 12m on 78mRL bench in the western side during the year 2018-19 & 2019-20. Necessary permission from DGMS has been obtained for opencast mining by grab (Annexure XVIII). Based on the results of the trial mining, the method shall be proposed for extraction of chrome ore deposit in other areas of the mine. It is estimated that approx. 56000 tonnes of chrome ore will be mined during trial mining on 78mRL bench by this method.

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Design Parameters considered for Opencast Mining by Grab

Maximum size of Sub Panels: 6m (Length) x 4m (Width) x 60m (Depth)

Maximum Depth of Excavation: 60mtrs

Maximum Length of Micro Piles: 75mtrs

Development for underground mining in Band I is proposed to commence from 2021-22 after obtaining all statutory clearances. It is proposed to access the ore body from the hanging wall side by combination of two shafts, i.e. one circular and another rectangular shaft. National Institute of Rock Mechanics (NIRM) has suggested both "Sub Level Stoping" or "Blasthole Stoping" with post filling as suitable method of stoping. However, due to higher production rate, less waiting time for stoping and less dilution into ore, NIRM has given more advantage to "Blasthole Stoping" with post filling. Accordingly, "Blasthole Stoping with post filling" method has been proposed in underground working.

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b) **Year-wise tentative Excavation in Cubic Meters indicating development, ROM, pit wise.**

I. In situ Tentative Excavation for Opencast Mining

Year	Pit No	Total tentative Excavation (CuM)	Top Soil (CuM)	Overburden (CuM)	ROM (CuM)		Mineral reject	ROM/ Waste Ratio (CuM/CuM)	Projected Av Grade (Cr_2O_3 %)
					Ore (CuM)	Mineral reject (CuM)			
1	2	3	4	5	6	7	8	9	10
2019-20	I	1197387	0	1100000	88116	9271	Chemically Subgrade: 10% to (-) 30% Cr_2O_3.	1 : 11.3	48
2020-21	I	1197116	0	1100000	87880	9236		1 : 11.3	48
2021-22	I	1186504	0	1100000	86504	0		1 : 12.7	52
2022-23	I	655688	0	600000	55688	0		1 : 10.8	52
	II	536289	0	500000	27030	9259		1 : 13.8	43
2023-24	I	0	0	0	0	0		NA	NA
	II	1176656	0	1100000	54436	22220		1 : 14.3	42

I: Band I Quarry. II: Band II Quarry. The yearwise excavations are tentative.

In situ Tentative Excavation during Trial of Opencast Mining by Grab

Year	Pit No	Total tentative Excavation (CuM)	Top Soil (CuM)	Sideburden (CuM)	ROM (CuM)		Mineral reject	ROM/ Waste Ratio (CuM/CuM)	Projected Av Grade (Cr_2O_3 %)
					Ore (CuM)	Mineral reject (CuM)			
1	2	3	4	5	6	7	8	9	10
2019-20	I	12854	0	1285	11569	0	NA	1 : 0.11	54

II. Dump rehandling (for the purpose of recovery of mineral):

As the existing dump consists of waste overburden material, so there is no proposal for dump rehandling for the purpose of recovery of mineral. However, approx. 14400 CuM of overburden from dump is proposed to be utilised for backfilling of mined out sub panels during trial of opencast mining by grab.

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APPROVED
21/10/18
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REGIONAL CONTROLLER OF MINES
भारतीय खान ब्यूरो
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c) Individual year wise development plans and sections showing pit layouts, dumps, stacks of mineral reject.

Individual year wise development plans and sections showing pit layouts, dumps, stacks of mineral reject are shown in plate nos: SMC/07. Summary of year wise mine development during the Mining Plan period is given below:

Particulars	2019-20	2020-21	2021-22	2022-23	2023-24
ROM in tonnes (+10% Cr_2O_3)					
Opencast Mining Band I	351000	351000	351000	226000	-
Opencast Mining Band II	-	-	-	125000	260000
Total	351000	351000	351000	351000	260000
Ore in tonnes (+30% Cr_2O_3)					
Opencast Mining Band I	326000	326000	351000	226000	-
Opencast Mining Band II	-	-	-	100000	200000
Total	326000	326000	351000	326000	200000
Mineral Reject / Sub Grade (+10% to -30% Cr_2O_3) in Tonnes					
Opencast Mining Band I	25000	25000	-	-	-
Opencast Mining Band II	-	-	-	25000	60000
Total	25000	25000	-	25000	60000
Overburden in CuM					
Opencast Mining Band I	1100000	1100000	1100000	600000	-
Opencast Mining Band II	-	-	-	500000	1100000
Total	1100000	1100000	1100000	1100000	1100000
ROM (tonnes) : Overburden (CuM)					
Opencast Mining Band I	01: 3.1	1 : 3.1	1 : 3.1	1 : 2.6	-
Opencast Mining Band II	-	-	-	1 : 4	1 : 4.2
Total	01: 3.1	1 : 3.1	1 : 3.1	01: 3.1	1 : 4.2
Backfilling in Mined out area (CuM)					
Band I	-	-	-	500000	1100000
Band II	-	-	-	-	-
Total	-	-	-	500000	1100000

Based on time series data and few sample test, approximate tonnage factor / bulk density being considered at present for different grades of chrome ore are, High Grade (+52% Cr_2O_3): 4.20 Tonne/CuM, Medium Grade (40 to 52% Cr_2O_3): 3.50 Tonne/CuM & Low Grade (10 to 40% Cr_2O_3): 2.70 Tonne/CuM. Thus yearwise tonnages are given accordingly.

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Proposed Mining during 2019-20

A. Opencast Mining

Name of Ore Band	Band I
Overall direction of excavation	West to East & Quarry Bottom
Top mRL	136mRL (H/W) & 158mRL (F/W)
RL of Quarry floor	30 mRL
No of Benches (wrt H/W top bench)	13 nos
Depth of Excavation (wrt H/W top bench)	106 mtrs
Direction of Advance	Towards East
Grid location of existing & proposed workings	3000 E – 3700 E 1400 N – 2300 N
ROM in CuM	97387
ROM in Tonnes	351000
Ore in tonnes (+30% Cr_2O_3)	326000 Tonnes
Mineral Reject/Sub Grade (+10% to -30% Cr_2O_3)	25000 Tonnes
Overburden in CuM	1100000
ROM (Tonnes) : Overburden (CuM)	1 : 3.1
Dumping of Overburden	Overburden Dump
Storing of Mineral Reject/Sub Grade	Sub-Grade Dump
Others: 1. Trial of Opencast Mining by Grab on 78mRL western ore bench. If the trial is successful, total production of ROM both from opencast and opencast by grab during 2019-20 shall be kept maximum at 351000 tonnes. 2. Construction of Gabion Wall / RCC Wall, over eastern side benches of 94mRL, 102mRL & 110mRL. Refer Plate No: SMC/07. 3. Southern side of Sub Grade dump to be re handled, in order to make scope for quarry expansion. Refer Plate No: SMC/07.	

Proposed Trial of Opencast Mining by Grab in Band I.

Particular of Year & Ore Band	2019-20 in Band I
Location of Trial Panels	78mRL (West) Bench
ROM in Tonnes (+10% Cr_2O_3)	50000
Ore in Tonnes (+30% Cr_2O_3)	50000
Mineral Reject / Sub Grade (+10% to -30% Cr_2O_3) in Tonnes	-
Side burden in CuM	1285
Side burden dumping area	Overburden Dump
ROM (tonnes) : Overburden (CuM)	1 : 0.03
Backfilling Quantity (CuM)	12854

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Proposed Mining during 2020-21

Name of Ore Band	Band I
Overall direction of excavation	West to East
Top mRL	136mRL (H/W) & 158mRL (F/W)
RL of Quarry floor	22 mRL
No of Benches (wrt H/W top bench)	14 nos
Depth of Excavation (wrt H/W top bench)	114 mtrs
Direction of Advance	Towards East
Grid location of existing & proposed workings	3000 E – 3700 E 1400 N – 2300 N
ROM in CuM	97116
ROM in tonnes	351000
Ore in tonnes (+30% Cr_2O_3)	326000 Tonnes
Mineral Reject/Sub Grade (+10% to -30% Cr_2O_3)	25000 Tonnes
Overburden in CuM	1100000
ROM (Tonnes) : Overburden (CuM)	1 : 3.1
Dumping of Overburden	Overburden Dump
Storing of Mineral Reject/Sub Grade	Sub-Grade Dump

Proposed Mining during 2021-22

Name of Ore Band	Band I
Overall direction of excavation	West to East & Quarry Bottom
Top mRL	136mRL (H/W) & 158mRL (F/W)
RL of Quarry floor	14 mRL
No of Benches (wrt H/W top bench)	15 nos
Depth of Excavation (wrt H/W top bench)	122 mtrs
Direction of Advance	Towards East
Grid location of existing & proposed workings	3000 E – 3700 E 1400 N – 2300 N
ROM in CuM	86504
ROM in tonnes	351000
Ore in tonnes (+30% Cr_2O_3)	351000
Mineral Reject/Sub Grade (+10% to -30% Cr_2O_3)	Nil
Overburden in CuM	1100000
ROM (Tonnes) : Overburden (CuM)	1 : 3.1
Dumping of Overburden	Overburden Dump
Storing of Mineral Reject/Sub Grade	Sub-Grade Dump

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Proposed Mining during 2022-23

Name of Ore Band	Band I	Band II
Overall direction of excavation	West to East & Quarry Bottom	West to East
Top mRL	136mRL (H/W) & 158mRL (F/W)	155mRL (H/W) & 155mRL (F/W)
RL of Quarry floor	6mRL and Sump at (-)2mRL	134mRL
No of Benches (wrt H/W top bench)	16 nos	3
Depth of Excavation (wrt H/W top bench)	130 mtrs	21
Direction of Advance	Towards East	Towards East
Grid location of existing & proposed workings	3000 E – 3700 E 1400 N – 2300 N	
ROM in CuM	55688	36289
ROM in tonnes	226000	125000
Ore in tonnes (+30% Cr_2O_3)	226000	100000
Mineral Reject/Sub Grade (+10% to -30% Cr_2O_3) in Tonnes	Nil	25000
Overburden in CuM	600000	500000
ROM (Tonnes) : Overburden (CuM)	1 : 2.6	1 : 4
Overburden	Overburden Dump	Back filling in mined out quarry of Band I
Storing of Mineral Reject/Sub Grade	Sub-Grade Dump	Sub-Grade Dump
Note: Opencast mining in Band II shall commence after exhaustion of opencast mining in Band I.		

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Proposed Mining during 2023-24

Name of Ore Band	Band II
Overall direction of excavation	West to East
Top mRL	155mRL (H/W) & 155mRL (F/W)
RL of Quarry floor	118 mRL
No of Benches (wrt H/W top bench)	5 nos
Depth of Excavation (wrt H/W top bench)	37 mtrs
Direction of Advance	Towards East
Grid location of existing & proposed workings	1300 N – 2300N 3000 E – 3700 E
ROM in CuM	76656
ROM in tonnes	260000
Ore in tonnes (+30% Cr_2O_3)	200000
Mineral Reject/Sub Grade (+10% to -30% Cr_2O_3)	60000
Overburden in CuM	1100000
ROM (Tonnes) : Overburden (CuM)	1 : 4.2
Dumping of Overburden	Back filling in mined out quarry of Band I
Storing of Mineral Reject/Sub Grade	Sub-Grade Dump
Note: No Opencast mining in Band I as Band I quarry has reached it's ultimate pit limit. Overburden being generated during opencast mining of Band II shall be backfilled in mined out quarry of Band I.	

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Geological Section wise ROM excavation quantity:

Band I (Opencast Mining)					
	ROM in Tonnes				
Sections	2019-20	2020-21	2021-22	2022-23	2023-24
A-A'	-	-	-	-	-
B-B'	-	-	16548	-	-
C-C'	17640	-	123603	15120	-
D-D'	53760	17640	82740	49980	-
E-E'	51660	47880	45360	66301	-
F-F'	112349	43150	82749	94599	-
G-G'	90781	184710	-	-	-
H-H'	24810	57620	-	-	-
Sub Total	351000	351000	351000	226000	-

Band II (Opencast Mining)					
Section	2019-20	2020-21	2021-22	2022-23	2023-24
1-1'	-	-	-	29864	9988
2-2'	-	-	-	25118	25118
3-3'	-	-	-	14254	14254
4-4'	-	-	-	5229	5229
5-5'	-	-	-	12459	12459
6-6'	-	-	-	10373	9277
7-7'	-	-	-	19546	17028
8-8'	-	-	-	8156	74911
9-9'	-	-	-	-	78962
10-10'	-	-	-	-	10759
11-11'	-	-	-	-	2015
Sub Total	-	-	-	125000	260000
Grand Total (Band I + II)	351000	351000	351000	351000	260000

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d) Brief Description on salient features of the proposed method of working indicating Category of mine.

i. Opencast Mining in Band I.

The proposed method of working is fully mechanized opencast mining using HEMM and in conjunction with deep hole blasting where ever required. Drilling and blasting requirement is approximately 10% of the total excavation. Overall slope of the quarry to be maintained at less than 30°, with individual bench adequately sloped. Overburden to be dumped over the existing dumpyard. Based on recommendation of Central Institute of Mining & Fuel Research (CIMFR), Dhanbad, (Refer Annexure XII) the pit bottom of Band I quarry shall be (-)2mRL with overall pit slope angle as 30° from horizontal and the height of overburden dump will be increased upto 75mtrs from ground level in four stages, i.e. maximum upto 207mRL. Conventional opencast mining shall reach it's ultimate limits by 2022-23. The mine is fully mechanized opencast mine & is categorized under Category "A (FM)".

ii. Opencast Mining in Band II

It is proposed to commence opencast mining in Band II after exhaustion of Band I from the year 2022-23. The proposed method of working would be fully mechanized opencast mining using HEMM and in conjunction with deep hole blasting where ever required. Overall slope of the quarry to be maintained at less than 30°, with individual bench adequately sloped. Opencast mining will commence from western side of lease area. Overburden being generated during opencast mining of Band II shall be backfilled in the mined out areas of Band I. The ultimate pit limit for Band II opencast mine is proposed to be 46mRL.

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iii. Underground Mining in Band I.

It is proposed to commence development works for underground working in Band I, by way of accessing the ore body from the hanging wall side by combination of two shafts (i.e. one circular and another rectangular shaft) and underground development in the footwall of ore body. The depth of the shafts are planned to be more than 700m. The finished diameter of main shaft (circular) shall be 6 m and dimension of service shaft (rectangular) shall be 5.5m X 5.1m. Initially shaft sinking is proposed to be carried out by drilling & blasting. The blasted material to be hoisted through a sinking winder. Later on shafts are to be equipped with koepe/Double Drum winding system. It is proposed to adopt "Blasthole Stoping with Post Filling" as method of stoping for underground mine. In this method two level are developed along the strike of the ore body. The top level is drill level and bottom is extraction level. From extraction level, a trough drive is made within the strike of the ore body. The trough rings after blasting creates a funnel shaped opening wherein the blasted ore from the upper level are collected and guided to the draw points. The blasted ore is recovered from the trough bottom and the stope is back filled. It has been proposed to develop the first stope block between -250mRL to -300RmL, with stope block height of 50m. As per report of National Institute of Rock Mechanics, NIRM, the maximum height of stope block should be 50m, width should be within 20 m (or the maximum ore body width), length should be 20 m (maximum). The recommended rib pillar and sill pillar thickness are 6m & 15m respectively.

EXTENT OF MECHANIZATION:

Opencast Mine: Following machinery or equivalent alongwith miscellaneous equipments are proposed to be deployed in Opencast Mining.

Machinery Category	Specification / Capacity	Numbers
Excavator	0.9 to 3.5 CuM	5
Dumper	32 Tonne	26
Drill Machine	110mm	1
Dozer	170 to 200 HP	3
Grader	135 HP	1
Front end Loader	0.3 to 1.7 CuM	2
Water Tanker	9 to 14 KL	3
Explosive Van	2.39 Tonnes	1
Diesel Dispensing Unit	6 KL	1
Pumps	Various Capacities	As per requirement
Diesel Generator	Various Capacities	As per requirement
Roller		1
Ambulance		1
Light Vehicle		As per requirement

The make, model, capacity and number may vary as per specific requirement.

Opencast Mining by Grab: Following machinery or equivalent alongwith miscellaneous equipments are proposed to be deployed during trial of Opencast Mining by Grab.

Machinery Category	Specification / Capacity	Numbers
Drilling Machine - Capable of simultaneous drilling & casing	Hole Dia: > 230 mm & hole up to 100 m	2 nos
Crane mounted Grab	Volume: 3 CuM Empty Wt: 5.8 Tonne	1 Nos
Excavator, Loader & Dozer	Excavator: 0.9 CuM Loader: 1.7 CuM Dozer: 170 HP	Excavator: 1 Loader: 1 Dozer: 1
Dumper	16 ~ 32 Tonne	2 Nos
Pumps, Welding Machine etc		As per requirement.
Ancilliary equipment		As per requirement.

The make, model, capacity and number may vary as per specific requirement.

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e) Brief description of the layout of mine workings, pit road layout, the layout of faces and sites for disposal of overburden/waste

Layout of Opencast Mine Working:

The mine has been developed for exploitation of Band I ore body. Present quarry surface in Band I is at 136mRL in H/W side and 158mRL in F/W side. The quarry in Band I has been developed with the bench configuration of 8mtrs height (max) & 10-12 mtrs width both in overburden and ore. Overall slope of the quarry is being maintained less than 30°. Present pit bottom is at 38mRL, which is proposed to be deepened upto (-)2mRL. The main sump for collection & dewatering is maintained at the quarry bottom. Suitable pumping arrangement has been made. The size of existing quarry is 595 mtrs (length) to 537 mtrs (width). The mine extends in east direction along the strike of the ore body. The layout of mine workings is shown on the surface plan. Refer Plate No SMC/03.

It is proposed to commence opencast mining in Band II after exhaustion of Band I from the year 2022-23. The proposed method of working would be fully mechanized opencast mining using HEMM and in conjunction with deep hole blasting where ever required. Overall slope of the quarry to be maintained at less than 30°, with individual bench adequately sloped. Opencast mining will commence from western side of lease area. Overburden being generated during opencast mining of Band II shall be backfilled in the mined out areas of Band I. The ultimate pit limit for Band II opencast mine is proposed to be 46mRL.

Pit Road Layout in Band I:

The main haul road up to 86mRL has been provided in the hangwall. From 86mRL to pit bottom, the haul road has been provided in footwall side. The pit roads is having a gradient of maximum 1 in 16, with width of 12-15 mtrs. Provisions of berm & drain have been made along haul roads.

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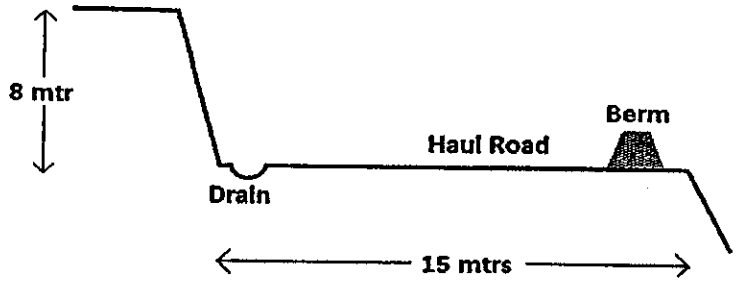
The Pit road layout of mine workings has been shown on the yearwise development plans. Refer Plate No SMC/07. Width of haul road are 12 mtrs with general gradient of maximum 1 in 16. Berms have been provided all along the haul roads as a safety barrier. The height of berm is 1.5 mtrs, width 1-2 mtrs & height 1 mtr. Berm has been designed as per tyre size of largest dumper plying on the haul road.



(Schematic Diagram showing Haul Road Design)

The haul road are maintained slightly inclined towards toe of the bench, so as to divert the water from the top surface of road. Near the toe of the road a drain is maintained to channelise water and thereby causing less damage to roads/benches. To provide one way traffic for vehicles road dividers have been provided at strategic locations. Haul roads are regularly maintained by engaging dozers & graders to clear spillages, undulations and pot holes, etc. Water sprinkling is done at regular intervals to suppress dust.

System of Drilling & Blasting:

Generally blasting is carried out for medium hard to hard rock formations, where excavator can't be engaged directly. Hard materials are dislodged by drilling and blasting prior to excavation and loading. Blast design has been made prior to drilling & blasting. Recommendations of Blast vibration studies as conducted by Indian School of Mines, Dhanbad are followed in order to control blasting & related vibrations within limit.

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Drilling is done by 115 diameter DTH drills. Staggered pattern of drilling is followed for blasting. Broad drilling parameters are as below.

Depth of Blast hole 8.5 m
Burden 2.5 to 4.5 m
Spacing 3 to 6 m
Hole diameter 115 mm

Emulsion / slurry explosives of 83mm diameter are used for blasting. Electric / Non electric delays and detonators are used for providing delays & blast initiation respectively. The average powder factor experienced during the last 5 years is mentioned below.

Year	Av PF (CuM/Kg)
2013-14	4.24
2014-15	4.30
2015-16	4.32
2016-17	4.60
2017-18	5.1

Based on the parameters above and past mining experiences, the powder factor is expected to be around 4 to 5 CuM/Kg of explosive.

Annual explosive requirement:

Considering maximum excavation of 11.97 lakh CuM of excavation per annum, 10% of blasting requirement & Av Powder Factor of 4.5 CuM/Kg, the requirement of explosives shall be approximately 28 tonnes per annum. The existing 5 tonne capacity magazine, situated in the mine shall meet the storage requirement of explosives needed for both Sukinda Mines (Chromite) & adjoining Mahagiri Mines (Chromite) of the same Lessee. An explosive van of 2.39 tonne capacity is being used for transportation of explosives and accessories to site and back to magazine.

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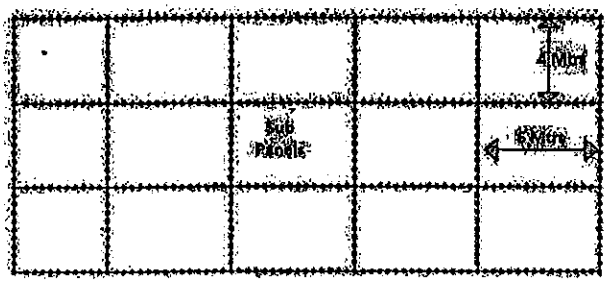
Site for disposal of overburden/waste:

The overburden is being dumped on the existing waste dump yard situated towards northern side of the leasehold area. The dump is made of three stages. Each stage is of 20mtrs height with adequate width of terrace. The size of existing dumpyard is 1200 mtrs (av length) to 440 mtrs (av width). It is proposed to increase the height of dump upto 75mtrs from ground level in four stages, i.e. maximum upto 207mRL. The layout of overburden dumpyard is shown on the surface plan. Refer Plate No: SMC/03. The overburden being generated during opencast mining of Band II shall be backfilled in the minedout areas of Band I quarry. Refer Plate No: SMC/11.

Layout of Panel for Trial of Opencast Mining by Grab:

In the opencast mining by grab method, excavation upto 60m depth has been considered with supporting the side walls by micropiles of steel pipes as per geo-technical study undertaken by Dept. of Civil Engineering, IIT, Roorkee, which confirms that mining can be done safely by this method. Refer Annexure XX. To support the sidewalls, vertical holes are drilled upto a maximum depth of 75m and simultaneously cased with steel pipes. The supporting & excavation is done over the orebody called as Panels. Each panel consisting of numer of sub-panels having maximum size of 6 m x 4 m and 60 m deep. Thereafter, the ore from sub-panel is excavated by engaging crane mounted grab. After excavation, the panels are backfilled by overbuden materials available in the mine before the adjacent panel is taken up for excavation. After backfilling is completed, the casings from micropiles are withdrawn.

(Schematic diagram showing sub panel size on 78mRL bench)



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f) Conceptual Mine planning of Opencast Workings up to the end of lease period taking into consideration the present available reserve describing the excavation, recovery of ROM, disposal of waste, backfilling of voids, reclammation & rehabilitation.

Reserves and life of opencast working:

The proved mineable reserve in opencast working of Band I under UNFC 111 category as on 01.07.2018 is 12.79 Lakh tonnes considering ultimate pit limit up to (-)2 mRL.

The proved mineable reserve in opencast working of Band II under UNFC 111 category as on 01.07.2018 is 16.01 Lakh tonnes considering ultimate pit limit up to 46 mRL.

During the period from 2019-20 to 2023-24, it has been proposed to exploit 16.64 Lakh tonnes of chrome ore from opencast workings from Band I & II, out of which 12.79 Lakh tonnes is proposed from opencast mining of Band I and remaining 3.85 Lakh tonnes from opencast mining of Band II.

After the present plan period, the life of the opencast mine shall be 5 years, i.e. upto 2028-29, keeping a maximum production level of 2.6 LTPA from opencast mining in Band-II.

The trial of opencast mining by grab is proposed at 78mRL bench in the western side of Band I quarry during the year 2018-19 & 2019-20. Based on the results of the trial mining, the method shall be proposed for extraction of chrome ore deposit in other areas of the mine. On successful implementation of opencast mining by grab, approx. 31.30 Lakh tonnes of chrome ore shall be added to the reserve, which shall extend the life of opencast mining in Band I by another 7 years keeping a production level of 4.5 Lakh tonnes per annum by this method.

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Conceptual opencast mine excavation:

The ultimate pit limit for opencast mine is considered up to (-)2 mRL & for opencast mining by grab as (-)62 mRL. For Band II, the ultimate pit limit has been considered as 46mRL.

Following aspects have been taken into consideration while designing the open pit excavation.

1. CIMFR has recommended the ultimate overall pit slope angle of 30°, pit bottom as (-)2mRL in Band I and height of dump as 75mtrs from ground level in four stages upto 207mRL. CIMFR has also recommended for 75mtrs of minimum distance between quarry edge and dump toe. CIMFR report is enclosed as Annexure XII.
2. As per opencast mining by grab method designed by Dept. Of Civil Engineering, IIT Roorkee, vertical ecavation upto 60mtrs depth in ore bearing zone is feasible by supporting side walls by series of micro piles. Refer Annexure XX.
3. Similar to Band I pit configuration, Overall pit slope angle of 30° and pit bottom as 46mRL has been considered for Band II opencast working.

Details of conceptual excavation, recovery of ROM:

Particulars of Mine		**Opencast Mining in Band-I**	**Opencast Mining by Grab in Band-I**	**Opencast Mining in Band-II**
RL of Pit Bottom		(-) 2mRL	(-) 62mRL	46 mRL
Number of benches developed		16 nos of benches (wrt H/W top bench)	50 nos of panels (each 12mts length)	13
Mineable Reserve: (as on 01.07.2018)	+30% Cr_2O_3	12.29 Lakh tonnes	31.30 Lakh tonnes	12.31 Lakh tonnes
	10 to (-) 30% Cr_2O_3	0.5 Lakh tonnes	Nil	3.70 Lakh tonnes
Overburden		39 Lakh CuM	0.81 Lakh CuM	67.64 L CuM
ROM : Overburden (Tonne : CuM)		1 : 3	1 : 0.02	1 : 4.2
Period of Working		2019-20 to 2022-23	To be ascertained after completion of trial mining.	2022-23 to 2028-29

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Disposal of Overburden & Backfilling in Mined out Quarry of Band

Year	Generation of overburden from Opencast Working (in L CuM)			Disposal of Overburden (in L CuM)			Utilisation of Overburden from Dump Yard (in L CuM)
	Band I		Band II	Dumping in Waste Dumpyard		Backfilling in Mined out Areas of Band I	Backfilling in Opencast Mining by Grab Panels
	Opencast	Opencast mining by Grab	Opencast	Upto 3rd Stage (60mtrs)	Upto 4th Stage (75mtrs)		
2019-20	11	0.01 (Trial)	-	11	-	-	0.14 (Trial)
2020-21	11	-	-	10.5	0.5	-	-
2021-22	11	-	-	-	11	-	-
2022-23	6	-	5	-	6	5	-
2023-24	-	-	11			11	-
Sub Total	**39**	**0.01**	**16**	**21.5**	**17.5**	**16**	**0.14**
Conceptual	-	0.8	51.64	0.00	0.00	54	8.3
G Total	**39**	**0.81**	**67.64**	**39**		**70**	**8.3**

There will be generation of marginal quantity of top soil during mining of Band II. Top soil shall be properly stored and utilised for plantation purpose.

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Reclamation and Rehabilitation:

A. Mined out area over Band I

During this Plan period, the present opencast mining in Band I is proposed to continue till ultimate pit limit of (-)2 mRL is reached. After completion of opencast mining, the mined out area of Band I shall be back-filled by overburden being generated during opencast mining of Band II and waste being generated from underground developments of Band I. Opencast working in band II is proposed to start from 2023-24. Accordingly, backfilling in mined out areas of Band I quarry shall also commence from 2023-24. Mined out quarry of Band I is proposed to be backfilled upto 114 mRL and can accommodate about 70 L CuM of overburden. Reclaimed area in mined out area of Band I shall be utilised for mineral storage & processing. A portion of reclaimed area (backfilled upto 136mRL) in mined out area of Band I shall be utilised for development of infrastructure purpose. After cessation of mining activities, rehabilitation of the back-filled area over Band-I shall be done by planting local species.

Trial of opencast mining by grab is proposed in 2019-20. Based on the results of the trial mining, the method shall be proposed for extraction of chrome ore in other areas of the Band I opencast quarry, where the conventional opencast would have reached it's ultimate limits. Upon implementation of opencast mining by grab, the opencast mining in Band II shall be deferred by few years.

B. Mined out area over Band II:

Mined out area of Band II is proposed to be reclaimed upto 78mRL by rehandling overburden from dumpyard & waste being generated from underground workings of Band I. In the conceptual end the backfilled areas of Band II is proposed to be rehabilitated by planting local species.

The above details are shown in the conceptual plan & section. Refer plate no: SMC/15 & SMC/16.

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B. UNDERGROUND WORKING

Leaving a safe parting of 248 mtrs below ultimate opencast pit limit of Band II i.e. (-)2mRL, underground workings is proposed to be commenced from 2021-22 after getting all statutory clearances. As per guidelines of the Geo-technical report prepared by National Institute of Rock Mechanics (NIRM) (refer Annexure XXI), detailed mine planning for underground mining has been done for Band I from -250mRL and below.

As per NIRM report, the wall rock, namely, serpentinite, which are in contact are weak till -125 to -150 mRL, and the ore body is also weak till -175 to -200 mRL. NIRM has developed 3D numerical models and the extraction sequence was simulated. Output in the form of displacement and safety factors was obtained from the models, and the results of parametric study were compared. It is observed that the displacements were higher in the elevations between -175 mRL and -225 mRL and reduced significantly beyond -250 mRL. This can be attributed to the fact that the strength of the ore body is less from -100 mRL to -250 mRL (GSI : 25 - 35), and it improved considerably beyond -250 mRL (GSI : 40 - 60). Hence, it is proposed to commence the underground development and mining below (-)250mRL.

i) Mode of Entry – Production (Circular) Shaft & Service (Rectangular) Shaft

It is proposed to have two vertical shafts. One to be used for production and another for services. The depth of the production shaft & service shaft is proposed to be 705mtrs & 645mtrs respectively. The location of shafts have been choosen by gravity distance consideration. As there is no space on the footwall side and the dip of the ore body is more than 80 degree, hence hanging wall location of shafts have been chosen. The distance between two shafts shall be 30 mtrs. Both the shafts shall be inter connected at regular intervals, to establish fresh air base as close to the working place as practically possible during sinking.

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The following parameters of vertical shafts have been proposed:

Particulars	Main Shaft (Circular)	Service Shaft (Rectangular)
Location	3178E & 2136N	3147E & 2117N
Depth of Shaft	475 m	475 m
Shape	Circular	Rectangular
Size of Shaft	Diameter: 6 mtrs	5.5 mtrs X 5.1 mtrs
Hoisting Capacity	9 Lakh tonnes per annum	For man and material winding
Pay Load	9 tonnes	8 tonnes
Winding System	Koepe Winder	Double Drum Winder
Approx. H.P.	2500	2000
Remarks	The size of shaft has been decided, keeping in mind hoisting capacity of approx. 9 Lakh tonnes of ROM & proportionate waste to be generated from underground.	The size of the shaft has been decided keeping in mind the maximum size of machinery which shall be lowered through the shaft.

Brief description on Development:

It is proposed to develop both the shafts either in conventional or faster sinking method. The top portion will have shaft collar to support head frame & other structures. The shaft shall be concrete lined upto the hard rock formations. Thereafter it will be supported by rock bolts. Keys shall be provided in the lining. Weep holes / water drainage garlands shall be provided at intervals throughout the shaft. However, study shall be conducted by a reputed scientific institute for support design of the vertical shafts.

Shaft Sinking Method:

The shafts will be sunk by wedge/burn cut drilling and blasting. Progress per round will vary between 3 to 5 mtrs. Blasted muck is loaded and taken out of the shaft by sinking winders. Side wall is lined in case of weak strata and is rock bolted incase of competent strata. Check survey is conducted at regular intervals to check the verticality of shaft. The cycle is repeated till shafts reaches their desired depth.

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Safety Precaution measures during Shaft Sinking: Following safety precautions will be taken during sinking of shafts.

1. Ventilation of bottom of shaft by auxillary ventilation fans.
2. Pumping arrangement to pump out any accumulation of water.
3. Provision of ladders & scaffold for protection to personnel working at shaft bottom.
4. Temporaray lining of side walls followed by permanent lining or rock bolting.

Brief description on Stoping Method:

The geo-technical analysis of the rock properties in the hangwall and footwall of the ore body at the levels below -200 mRL have indicated that the rocks are competent for mining. Accordingly, the size of the stopes have been designed by NIRM considering the self sustainability of rocks below -200mRL.

NIRM has proposed Blast Hole Stoping method of extraction of ore followed by post filling. This method is practiced for steeply dipping ore bodies for high production level and maximum ore recovery.

In this method two level are developed along the strike of the ore body . The top level is Drill level and bottom is Extraction level. From extraction level, a trough drive is made within the strike of the ore body. The trough rings, after blasting create funnel shaped opening wherein the blasted ore from the upper level are collected and guided to the draw point. The blasted ore is recovered from the trough bottom and after complete extraction of ore from stope, it is back filled.

Production drilling shall be done with a combination of DTH drilling and Long hole drilling. The trough shall be of 12 m height and shall be drilled by long hole drill machine. The rest 38mtrs shall be drilled by a combination of DTH and Long hole drilling machine, from -250 mRL. Blast holes of 115mm diameter by DTH and 57mm diameter by long hole shall be drilled to cover the full width and height of the ore body.

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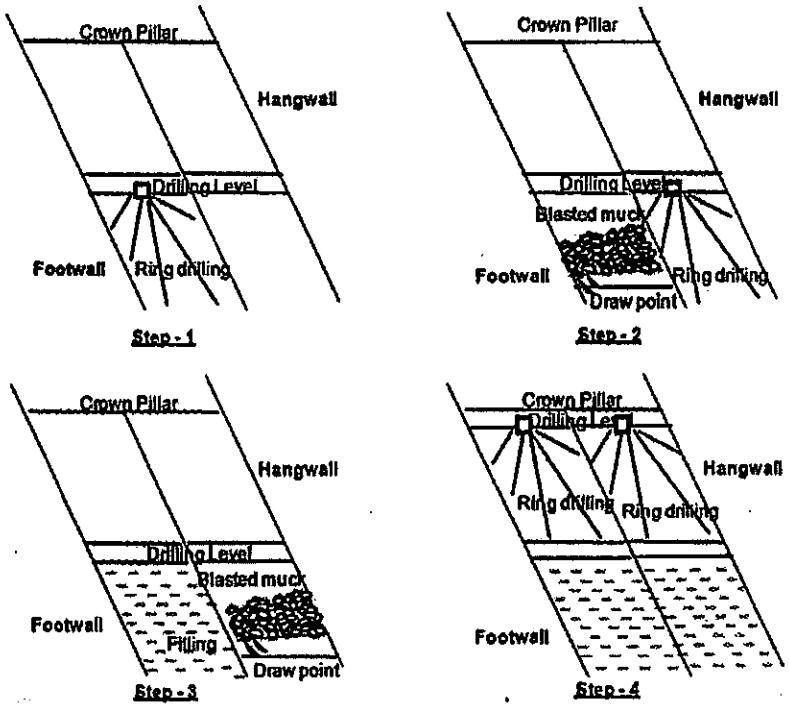
As per studies by NIRM, the recommended maximum stope height is 30m the stope width shall be within 20 m (or the maximum ore body width) below 250 mRL. The length of the stope (along the strike) shall be maximum 20m. The recommended rib pillar thickness (within the ore body) is 6mtrs and the crown pillar thickness is 15m.

It is proposed to adopt a methodology of extracting stopes in a rational sequence in primary, secondary and tertiary, so as to achieve an extraction of about 85% between crown pillar to sill pillar and achieve overall insitu recovery of about 75%.



Conceptual design of Sub-Level Blasthole Stoping

SCHEMATIC LAYOUT OF BLASTHOLE STOPES WITH CONSOLIDATED BACKFILLING

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Transportation through Shafts:

The ore shall be hoisted by skip through main shaft which shall be circular one having 6m in dia. The diameter of main shaft has been decided, keeping in mind, the ROM hoisting capacity of 9Lakh tonnes per annum along with the waste to be generated. The service shaft shall be rectangular one & having a dimension of 5.5m X 5.1m. The service shaft shall serve as a second outlet along with provisions for men & material hoisting. The size of service shaft has been decided, keeping in mind the size of equipment to be lowered to underground through this shaft.

The ore & waste loading point in under ground shall be -365mRL and -300mRL respectively.

Level Development:

During this Plan period two shafts shall be sunk upto -145 mRL & the interconnection x-cut between two shaft shall be developed at +30 mRL & -80 mRL, so that the fresh air base is established as close to the working place as practically possible. Size of the x-cuts and drive shall be 3m X 3m & 4m x 3m respectively.

Ventilation System:

During sinking of shaft, the face shall be ventilated by auxiliary ventilation fan. The fan shall be installed at the nearest Fresh Air Base to draw the fresh air. Air shall be coursed through flexible ducts, which shall be extended from time to time as the face progresses.

Ventilation of development headings shall be done by auxiliary ventilation fan and flexible ducts.

At +30 mRL a connection shall be made between the two shafts to establish proper ventilation (one shaft shall be intake & other shaft shall be return). Beyond 30 mRL, both the shaft shall be interconnected at regular intervals to establish fresh air base at deeper levels.

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ii) Underground layout

It is proposed to sink two shafts during this plan period. No lateral development is proposed except interconnection x-cuts between two shafts.

Sizes and intervals of levels and raises / winzes with proper reasoning:

As per recommendation of NIRM report, the level interval of 50 mtrs has been considered. It has been decided to develop -250mRL , -300mRL levels from service shafts.

Proposed year wise / level wise extent of development from 2019-20 to 2023-24 along with the support system:

[a] Proposed underground development during 2019-20 : NIL

[b] Proposed underground development during 2020-21 : NIL

[c] Proposed underground development during 2021-22 :

Development	Size	Top mRL	Bottom mRL	Total Length (m)	Waste volume in CuM
Main Shaft	Dia: 6m	135	75	60	1697
Service Shaft	5.5m x 5.1m	135	75	60	1683
Total				120	3380

[d] Proposed underground development during 2022-23 :

Development	Size	Top mRL	Bottom mRL	Total Length (m)	Waste volume in CuM
Main Shaft	Dia: 6m	75	-35	110	3111
Service Shaft	5.5m x 5.1m	75	-35	110	3086
30mRL Connecting X-Cut	3m x 3m	-	30	53	477
Total				120	6674

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[e] Proposed underground development during 2023-24 :

Development	Size	Top mRL	Bottom mRL	Total Length (m)	Waste volume in Cum's
Main Shaft	Dia: 6m	-35	-145	110	3111
Service Shaft	5.5m x 5.1m	-35	-145	110	3086
-80mRL Connecting X-Cut	3m x 3m	-	-80	53	477
Total				120	6674

Support System:

As per recommendation of NIRM for underground support system below -250 mRL, following support design is proposed. In all the waste drive and x-cuts there shall be three roof bolts in a row with row spacing of 1.2 m. In ore drives and x-cuts there shall be four roof bolts in a row with row spacing of 1 m. The support system have been designed considering a bolt capacity of 8 tonnes for the 1.8 m long, 20mm dia. full column cement grouted bolts.

iii) System of drilling and blasting

During shaft sinking, drilling shall be done by jack hammer / jumboo drill. Emulsion/slurry explosive shall be used in catridge form for blasting.

Drilling pattern in Ore	Not Applicable
Drilling pattern in Waste Rock	Burn cut / Wedge cut during shaft sinking
Drilling pattern in Stopes	Not Applicable
Maximum number of holes blasted in a round.	As per requirement.
Charge per round (Kg)	As per requirement
Charge per hole (kg)	As per requirement
Type of explosive	Emulsion / Slurry Explosive
Powder Factor (Norms) Rock development- Ore development- Stope -	 1.5 Kg / CuM Not Applicable Not Applicable
Powder Factor (Actual) Rock development- Ore development- Stope -	Upon starting of sinking of shafts, the actual powder factor shall be assessed.

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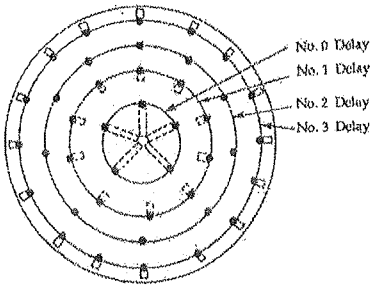
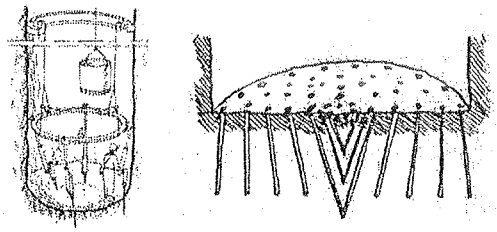


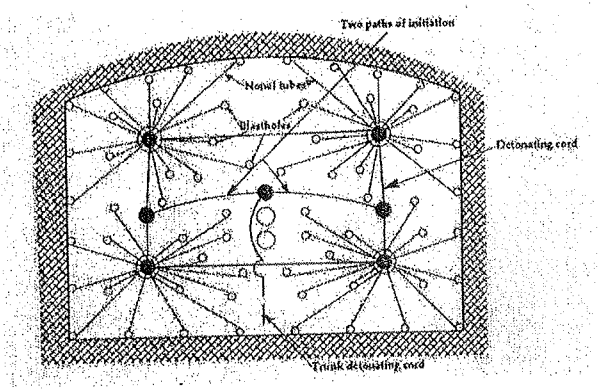


(Cone Cut Drilling Pattern)

An important requirement in shaft sinking is to provide optimum fragmentation of the rock so that it can be cleared quickly from the congested shaft-face area. Blasting operation is carried out against gravity, and the scatter of the broken rock is confined in the shaft. It is common to use generous distribution of explosives throughout the rock using a large number of small diameter (35 – 42 mm) shotholes.

The cone cut drilling patterns are proposed for shaft sinking based on suitability.

In development faces Burn cut drilling pattern shall be followed which will be done by single boom/ double Boom of Jumbo. There will be 47nos of holes of 45mm diameter. 5 holes will be reamed to 89mm diameter. In development faces slurry explosive of 25 mm & 40mm size of cartridge shall be used for effective blasting.



The existing magazine of 5 tonne capacity shall cater the explosive requirement during blasting in shaft sinking and underground developments.

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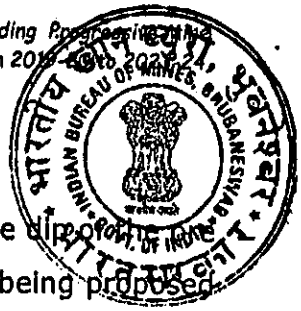

iv) Method and Sequence of Stoping

Method of Stoping

Considering the geo-technical studies carried out by NIRM and the dip of the ore body, blast hole stopping with post filling method in the mine is being proposed with stope height of 50m, stope width of 20 m (or the maximum ore body width) and the length of the stope (along the strike) of maximum 20 m.

Sequence of Stoping

The sequence of panel extraction shall be in three steps, i.e. primary, secondary and tertiary blocks. The primary block shall be extracted first, then secondary and eventually the tertiary blocks. The extraction method shall be blast hole stoping with post filling.

	Stope parameters:	
1	Number of working stopes	Presently Stopes are in proposal stage.
2	Size of the panel	L = 20 m & Width = Ore Body width
3	Level interval	50 m
4	Thickness of crown pillar	188m (Parting between surface & UG working)
5	Thickness of Sill pillar	15 m
6	Thickness of Rib pillar	6 m
7	Size and interval of Stope pillar	Not Applicable
8	Size/shape of man way	Not Applicable
9	Size/shape of ore pass	Not Applicable
10	Method of stowing / back filling	Hydraulic Filling
11	Method of drainage of stowed water	Decantation & Percolation

v) System of underground transportation

During the Mining Plan period only two vertical shafts shall be sunk and there is no proposal for lateral development.

From face to pit bottom or loading point: Not applicable
From pit bottom to surface: Not applicable
From surface to end use plant: Not applicable
Safety features provided on conveyor/ haulage track/ roadway: Not applicable

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vi) System of winding / hoisting :

The ore shall be hoisted by skip through main shaft which shall be circular one having minimum 6m in dia. The diameter of main shaft has been decided, keeping in mind a hoisting capacity of 9 Lakh tonnes of ROM & waste per annum. The service shaft shall be rectangular one & having a dimension of minimum 5.5m X 5.1m. The service shaft shall hoist men & material from underground.

vii) Extent of Mechanization

During this Mining Plan period two shafts alongwith connecting x-cuts shall be developed. Following equipment / machinery are proposed to be engaged:

01. Sinking Winders/Main Winder with Headgear and accessories.
02. Kibble and loading arrangement by grab.
03. Multi boom drilling machine (Jumbo drills)
04. Compressors
05. Compressed air operated pump
06. Ventilation Fan
07. Jackhammers
08. Auxilliary Ventilation Fan
09. LHD for development of x cuts
10. DG Sets
11. Cement Mixture machine etc.

viii) Subsidence management

The underground development has been planned as per recommendations of scientific study carried out by NIRM. Moreover, the stopes will be backfilled by cemented fill material. Therefore, subsidence is not expected. However, the stability of void shall be monitored regularly by strata monitoring instruments. Also, subsidence survey shall be carried out at regular interval.

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Conceptual Mine planning of Underground Workings up to the end of lease period taking into consideration the present available reserve and resources describing the ROM excavation, disposal of waste, stowing/backfilling, surface subsidence, reclamation & rehabilitation.

Reserve and life of underground working:

The proved mineable reserve below the opencast limit under UNFC 111 & 122 category as on 01.07.2018 is 41.69 Lakh tonnes and 17.3 Lakh tonnes respectively for Band I upto a depth of -495mRL. Feasible mineral resources under UNFC 211 category as on 01.07.2018, for Band I is 156.93 Lakh tonnes upto a depth of -495mRL of Band I. Considering 6 Lakh tonnes of production per annum from 4th year, the life of above reserve & resource (58.99 + 156.93 = 215.92 Lakh tonnes) shall be 38 years from the date of starting of production, i.e. from 2027-28. Thus, life of mine is beyond the lease period of the mine, i.e upto 03.09.2049.

ROM excavation, disposal of waste:

The year wise ROM & waste generation upto end of lease period (as per The Mines And Minerals (Development And Regulation) Amendment Act, 2015, the lease period of the mine will be extended upto 03.09.2049) is given below in the table.

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Year	Opencast Working										Underground Working								Grand Total ROM from both opencast & underground working, Tonnes	Grand Total OB from both opencast & underground working, Tonnes
	Overburden Generation, CuM				Disposal of Overburden		ROM, Tonnes				Dev in mtrs	Generation of waste in CuM	Disposal of Overburden, CuM			ROM, in Tonnes				
	Band I Opencast	Band II Opencast	Opencast Mining by Grab	Total	In OB dump CuM	Back filling of Minedout Quarry, CuM	Band I	Band II	Opencast Mining by Grab	Total			Dumping in OB dumpyard	Backfilling in minedout Quarry area	Backfilling in minedout Underground stope	Development	Stope	Total		
2019-20	1100000		1440	1101440	1101440		351000		50000	401000	0	0	0			0	0	0	401000	1101440
2020-21	1100000			1100000	1100000		351000			351000	0	0	0			0	0	0	351000	1100000
2021-22	1100000			1100000	1100000		351000			351000	120	1680	1680			0	0	0	351000	1101680
2022-23	600000	500000		1100000	600000	500000	226000	125000		351000	240	3360	3360			0	0	0	351000	1103360
2023-24		1100000		1100000		1100000		260000		260000	720	10100		10100		0	0	0	260000	1110100
2024-25		1100000		1100000		1100000		260000		260000	1100	16100		16100		0	0	0	260000	1116100
2025-26		1100000		1100000		1100000		260000		260000	1000	6700		6700		0	0	0	260000	1106700
2026-27		1100000		1100000		1100000		260000		260000	1500	10000		10000		0	0	0	260000	1110000
2027-28		1100000		1100000		1100000		260000		260000	2000	13500		13500		25000	0	25000	285000	1113500
2028-29		764000		764000		764000		185000		185000	2200	14700		14700	45000	38000	377000	415000	600000	778700
2029-30											2200	14700		14700	130000	55000	545000	600000	600000	14700
2030-31											2200	14700		14700	130000	55000	545000	600000	600000	14700
2031-32											2200	14700		14700	130000	55000	545000	600000	600000	14700
2032-33											2200	14700		14700	130000	55000	545000	600000	600000	14700
2033-34											2200	14700		14700	130000	55000	545000	600000	600000	14700
2034-35											2200	14700		14700	130000	55000	545000	600000	600000	14700
2035-36											2200	14700		14700	130000	55000	545000	600000	600000	14700
2036-37											2200	14700		14700	130000	55000	545000	600000	600000	14700
2037-38											2200	14700		14700	130000	55000	545000	600000	600000	14700
2038-39											2200	14700		14700	130000	55000	545000	600000	600000	14700
2039-40											2200	14700		14700	130000	55000	545000	600000	600000	14700
2040-41											2200	14700		14700	130000	55000	545000	600000	600000	14700
2041-42											2200	14700		14700	130000	55000	545000	600000	600000	14700
2042-43											2200	14700		14700	130000	55000	545000	600000	600000	14700
2043-44											2200	14700		14700	130000	55000	545000	600000	600000	14700
2044-45											2200	14700		14700	130000	55000	545000	600000	600000	14700
2045-46											2200	14700		14700	130000	55000	545000	600000	600000	14700
2046-47											2200	14700		14700	130000	55000	545000	600000	600000	14700
2047-48											2200	14700		14700	130000	55000	545000	600000	600000	14700
2048-49											2200	14700		14700	130000	55000	545000	600000	600000	14700
2049-50											2200	14700		14700	130000	55000	545000	600000	600000	14700
Total	3900000	6764000	1440	10665440	3901440	6764000	1279000	1610000	50000	2939000	55080	384840	5040	379800	2775000	1218000	11822000	13040000	15979000	11050280

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Extent of Mechanization

During the conceptual period following equipments / machineries are proposed to be engaged:

Name of Equipments	Capacity	Projected norms of performance/ Shift	Number of equipments
Load-haul-dump	4 CuM	240 T	3
Load-haul-dump	2 CuM	120 T	2
Low profile dump truck	15 T	180 T	2
Low profile dump truck	25 MT	300 T	4
Drill jumbo (Double boom)	1.2m /min	250 m	1
Drill jumbo (Single boom)	1.2m /min	250m	3
Long hole Drilling Machine	6 m/hr	30	4
Down-the-hole Drill 115 mm	2 m/hr	10	4
Dewatering Pumps (120 HP)	72 KL/hr	---	2
Jaw Crusher	120 TPH	--	1
Service Utility Vehicle	--	--	2

Backfilling & Surface Subsidence:

As suggested by NIRM, the method of extraction suitable for this condition is "Blasthole Stoping with Post Filling". Therefore, all the stopes after being mined out shall be suitably backfilled. Subsidence due to underground mining is not anticipated. However, the stability of void shall be monitored regularly by strata monitoring instruments. Also, subsidence survey shall be carried out at regular interval.

Mine Ventilation

During sinking of shafts, the face shall be ventilated by auxiliary ventilation fan. The fan shall be installed at the surface. Air shall be coursed through flexible ducts to the face. At 30mRL two shafts shall be interconnected, where a ventilation fan will be installed. The main ventilation fan of adequate capacity shall be installed for the mine for ventilation of underground working. Service shaft shall be intake, whereas Main shaft shall act as return.

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ROM evacuation system:

Load haul dumper (LHD) shall muck ore from stopes and development headings and load to low profile dump trucks (LPDT). LPDT shall carry the ROM and dump into a underground ore bin to be constructed at -300mRL. Skip loading system shall be arranged between -300mRL to -365mRL. This system is broadly consisting as under:

- Rock Breaker & Grizzly
- Ore bin of 1500 tonnes capacity.
- Grizzly feeder to feed ROM to underground Crusher.
- Conveyor.
- Underground surge ore bin.
- Measuring bin.
- Loading arrangement from measuring bin to skips.
- Skip shall hoist ROM to a surface bunker.
- From surface bunker ROM shall be transported by means of conveyor and/or by tippers to crushing & screening plant for further processing to various sizes.
- After screening to various sizes, the processed ore shall be taken to stack yard.

Surface Crushing & Screening Plant

The ore to be produced from the underground mine will be hard lumpy variety and needs crushing and screening before being dispatched to company's plants, for which following procedures are proposed.

- ROM excavated is crushed & screened to different sizes such as (-) 10 mm, (+) 10 mm to (-) 25 mm and 25 to (-)75 mm.
- After proper screening, the materials are again transported to the ore stack yard by tippers engaged for the purpose for future transportation to the captive plants of the company.
- Accordingly, a 120TPH Crushing & Screening Plant is proposed to be installed within the leasehold area.

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Backfilling Plant

A suitable capacity backfilling plant is proposed to be installed on the surface for backfilling of underground mined out stope voids. It is proposed to use overburden as filling constituents for hydraulic filling.

The filling plant would have following major components:

- Fill storage tank or Overburden Bunker
- Mixing tank (agitator)
- Water tank
- Boreholes
- Underground pipe line network

Installation of Surface Equipment / Infrastructure

During the conceptual period following equipments / infrastructure are proposed to be installed on the surface.

Name of Equipments / Infrastructure	Capacity	Numbers
Koepe Winder with Headgear	Approx. 2500 HP	1
DD Winder with Headgear	Approx. 2000 HP	1
Compressor	As per requirement	
ROM Crushing & Screening Plant	120 TPH	1
Mobile/Semi Mobile Overburden Crushing & Screening Plant	100 TPH	1
Backfilling Plant	100 CuM/Hr	2 Nos
DG Sets	As per requirement	
Main Ventilation Fan	14000 CuM / Min	1 No

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Mining between UPL of opencast working and UG workings, i.e between (-)2mRL to (-)250mRL in Band I.

Presently, trial mining of opencast mining using grab is proposed upto a depth of 60mtrs from the UPL of opencast quarry of Band I, i.e. maximum upto (-)62mRL. Based on the results of the trial mining, the method shall be proposed for extraction of chrome ore in other areas of the Band I opencast quarry, where the conventional opencast would have reached it's ultimate limits.

Presently, there is no suitable conventional mining method available to do underground mining in highly weathered formations, i.e both wall rocks and ore body. With technological advancement in future, necessary effort shall be made to develop a suitable underground mining method to mine out ore from soft zone, i.e. from (-)2mRL to (-)250mRL. In this regard, necessary scientific studies shall be carried out from the proposed underground development below (-)250mRL.

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3.0 MINE DRAINAGE:

(a) Minimum and maximum depth of water table based on observations from nearby wells and water bodies:

The maximum & minimum level of ground water in the nearby bore wells are given below as per annual environmental monitoring report for the year 2017-18 (Annexure – XIX).

Station No	Location	Maximum Water level below ground level (mtr)	Minimum Water level below ground level (mtr)
WL-G1	Bore Well inside Mines (Mahagiri Mines)	7.1	17.2
WL-G2	Bore Well Mahagiri Enclave	5.9	17.3
WL-G3	Bore Well inside Mines Main Office-SMC	8.9	23.9
WL-G4	Bore Well Village Goramian	4.8	13.9
WL-G5	Bore Well OMC Labour Colony	4.6	13.5
WL-G6	Bore Well Village Giringamali	5.1	14.1

(b) Maximum and minimum depth of Workings:

The maximum and minimum depth of working is 120 mtrs (south side of quarry from F/W to pit bottom) & 56 mtrs (eastern side of quarry from F/W to pit bottom) for Band I opencast mine.

(c) Quantity and quality of water likely to be encountered, the pumping arrangements and places where the mine water is finally proposed to be discharged:

Opencast Working Pumping

At present there is marginal accumulation of rain water & seepage water in the quarry. A 120 HP pump has been installed in the quarry to discharge the quarry water to upgraded ETP-4 situated on the surface for treatment. After treatment, the treated water is being used for industrial & plantation purposes. The excess water after industrial use, if any, is being discharged to the outside of the lease area. As the quarry depth is proposed to be increased, it is expected that there will be more seepage of water. Accordingly, provision of additional pumping and treatment capacity are to be made.

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Under ground Pumping:

Commencement of shaft sinking shall be done in 2021-22. During sinking provision for pumping shall be kept to dewater any accumulation of water in the shafts.

(d) Regional and local drainage pattern. Annual rainfall, catchments area, and likely quantity of rain water to flow through the lease area, arrangement for arresting solid wash off etc:

The area comprises of undulating terrain. The Daitari hill range is located in the north and the Mahagiri range occupies the southern portions. The central portions of the area is drained by Damsal Nala flowing in westerly direction. It forms the main watershed of the area. The entire drainage originating from Diatari hills in north and Mahagiri in the south joins Damsal Nala. The maximum elevation of the area is 600 m above mean sea level in the northern portions (Diatari Hill) while the lowest is less than 100m above sea level in the west central parts of valley. The only surface water source in this area is perennial Damsal Nala which is situated at 1.3 km distance from the lease area due north. The water flowing through this nala ultimately joins into the Brahmani river. The maximum elevation of the lease area is 160m RL on the southern side while the minimum elevation is around 120 mRL on the northern side. No natural drainages are present within the lease area.

Annual rainfall during 2017 was 1968mm as per data maintained at mines office. The lease area is 116.76 Hacts. Based on the rainfall, the quantity of surface runoff shall vary. Sufficient nos of settling ponds, check dams and retaining walls are provided to arrest solid wash offs from surface runoff.

The mine water discharge is pumped directly to upgraded ETP 04 situated on the surface for treatment. After treatment, the treated water is being used for industrial & plantation purposes. The excess water after industrial use, if any, is being discharged to the outside of the lease area.

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Likely quantity of water generation, existing treatment capacity & accumulation of water in pit are described in tabular format.

Review of ETP Capacity with respect to Monsoon Period											
Total area of Sukinda & Mahagiri in Ha	Mahagiri Forest Catchment (No Impact area) in Ha	SMC quarry impact area in Ha + No impact area (Outside Mines)	Total area for surface runoff calculation in Ha	Surface Runoff Area in Sq.Mtr	Avg Rainfall in the monsoon Period (July to October 17) in Mtr	Runoff coefficient as per rational method for forest land	Total runoff Generated from MMC & SMC during monsoon in CuM	Avg runoff generation/ day in CuM	Addition Load to ETP from Mine de-watering of SMC & MMC in CuM	Avg water to be treated during monsoon Period in CuM	Existing ETP Capacity 360 KLH x 24 Hrs Operation
190.54	38.55	32.6 **	119.387	1193870	1.4	0.4	668567	5571	1000	6571	8640
Review of ETP Capacity with respect to Maximum Rain Fall in a Day											
Total area of Sukinda & Mahagiri in Ha	Mahagiri Forest Catchment (No Impact area) in Ha	SMC quarry impact area in Ha + No impact area (Outside Mines)	Total area for surface runoff calculation in Ha	Surface Runoff Area in Sq.Mtr	Max rainfall per Day in mtr	Runoff coefficient as per rational method for forest land	Total runoff Generated from MMC & SMC during monsoon in CuM	Addition Load to ETP from Mine de-watering from MMC in CuM	Total water to be treated during peak rain fall @100mm in CuM	Existing ETP Capacity 360 KLH x 24 Hrs Operation	Excess water stored at Existing Settling Pits & SMC opencast quarry
190.537	38.55	32.6	119.387	1193870	0.09	0.4	42979	700	43679	8640	35039
* During the peak rainfall the excess water is being stored at existing settling ponds and pumped to ETP during DRY days. The existing settling ponds capacity is 11710 CuM and opencast quarry bottom capacity is 10.9 Lakh CuM.											
** Sukinda Mine quarry Impact area: 30.7 Ha No Impact Area (Staff Colony): 1.9 Ha Total: 32.6 Ha											

Method of treatment of hexavalent chromium in ETP

Mines seepage water from opencast pit and mines runoff water during monsoon period is pumped at controlled rate to Flash Mixing tank, where reducing agent ($FeSO_4$) is dosed along with polyelectrolyte through metering type dosers. The content is then let into High Rate Reactivator type Clarifier, which reduces consumption of reagents and tolerate fluctuation in turbidity of feed while yielding consistent output quality. The clarifier supernatant is collected in supernatant tank and after on-line adjustment of pH using NaOH, it is pumped through Multi grade Pressure Sand Filter. The output from the filter is of reusable quality or safe for disposal. The sludge from the clarifier is continuously withdrawn in sludge sump and pumped through filter Press for dewatering. The dewatered cakes contains Cr(OH)3 and Fe(OH)3 which then is disposed off through SPCB approved agency for Land Fill.

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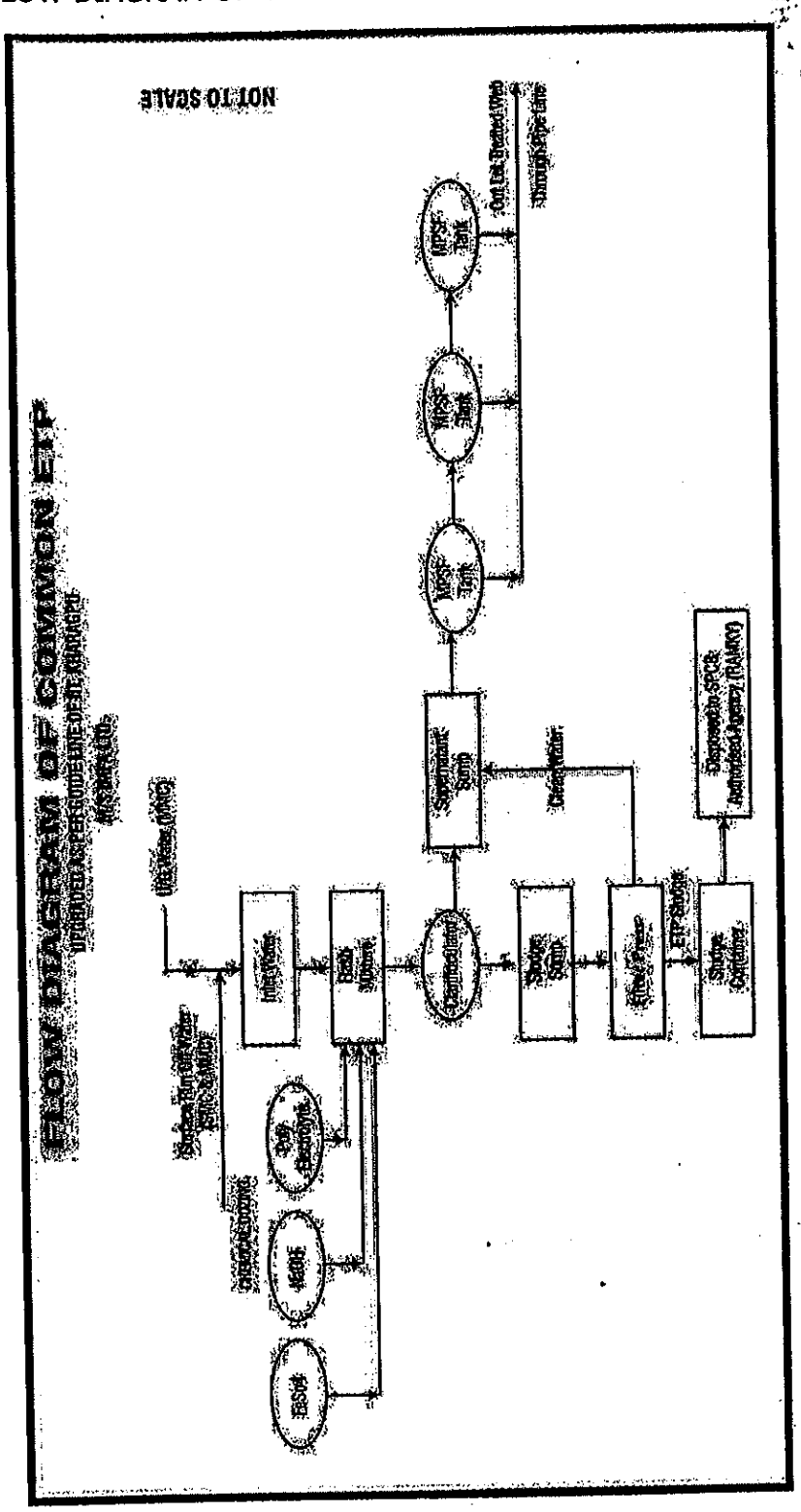
INDIAN BUREAU OF MINES, BHUBANESWAR
GOVT. OF INDIA
भारत सरकार

FLOW DIAGRAM OF COMMON EFFLUENT TREATMENT PLANT



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4.0 STACKING OF MINERAL REJECTS / SUB GRADE MATERIAL AND DISPOSAL OF WASTE

a) Nature and quantity of top soil, overburden / waste and Mineral Reject to be disposed off: The waste materials, which are being generated in the working quarry mainly comprises of weathered Serpentinite, Limonitic material, Nickelliferous Limonite & lateritic soil.

The analysis report of serpentine and nickelliferrous limonite is attached as Annexure XXX. The industrial use of serpentine is feasible, only if the MgO content is more than 40%. Since, serpentine within the mine is having MgO content less than above, so it is dumped in the overburden dumpyard.

The nickeliferrous limonite generated from the quarry is being separately kept in the waste dumpyard at designated place for future use.

Top soil is not present in the quarry area of Band I. However, there will be generation of marginal quantity of top soil during mining of Band II.

During the Mining Plan period, if there is any generation of ROM having 10 to 30% Cr_2O_3 grade from opencast mining of Band I, then same shall be stored over the sub grade dump kept for the purpose.

Quantity of Top soil and Mineral Rejects to be disposed off:

Year	Top Soil (CuM)		Mineral Rejects (CuM)			
	Reuse / Spreading	Storage	Back filling	Storage	Blending	Beneficiation
2019-20	Nil	Nil	Nil	9271	Nil	Nil
2020-21	Nil	Nil	Nil	9236	Nil	Nil
2021-22	Nil	Nil	Nil	Nil	Nil	Nil
2022-23	Nil	Nil	Nil	9259	Nil	Nil
2023-24	Nil	Nil	Nil	22220	Nil	37037 CuM (100000 Tonnes)
Total	Nil	Nil	Nil	49986	Nil	37037 CuM (100000 Tonnes)

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Rate of yearly generation & disposal of overburden and wastes during the plan period

The rate of yearly generation of overburden and waste to be generated during the plan period, (2019-20 to 2023-24) are given below:

Generation & Disposal of Overburden / Waste in Lakh CuM:

Year	Generation of overburden from Opencast Working (in L CuM)			Disposal of Overburden (In L CuM)			Utilisation of Overburden from Dumpyard, (in L CuM)
	Band I		Band II	Dumping in Waste Dumpyard		Backfilling in Mined out Areas of Band I	Backfilling in Opencast Mining by Grab Panels
	Opencast	Opencast mining by Grab	Opencast	Upto 3rd Stage (60mtrs)	Upto 4th Stage (75mtrs)		
2019-20	11	0.01 (Trial)	-	9.86 (In Dump) 1.14 (In Common boundary dumping)	-	-	0.14 (Trial)
2020-21	11	-	-	10.5	0.5	-	-
2021-22	11	-	-	-	11	-	-
2022-23	6	-	5	-	6	5	-
2023-24	-	-	11			11	-
Total	**39**	**0.01**	**16**	**21.5**	**17.5**	**16**	**0.14**

b) Dumping and Backfilling:

The overburden dump over an area of 43.18 ha & sub grade dump over an area of 6.6 ha is existing over non mineralised zone and beyond the ultimate pit limit. Opencast working in Band I shall reach it's ultimate limit during the year 2022-23. In the same year, mined out areas of opencast quarry of Band I is proposed to be backfilled by overburden being generated from opencast working of Band II. Mined out opencast quarry of Band I is proposed to be backfilled upto 54mRL during the plan period. However, in case of success of trial of opencast mining by grab, opencast mining in Band II shall be deferred till completion of opencast mining by grab in Band I. Accordingly backfilling in Band I shall be deferred and the review of mining plan shall be modified.

Based on recommendations of CIMFR, the height of overburden dump is proposed to be increased upto 75mtrs from ground level in four stages (maximum upto 207mRL). The dumpyard is having sufficient capacity to accommodate the overburden and waste being generated during opencast working and underground development of Band I in the Mining Plan period.

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The existing waste dumpyard is situated in the northern side of lease area. Refer Plate No SMC/03. The waste dump consists of three stages. It is proposed to increase the height of overburden dumpyard upto 75mtrs from ground level in four stages (maximum upto 207mRL).

Details of existing overburden dump & sub grade dump is given below:

Dump type	Area (In Hacts)	Height (in Mtrs)	No of terraces (Stages)	Angle (Degree from Horizontal)	Designed Capacity (excluding dumping before grant of ML)	Cumulative Dumping (as on 30.06.2018)	Top RL (as on 30.06.2018)	
							North Side	South Side
Over burden	43.18	60 mt.	3	23°	**159 Lakh CuM** (75mtrs height from ground level in Four stages, i.e maximum upto 207mRL)	113.30 Lakh CuM	187mRL	187mRL
Sub Grade	6.6	23 mt.	2	23°	**7.5 Lakh tonnes**	6.12 Lakh tonnes	177mRL	179mRL

Following precautions are envisaged in the overburden dump yard:

1. The maximum height of overburden dump to be 75 mtrs from ground level in four stages (maximum upto 207mRL).
2. Garland drains to be provided around the periphery of the dump to channelise & collect run-off water.
3. Proper terracing to be done, so that overall slope does not exceed 28 degree from horizontal.
4. The dump to be vegetated with suitable native species to prevent soil erosion.
5. Retaining wall to be provided at toe of dump to check run-off and siltation. .

The dead ends of the dump have been stabilised by plantation. Garland drains, check dams & retaining wall have been provided along the toe of the dump.

Existing environmental protective works carried out around overburden dump is summerised below. The same are shown in Surface Plan (SMC/03).

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Existing Environmental Protective Works around Overburden Dump

Maximum height of dump and No of Terraces	60 mtrs from ground level in 3 terraces (stages). Height of overburden dump is proposed to be increased upto 75mtrs from ground level in four stages (maximum upto 207mRL).
Overall slope of dump	Less than 28 degree from horizontal
Garland drain, Check Dams & Settling Ponds	2852mtrs long garland drain have been provided around the dumpyard for channelizing the surface run-off. 2 nos of settling ponds & 4 nos of check dams have also been provided. The width of garland drain on bottom is 0.6m and 1.2m on top. The depth of garland drain is 1.2m.
Settling Ponds	2 nos of settling ponds have been provided for dumpyard. One settling pond of 1200CuM (LxWxH = 25mx16mx3m) is situated in northern side of dumpyard and another settling pond of 5500 CuM (LxWxH = 14mx16mx3m) is situated below sub grade dump as intermediate settling pond.
Total length of retaining wall, mtrs	In order to check siltation, a retaining wall of 1940mtrs long have been provided at the toe of over burden dump & sub grade dump. The dimensions of the retaining wall are 1.2m (Height) x 0.3 m(Width) for RCC and 1.2m (Height) x 1 m(Width) for boulder retaining wall respectively.
Plantation over dump slope	Plantation over dump slopes have been done over an area of 13.68 Ha by planting 49332 nos of plants with a survival rate of around 90% as on 2017-18.
Others	Coir matting: To avoid the problem of soil erosion and formation of gullies in critical areas, application of natural geotextiles such as coir matting with plantation has been undertaken. Coir matting has been done over an area of 3856 sq m on the dump slopes of the first stage and an area of 7490 sq m on dump slope of the second stage. In addition to coir matting on dump slope, selected species of grasses and plants are planted. Till date a total of 11346 sq mtr of coir matting has been put over different places of dump yard. Grass thatching has been done on dump slopes to stabilise the dump slope to arrest the soil erosion. Dump slope stabilisation by small terracing & bamboo terracing has also been carried out in some part of dumpyard. In Small terracing, terraces are made at an interval of 5m height having a width of 1.2m along the slope. Top soil are spread over the small terraces and plantation of various fast growing native species have been undertaken on the dump slope. 630mm dia PVC pipeline has been laid over 1st stage & 2nd stage of dump to channelise surface run-off to ground level without eroding dump slopes.

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C) Manner of disposal of waste, configuration and sequence of year wise build up of dumps along with the proposals for protective measures.

One overburden dump is being maintained in the northern side of the lease over an area of 43.18 ha. The dump is made up of three stages of 20mtrs height each & having terrace of adequate width. Based on recommendations of CIMFR, the height of overburden dump is proposed to be increased upto 75mtrs from ground level in four stages (maximum upto 207mRL).

Common dumping along A-B-C boundary line is in progress with M/s Balasore Alloys Limited. MoU has been signed between both the lessees & necessary permission from Director General of Mines Safety has also been obtained. Refer Annexure XVI. The proposed manner of disposal of waste & sequence of yearwise build up of waste dump during the plan period are shown in Plate No: SMC/12 & 13.

Year wise build up of overburden dumps is given below:

Year	Details of Build up of overburden Dump
2019-20	Location of dumping and Grid: 1st, 2nd & 3rd Stage. Grid: 2000E to 3500E and 1600N to 2600N
	Maximum height and Overall Slope of Dump: 60mtrs & 23 degree
	Designed Capacity of Dump: 159 Lakh CuM (75mtrs height from ground level in Four stages, i.e maximum upto 207mRL)
	Bottom RL of Individual Terraces: 1st - 125mRL, 2nd - 155mRL & 3rd : 167mRL
	Individual Terrace Height: 20 mtrs
	Top RL of Individual Terraces: 1st : 155mRL, 2nd : 175mRL & 3rd : 187mRL
	Method & Manner of disposal of Waste/Overburden: Unloading by tippers on dump yard. Overburden is pushed and compacted by engaging dozers. Dumps are of advancing type.

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Year wise build up of overburden dumps is given below:

2020-21	Location of dumping and Grid: 2nd, 3rd & 4th Stage. Grid: 2000E to 3500E and 1600N to 2600N
	Maximum height and Overall Slope of Dump: 75mtrs & 23 degree
	Designed Capacity of Dump: 159 Lakh CuM (75mtrs height from ground level in Four stages, i.e maximum upto 207mRL)
	Bottom RL of Individual Terraces: 1st - 125mRL, 2nd – 155mRL, 3rd : 167mRL & 4th : 187mRL
	Individual Terrace Height: 20 mtrs
	Top RL of Individual Terraces: 1st : 155mRL, 2nd : 175mRL, 3rd : 187mRL & 4th : 207mRL
	Method & Manner of disposal of Waste/Overburden: Unloading by tippers on dump yard. Overburden is pushed and compacted by engaging dozers. Dumps are of advancing type.
2021-22	Location of dumping and Grid: 4th Stage. Grid: 2000E to 3500E and 1600N to 2600N
	Maximum height and Overall Slope of Dump: 75mtrs & 23 degree
	Designed Capacity of Dump: 159 Lakh CuM (75mtrs height from ground level in Four stages, i.e maximum upto 207mRL)
	Bottom RL of Individual Terraces: 1st - 125mRL, 2nd – 155mRL, 3rd : 167mRL & 4th : 187mRL
	Individual Terrace Height: 20 mtrs
	Top RL of Individual Terraces: 1st : 155mRL, 2nd : 175mRL, 3rd : 187mRL & 4th : 207mRL
	Method & Manner of disposal of Waste/Overburden: Unloading by tippers on dump yard. Overburden is pushed and compacted by engaging dozers. Dumps are of advancing type.
2022-23	Location of dumping and Grid: 4th Stage. Grid: 2000E to 3500E and 1600N to 2600N
	Maximum height and Overall Slope of Dump: 75mtrs & 23 degree
	Designed Capacity of Dump: 159 Lakh CuM (75mtrs height from ground level in Four stages, i.e maximum upto 207mRL)
	Bottom RL of Individual Terraces: 1st - 125mRL, 2nd – 155mRL, 3rd : 167mRL & 4th : 187mRL
	Individual Terrace Height: 20 mtrs
	Top RL of Individual Terraces: 1st : 155mRL, 2nd : 175mRL, 3rd : 187mRL & 4th : 207mRL
	Method & Manner of disposal of Waste/Overburden: Unloading by tippers on dump yard. Overburden is pushed and compacted by engaging dozers. Dumps are of advancing type.
2023-24	No dumping. Only plantation work. Grid: 2000E to 3500E and 1600N to 2600N

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Proposals for protective measure:

Plantation shall be done over the dead ends of waste dump yard in a phased manner. The existing garland drains, check dams & retaining wall shall be maintained.

Proposals for protective measures of the overburden dump yard is as below.

Year	Protective Measures in Dump Yard					
	Plantation		Coir Matting	Retaining Wall	Garland Drain	Check Dam
	Area in Hact	No. of Plants	Sq mtr	Mtrs	Mtrs	Nos
2019-20	0.6	1500	2000	116	346	1
2020-21	1.1	2750	3600	160	Nil	Nil
2021-22	0.9	2250	2000	192	Nil	1
2022-23	0.8	2000	3000	Nil	Nil	Nil
2023-24	1.3	3250	Nil	Nil	Nil	Nil
Total	4.7	11750	10600	468	346	2

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5.0 USE OF MINERAL AND MINERAL REJECT

a) Requirement of end-use industry specifically in terms of physical and chemical composition.

Since this is a captive mine, ore being mined out from this mine is utilised at lessee's ferro chrome plants. The ROM is stacked as per different grade specifications before being dispatched to captive ferro chrome plants. Chrome ore at 30% Cr_2O_3 cut off is directly used in company's Ferro Chrome and Charge Chrome plants after proper blending.

Physical Specification: Size of Lumps & Chips is 10-100 mm & size of fines is (-)10mm.

Chemical Specification: The cut off grade of ore as stipulated by captive ferro chrome plants is +30% Cr_2O_3.

b) Requirement of intermediate industries involved in upgradation of mineral before its end-use.

There is no requirement of intermediate industry for upgradation of mineral produced from the mine. ROM from mine is stacked as per different grade specifications and is dispatched to lessee's captive plants.

c) Requirements for captive consumption.

This being a captive mine of the lessee, 100% of the ore is being utilised for captive consumption only.

d) Precise physical and chemical specification stipulated by buyers

Not applicable, as there is no sale of chrome ore from this mine.

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e) Details of processes adopted to upgrade the ROM to suit the user requirements.

Presently ROM generated from this mine is having grade above 30% Cr_2O_3. ROM from the mine is stacked as per different grade specifications and is dispatched to lessee's captive plants.

ROM excavated earlier having 10 to 30% Cr_2O_3 grade has been kept separately in a designated place for beneficiation purpose. It is proposed to upgrade this 10 to (-) 30% Cr_2O_3 ROM to (+) 30% Cr_2O_3 grade by setting up a Chrome ore Beneficiaton Plant within the lease area.

During the Mining Plan period, if there is any generation of ROM having 10 to 30% Cr_2O_3 grade from opencast mining of Band I & II, then same shall be stored in the subgrade dump, kept separately in a designated place for beneficiation purpose.

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6.0 PROCESSING OF ROM AND MINERAL REJECT

a) Brief description on nature of processing / beneficiation

It is proposed to do the beneficiation by wet gravity separation method. A bench scale study was conducted by lessee on chromite ore (10-30% Cr_2O_3) in the laboratory of the Indian Bureau of Mines, Nagpur during 2002. The bench scale study as conducted by IBM indicates that the sample is amenable to beneficiation. Further study was carried out at Institute of Minerals & Material Technology (IMMT), Bhubaneswar to develop flow sheet for enriching chromite ore (10-30% Cr_2O_3) to usable grade and restricting Cr_2O_3% in tailing below the threshold value (10%). During April 2016, Institute of Minerals & Material Technology (IMMT), Bhubaneswar submitted their final report which is attached as Annexure XXII.

A quantity of approx. 6.12 lakh tonnes of chrome ore having (+) 10 to (-) 30% Cr_2O_3 has been stacked within leasehold area at an ear marked location for beneficiation in the Chrome Ore Beneficiation (COB) Plant. In addition to above, if there is any generation of ROM having 10 to 30% Cr_2O_3 grade from opencast mining of Band I & II during this Plan period, then same shall be stored in the subgrade dump, kept separately in a designated place for beneficiation purpose.

In order to process the same, a COB plant has been proposed to be installed from the year 2020-21. The company's proposal to set up a COB plant within the lease hold area shall be designed to process 40 tonnes of chrome ore (having 10 – 30% Cr_2O_3) per hour.

Details of COB plant parameters and results of recovery of usable grade ore are detailed below.

Feed Rate	40 tonnes / hr
Feed Grade	10 – 30 % of Cr_2O_3
Output Grade	Above 30 % of Cr_2O_3
Tailing Grade	Below 10% of Cr_2O_3

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b) Flow sheet/schematic diagram of the processing procedure indicating material balance chart, feed, product, recovery, and its grade at each stage of processing.

As per IMMT, Bhubaneswar study report (Flowsheet-I), in which scrubbing, desliming was the beneficiation techniques, two different techniques i.e. tabling and falcon concentration were applied to recover chromite values from hydrocyclone underflow. In both the cases, the concentrate generated had Cr_2O_3% of around 32% with yield around 75% by weight. The tailing generated contained 10% Cr_2O_3, with around 25% by weight and can be rejected.

Basic Parameter of COB plant:

Input grade	:	10 to 30% Cr_2O_3
Out put grade	:	Above 30% Cr_2O_3
Feed Rate	:	40 T/Hr
Yield	:	75 % by weight concentrate.
Concentrate Grade	:	> 30% Cr_2O_3%
Tailing	:	25% by weight
Tailing grade	:	< 10% Cr_2O_3

The proposed location of COB plant is shown in Plate No. SMC/15.

The proposed production schedule from COB plant shall be as follows:

Year	Feed to COB Plant, Tonnes	Ore Concentrates, Tonnes	Tailings, Tonnes	Remarks
2019-20	Nil	Nil	Nil	Obtaining Env Clearance & Other Statutory clearances.
2020-21	Nil	Nil	Nil	Site Preparation, Erection and Commissioning of COB plant.
2021-22	Nil	Nil	Nil	
2022-23	Nil	Nil	Nil	
2023-24	100000	75000	25000	Tailings after being dried shall be disposed in the designated place.

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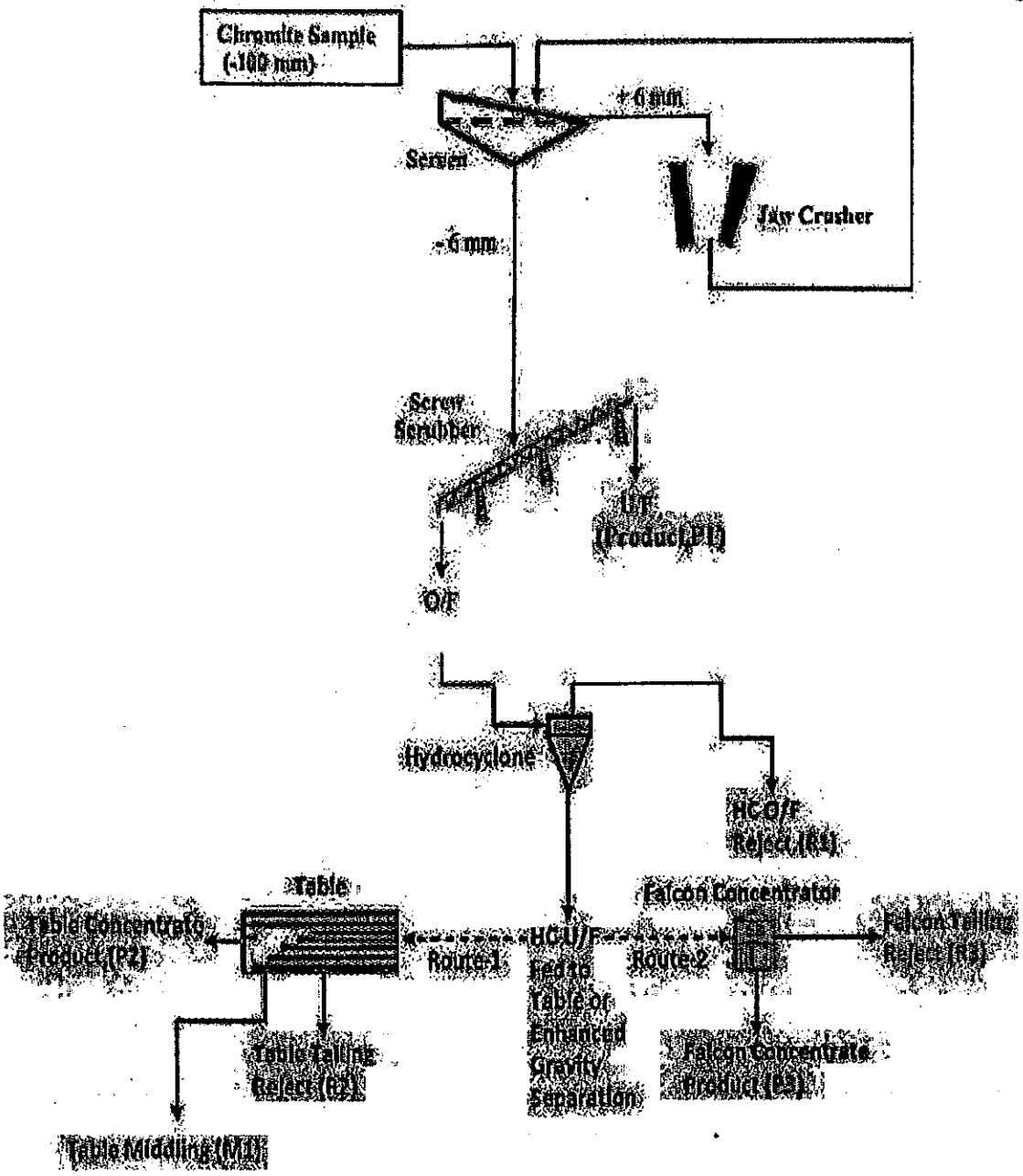
The tentative Flow Sheet of COB plant:



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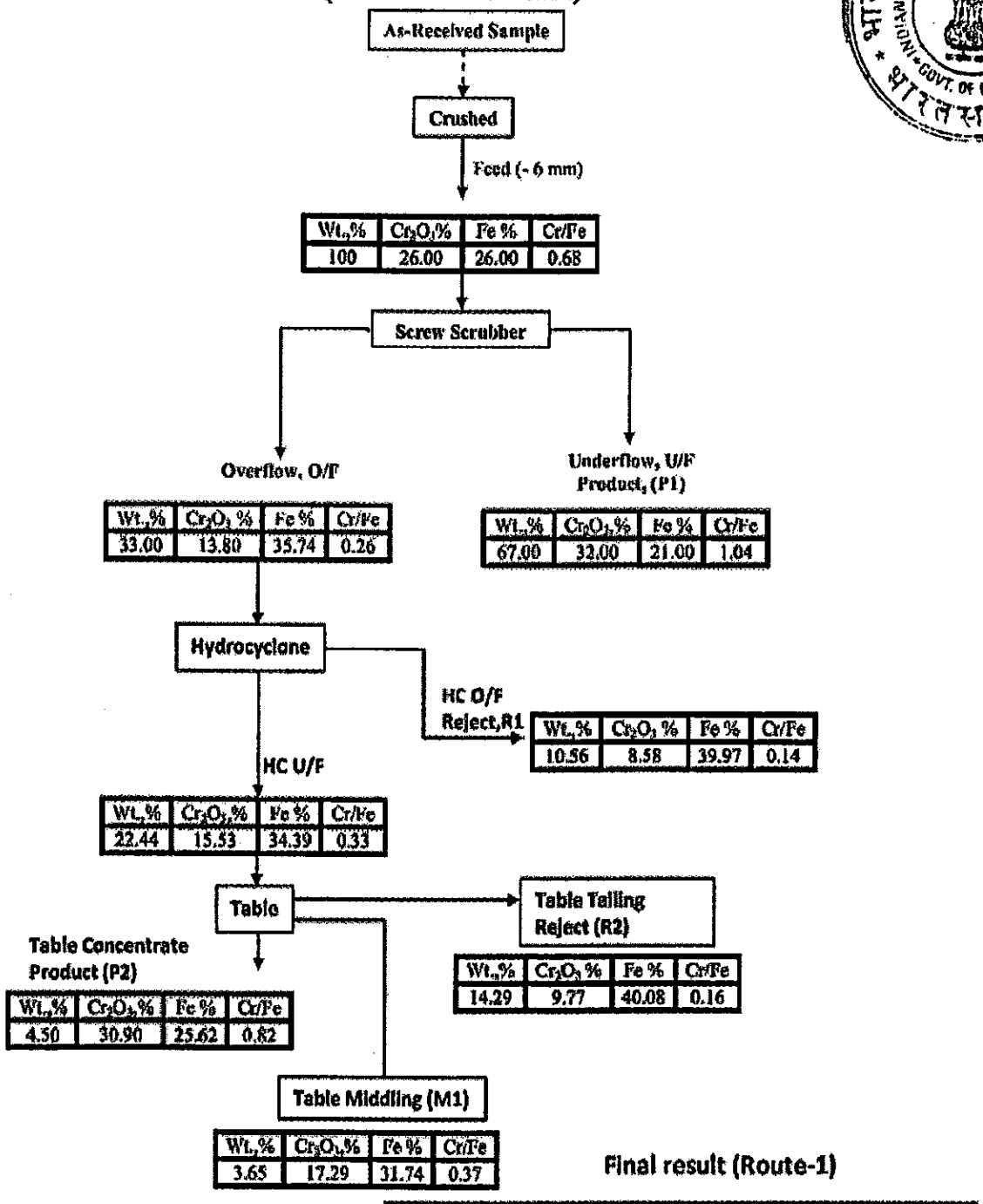
Beneficiation results of Flowsheet(Option-I)

(Route-1 with table)



Final result (Route-1)

	Wt.,%	Cr_2O_3 %	Fe %	Cr/Fe	Size
Overall Product(P1+P2+M1)	75.15	31.22	21.80	1	<6mm
Overall Reject(R1+R2)	24.85	9.26	40.03	0.15	<6mm

Beneficiation result (Flowsheet-I) with Tabling

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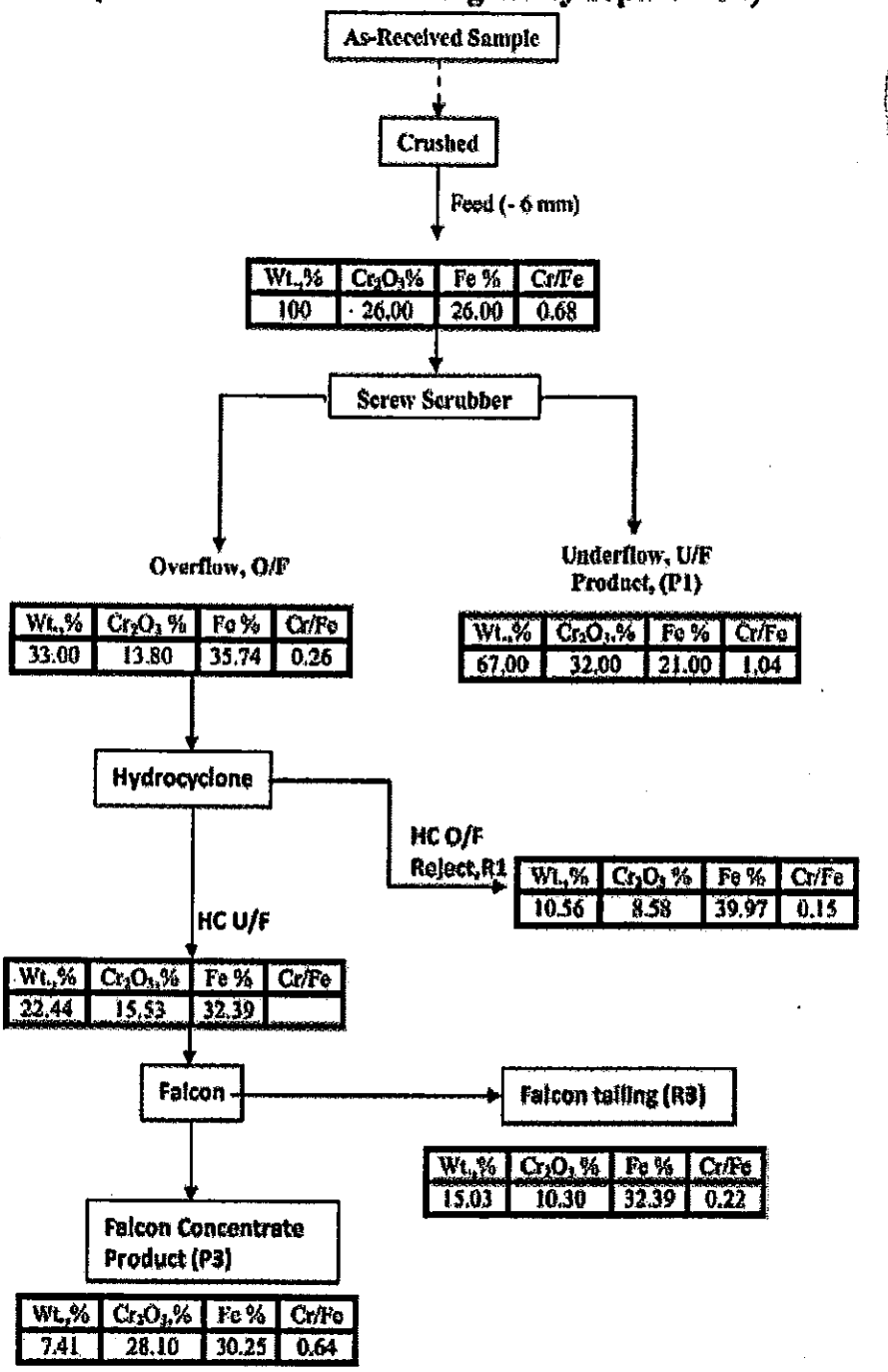
(Route-2 with enhanced gravity separation)



Final result (Route-2)

	Wt.,%	Cr_2O_3,%	Fe %	Cr/Fe	Size
Overall Product(P1+P3)	74.41	31.61	21.92	1	<6mm
Overall Reject(R1+R2)	25.59	9.59	35.52	0.18	<6mm

Beneficiation result (Flowsheet-I) with Falcon Concentration

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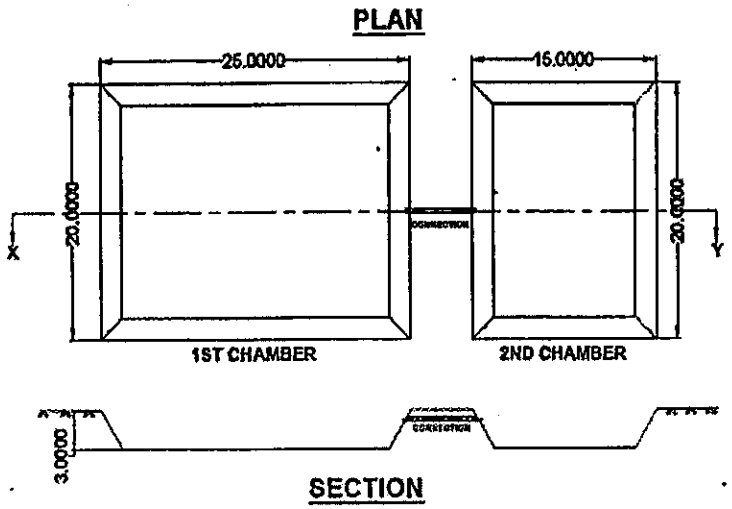
c) Disposal method for tailings or reject from the processing plant.

As per IMMT, Bhubaneswar study report (Flowsheet-I), in which scrubbing, desliming was the beneficiation techniques, the tailing generated contained around 9.26% Cr_2O_3, with around 25% by weight and can be rejected. Hence it is expected that grade of the tailings generated will be below 10% Cr_2O_3. The tailing collected from the pressure filter / tailing ponds after being dried shall be stored in a designated place near subgrade dump. Refer Plate No SMC/11.

d) Quantity and quality of tailings /reject proposed to be disposed, size and capacity of tailing pond, toxic effect of such tailings, if any, with process adopted to neutralize any such effect before their disposal and dealing of excess water from the tailings dam.

As per IMMT report tailing generation will be around 25% weight. It is calculated that approx. 25000 tonnes of tailing shall be generated per annum. The tailing pond inside the COB plant shall comprise of two separate chambers, where the suspended solids will settle in the first chamber and supernatant water will be collected in the second chamber and the same shall be recirculated to the plant for reuse. No water from the COB plant shall be discharged outside the COB plant. Chrome ore tailings of below 10% Cr_2O_3 are treated as waste. The tailing collected from the pressure filter / tailing ponds after being dried shall be stored in a designated place near subgrade dump. Size and capacities of the tailing ponds are 25m x 20m x 3m & 20m x 15m x 3m. Alternately, filter press for separation of solid waste from the slurry can also be used.

Schematic arrangement of Tailing Pond.



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e) Quantity and type of chemicals if any to be used in the processing plant.

The proposed process in the COB plant is a wet gravity seperation method and does not involve any use of chemicals.

f) Quantity and type of chemicals to be stored on site / plan

Not applicable as there is no use of chemicals involved in the process.

g) Quantity of water required for processing, source of supply of water, disposal of water and extent of recycling & water balance chart.

COB plant shall require 220 kl of water per hour. The source of water is from the Effluent Treatment Plant (ETP) outlet. The water will be re-circulated from the tailing pond. No water will be allowed to go outside the COB plant. Only the evaporated water loss will be made up from the ETP outlet. A sump of 500 CuM capacity shall be constructed from which the water shall be fed to COB plant.

Approx. Water requirement:

Per hour	:	220 KL (In process)
Recovery water	:	90 %
Re-use	:	200 KL/Hr.
Makeup water required	:	20 KL/Hr.
Source of water	:	ETP Outlet

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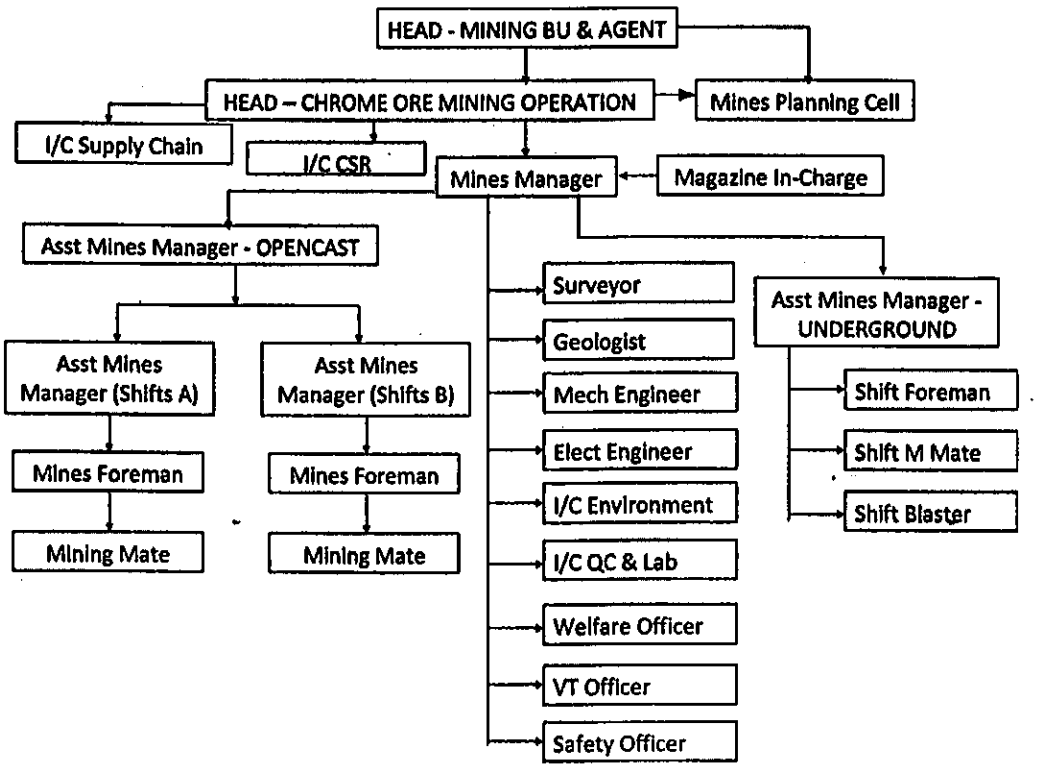
7.0 OTHER

a) Site services :

The infrastructures available within the ML area are office buildings, Effluent Treatment Plants, Tubewell, Weighbridges, rest shelters, Security barracks, cycle sheds, electric sub-station, staff colonies, HSD pump, group VT Center, Dispensary, DG room, latrine & urinals, First aid room, site offices, explosive magazine, stores, canteen & workshop etc.

b) Employment Potential :

Category	Nos			Nature of Employment
	Opencast	Underground	Total	
Technical Personnel	50	23	73	Departmental
Competent Personnel	72	35	107	Departmental
Competent Personnel & Workers	590	86	676	Contractual
Manpower for UG activities	0	15	15	Departmental
Manpower for UG activities	0	50	50	Contractual
Total	712	209	921	



Proposed Organisation Chart

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8.0 PROGRESSIVE MINE CLOSURE PLAN UNDER RULE 23 OF MCDR 2017

8.1 Environment Base line information:

- *Existing land use pattern as on 30.06.2018:*

Land use	Forest (Ha)	Non forest (Ha)	Total (Ha)
Area under mining	28.830	0.000	28.830
Overburden Dump & Sub Grade Dump	48.570	1.020	49.590
Mineral storage	11.132	0.060	11.192
Infrastructures (Workshop, Admn Building etc)	12.908	0.102	13.010
Roads	3.130	0.050	3.180
Effluent Treatment Plant, Settling Pond, Pipeline etc	5.660	0.000	5.660
Township	1.050	0.000	1.050
Chrome Ore Beneficiation Plant	0.000	0.000	0.000
Safety Zone	3.660	0.478	4.138
Others (Magazine)	0.110	0.000	0.110
Total	115.050	1.710	116.760

The entire ML area was Non Forest as per Hal records. As per Sabik records the land schedule of the ML area consists of 115.05 Ha of Forest Land and 1.71 Ha of Non Forest Land. Persuance to MoEF&CC circular No. F.No.8-78/1996-FC, dated 10.03.2015, lessee has obtained forest clearance (stage II) from MoEF&CC, over 115.05 ha of forest land, vide letter no: 8-16/2016-FC, dated 22.06.2018. (Annexure XIII).

- *Water regime, Quality of air, ambient noise level, flora & climatic conditions.*

The water, air & noise monitoring for all seasons is being conducted by an approved agency, i.e. M/s SIMA Labs Pvt Ltd, New Delhi.

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Ground Water:

Rainfall is the principal source of ground water, which percolates down the water table. The weathered lateritised - limonitised formation as well as the underlying semi weathered and fractured country rocks form the repository of ground water in the area. The nature, extension and yield potentials of the ground water reservoir are controlled by wide lithological variations, structural setup and weathering characteristics of the rock formation. The ground water generally occurs under phreatic conditions and occasionally under semiconfined to confined conditions in deeper horizons. Monitoring of ground water level & water quality is being carried out at six & ten numbers of sampling locations respectively for the mine. Monitoring is carried out for all the four seasons (i.e. Summer, Monsoon, Post-Monsoon & Winter Season). The baseline information for ground water level & quality for the year 2017-18 is given in the Annual Report on Environmental Parameters Monitoring, which is attached as Annexure XIX.

Surface water:

The valley is drained by Damsal Nala which sustains perennial flow and generally follow a westerly course and finally joins with the river Brahamani. The nala and its tributaries exhibit a dendritic drainage pattern. There is no natural drainage & surface water body in the lease hold area. The baseline information for surface water quality for the year 2017-18 is given in the Annual Report on Environmental Parameters Monitoring, which is attached as Annexure XIX.

Quality of air:

Ambient Air Quality Monitoring was conducted at eight selected locations in Core & Buffer Zone. Monitoring was carried out on fortnight basis, twice in a month for each station. Fugitive Emission Monitoring was also carried out at four selected locations in Core Zone. Frequency of monitoring was on fortnight basis (twice in a month for each station).

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The baseline information for ambient air quality, fugitive emission & dust fall for the year 2017-18 is given in the Annual Report on Environmental Parameters Monitoring, which is attached as Annexure XIX.

Ambient noise level:

The Ambient Noise Monitoring within the Core & Buffer zone area was carried out at thirteen sampling stations covering the mining leasehold and residential areas. Measurements were taken during day time and night time at each of the locations during the four seasons. On site, field measurement procedure was adopted for the record of all observations.

Flora:

Patches of grass lands are commonly found in forest and non-forest areas in the buffer zone of the valley. Bushy lands are common in the buffer zone. They are mostly in forests (Mahagiri and Daitary) and their immediate surroundings. In general the characteristic nature of the forest of this region is tropical decidious. The general flora found in the area are Sal, Tendu, Mahua, Harida, Bahara, Neem, Chakunda, Mango, Jamun, Jack fruit etc.

Climatic conditions:

The climate of this region is mainly tropical type. South west monsoon season starts from June and extends upto October. Average annual rainfall of the region varies between 1300 to 1600 mm, out of which about 80% of the rainfall can be observed in the monsoon season only. The summer is severe during May-June with temperature as high as ~46°C. A pleasant winter prevails from December to January. During monsoon season, the average relative humidity goes upto 86% which is hightest in comparison with other months. During winter, in the month of January, it comes down to approx 56%.

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- *Human Settlements*

No human settlements are present within the lease hold area. In the buffer area it is sparcely populated mainly by schedule caste & schedule tribe people.

Population Distribution around mines area:

Zone	Total Household	Total Population	Total Male	Total Female	Male : Female Ratio
0-2 km	2979	13578	7112	6466	1 : 0.9
2-5 km	2587	13207	6615	6592	1 :0.99
5-10 km	13574	65307	33070	32237	1 : 0.97
Total	19,140	92,092	46,797	45,295	1 : 0.96

As per Census 2011, the overall literacy rate of the area is found 53% with male literacy of 61% and female literacy at 45%.

- *Public buildings, places of worship and monuments*

There are no public building or places of archaeological / tourist / religious importance within the lease area. Among the historical places, Biraja Mandir at Jajpur, Mahabinayak Temple at Chandikhol and Lalitgiri cave are located at distances of 110 km, 70 km and 90 km, respectively. There are a number of amenities in the buffer zone. Some rural Health and Medical facilities, primary schools, middle schools, secondary schools, senior secondary schools and graduate collage along with bus stop, power supply, post office and telephone line are present.

- *Any sanctuary in the vicinity of leasehold*

Nearest zoo is at Bhubaneswar and Birds Sanctuary at Chilika, situated at 160 km and 320km, respectively.

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8.2 Impact Assessment:

i) Land use pattern indicating the area likely to be degraded due to quarrying, dumping, roads, workshop, processing plant, tailing pond/dam, township etc.

Land use	As on 30.06.2018, (In Ha)			At the end of Plan Period, 2023-24, (In Ha)			By the end of conceptual period, (In Ha)		
	Forest	Non forest	Total	Forest	Non forest	Total	Forest	Non forest	Total
Area under Mining	28.830	0.000	28.830	36.158	0.000	36.158	42.437	0.000	42.437
Overburden Dump & Subgrade Dump	48.570	1.020	49.590	50.663	1.020	51.683	50.663	1.020	51.683
Mineral storage	11.132	0.060	11.192	7.210	0.060	7.270	0.810	0.000	0.810
Infrastructure (Workshop, Admn Building etc)	12.908	0.102	13.010	7.773	0.102	7.875	8.788	0.162	8.950
Roads	3.130	0.050	3.180	3.375	0.050	3.425	2.870	0.050	2.920
Effluent Treatment Plant, Settling Pond, Pipeline etc.	5.660	0.000	5.660	3.624	0.000	3.624	3.235	0.000	3.235
Township	1.050	0.000	1.050	1.050	0.000	1.050	1.050	0.000	1.050
Safety Zone	3.660	0.478	4.138	3.660	0.478	4.138	3.660	0.478	4.138
Chrome Ore Beneficiation Plant	0.000	0.000	0.000	1.110	0.000	1.110	1.110	0.000	1.110
Others (Magazine)	0.110	0.000	0.110	0.110	0.000	0.110	0.110	0.000	0.110
Others (Dry Tailing Storage Area)	0.000	0.000	0.000	0.317	0.000	0.317	0.317	0.000	0.317
Total	115.050	1.710	116.760	115.050	1.710	116.760	115.050	1.710	116.760

ii) Air quality

From the proposed mining, mineral beneficiation & transport of mineral, there will be marginal increase in impact on air quality during initial two years. Thereafter, from third year onwards opencast mining by conventional method shall decrease and opencast mining by grab will increase. As a result, the impact on air quality shall be reduced remarkably due to negligible excavation of overburden in the opencast mining by grab.

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Air Pollution Control Measures:

- Dust suppression arrangements at all dust generation points.
- Wet drilling will be practiced in both opencast & underground mining.
- Wet mineral beneficiation process will be adopted.
- Regular water sprinkling and maintenance of transportation roads.
- Dust mask provision to workers engaged in dust generating operations
- Mineral transporting trucks shall be covered.
- Periodical monitoring of air quality to take preventive & corrective measues.

iii) Water quality
Impact on Water Environment

- No further impact is envisaged on surface water resources.
- Mining has already intersected ground water table.

Water Conservation and Pollution Control Measures

- Process water from beneficiation plant and workshop will be recycled and reused.
- Domestic effluent from the mine will be discharged in septic tank/soak pit.
- Tailing pond will be made impervious.
- Garland drains will be provided around the waste dump and mineral processing area to channelise the surface runoff.
- Surface runoff will be collected in a settling pond and will be treated in ETP.
- Rainwater harvesting structures will be provided.

iv) Noise levels
Impact on Ambient Noise Level

The major noise generating sources during operation period will be from Drill machine, HEMMS, Crushers, DG sets and compressors.

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Control Measure of Noise Pollution

- Provision of effective noise enclosures to noise generating equipments to attenuate the noise level.
- Provision of vibration isolators to air compressors and pumps in order to reduce noise generation / absorb noise.
- Proper maintenance and lubrication of machinery will be carried out to reduce noise generation.
- The DG Set will be placed inside an enclosure.
- Development of plantation around the plant area, around office buildings, township and internal roads wherever possible to attenuate noise.
- In order to reduce noise exposure levels of the workers, they will be issued with earmuffs/ ear-plugs, especially those deployed in high noise areas, such as drilling operators, workers working near crushers, compressors, pump-house, DG Set etc.

v) Vibration levels (due to blasting)

Ground Vibration will be from opencast & underground stope blasting only. Opencast blasting requirement is only 10% of total excavation. Controlled blasting is carried out as per recommendations of Indian School of Mines, Dhanbad. After underground workings are developed, necessary ground vibration studies shall be carried out by scientific agencies. Therefore, no adverse impacts are anticipated due to blasting.

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vi) Water regime

Ground water level is being monitored regularly in core & buffer zone. The maximum & minimum level of ground water fluctuations in the nearby borewells is given below.

Station No	Location	Maximum Water level below ground level (mtr)	Minimum Water level below ground level (mtr)
WL-G1	Bore Well Inside Mines (Mahagiri Mines)	7.1	17.2
WL-G2	Bore Well Mahagiri Enclave	5.9	17.3
WL-G3	Bore Well Inside Mines Main Office-SMC	8.9	23.9
WL-G4	Bore Well Village Goramian	4.8	13.9
WL-G5	Bore Well OMC Labour Colony	4.6	13.5
WL-G6	Bore Well Village Giringamali	5.1	14.1

vii) Acid mine drainage

No acid mine drainage is anticipated.

viii) Surface subsidence

The scope of subsidence due to underground mining is not anticipated since voids in stopes will be post filled. Underground workings has been designed as per recommendations of NIRM. However, the stability of void shall be monitored through instruments like load cell, BH extensometer, Convergence meter etc. Subsidence survey for underground shall be done at regular interval on surface.

vii) Socio-economics

Rehabilitation & Resettlement of population is not involved in this project. The mine is already working. There will be only increase in construction activities for underground, COB plant and related ancilliary activities. This will give an opportunity for employment to local people. The mining activities have already benefited the local people in the following ways :

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- Better economic status of the community.
- Faster industrial development of the area.
- Higher inputs in the area towards infrastructural facilities provided for better access to markets, health care, education, communication etc.

Apart from above, following CSR activities are being done as a corporate policy by the lessee:

1. Health
2. Education
3. Drinking Water Facility
4. Cultural and Recreational Activities
5. Afforestation and Environment
6. Vocational training
7. Self Employment

viii) Historical monuments etc.

There is no historical monuments within the core & buffer zone of the lease hold area.

8.3 Progressive reclamation Plan :

To mitigate the impacts and ameliorate the condition, year wise proposals or the Mining Plan period are described separately and shown in the table given below.

8.3.1. Mined-Out Land:

During this Plan period, the present opencast mining method is proposed to continue till ultimate pit limit of (-)2 mRL in Band I. In addition to conventional opencast mining, it is proposed to carry out opencast mining by grab. Opencast mining by Grab is proposed upto a depth of 60mtrs from ultimate pit limit of opencast quarry. As opencast mining by grab shall continue, backfilling of the quarry is not possible during the period from 2019-20 to 2023-24. However, the excavated panels of opencast mining by grab shall be backfilled with overburden.

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8.3.2 Topsoil Management:

Topsoil is not available with in the proposed mined out area. Hence, there will be no generation of top soil during the plan period.

8.3.3 Tailings Dam Management:

Presently no beneficiation is being done within the lease area. It is proposed to set up a 40TPH chrome ore beneficiation plant during the year 2023-24. It is expected that approx. 25000 tonnes of tailing shall be generated per annum. The grade of tailing is expected below 9% Cr_2O_3. The proposed tailing pond inside the COB plant shall comprise of two separate chambers, where the suspended solids will settle in the first chamber and supernatant water will be collected in the second chamber and the same shall be recirculated to the plant for reuse. Alternately, filter press for separation of solid waste from the slurry can also be used. No water from the COB plant shall be discharged outside the COB plant. Chrome ore tailings of below 10% Cr_2O_3 are treated as waste. The tailing collected from the pressure filter / tailing ponds after being dried shall be stored in a designated place near subgrade dump. Refer Plate No SMC/11.

8.3.4 Acid mine drainage:

There will be no acid mine drainage.

8.3.5 Surface subsidence mitigation measures through backfilling of mine voids or by any other means and its monitoring mechanism.

The scope of subsidence due to underground mining will not be there, as during the plan period only shaft sinking is proposed.

The excavated panels of opencast mining by grab shall be backfilled with overburden & necessary monitoring shall be implemented in consultation with scientific agencies.

Summary of yearwise proposal (2019-20 to 2023-24) for item no 8.3

Items	Details	Proposed					Actual	Remark
		2019-20	2020-21	2021-22	2022-23	2023-24		
Dump Management	Area afforested (ha)	0.6	1.1	0.9	0.8	1.3		In Overburden Dumpyard
	No of saplings planted	1500	2750	2250	2000	3250		In Overburden Dumpyard
	Cumulative no of plants							
	Cost including watch & care during the year	3.6	6.6	5.4	4.8	7.8		Calculated @ 6 Lakhs / Hact per year
Management of worked out benches	Area available for rehabilitation (ha)	Nil	Nil	Nil	Nil	Nil		It is a working quarry. Opencast Mining & Opencast Mining by Grab shall continue. All the benches are active.
	Afforestation done (ha)	Nil	Nil	Nil	Nil	Nil		
	No of saplings planted in the year	Nil	Nil	Nil	Nil	Nil		
	Cumulative no of plants	Nil	Nil	Nil	Nil	Nil		
	Any other method of rehabilitation (specify)	Nil	Nil	Nil	Nil	Nil		
	Cost including watch & care during the year	Nil	Nil	Nil	Nil	Nil		
Reclamation and Rehabilitation by backfilling	Void available for backfilling (L x B x D) pitwise / stope wise, in CuM	14400*	Nil	Nil	7000000**	6500000**		* Void created by Opencast Mining by Grab on trial basis. ** Mined out quarry of Band I
	Void filled by waste/tailing	14400*	Nil	Nil	500000**	1100000**		* Void backfilled in Opencast Mining by Grab on trial basis. ** Backfilling in mined out quarry of Band I
	Afforestation on the backfilled area	Nil	Nil	Nil	Nil	Nil		
	Rehabilitation by making water reservoir	Nil	Nil	Nil	Nil	Nil		
	Any other means (specify)	Nil	Nil	Nil	Nil	Nil		
Rehabilitation of waste land within lease	Area available (ha)	Nil	Nil	Nil	Nil	Nil		
	Area rehabilitated (ha)	Nil	Nil	Nil	Nil	Nil		
	Method of rehabilitation	Nil	Nil	Nil	Nil	Nil		
Others (Specify)	Retaining Wall. Mtrs	116	160	192	Nil	Nil		Overburden Dump Yard
	Garland Drain	346	Maintenance	Maintenance	Maintenance	Maintenance		Around Overburden Dump Yard
	Coir Matting, Sq Mtr	2000	3600	2000	3000	Nil		Overburden Dump Yard
	Check Dam, Nos	1	Nil	1	Nil	Nil		Overburden Dump Yard

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8.4 Disaster Management and Risk Assessment:

Risk Assessment

Landslide:

The mine is situated in a plain land. There is no chance of slope failure in opencast mining as the overall pit slope angle is being maintained less than permissible limit, i.e. 30^0.

Subsidence:

The scope of subsidence due to underground mining will not be there since voids in stopes will be post filled. Underground workings has been designed as per recommendations of NIRM. When void is stable the question of subsidence does not arise.

Flood and inundation:

There is no natural nala or river course or lake within the lease hold area which may create danger of inundation and flooding of mines. Damsal nala which is 1.3 km away towards the north east of the mines is having highest flood level of 90 mRL. The lowest surface level within the mining lease area is 110mRL. So, there is no anticipation of flood and inundation.

Fire:

Sources of mine fire are likely to be from oil depot, power line, machinery etc. Regular periodic & preventive maintenance of machinery and electrical installations is being done, so as to prevent any danger from fire. Adequate no of fire extinguishers, water & sand are provided where ever necessary.

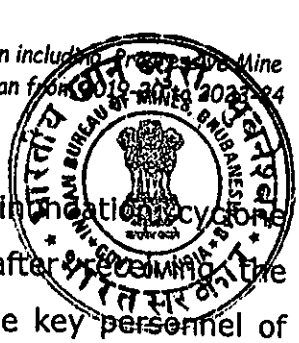
Seismic activity:

The mine lease area falls in Seismic Zone-II. There has been no history of earth quack in the area. The State of Odisha falls under seismic zone - I, II and III. Minor earthquakes have been felt many often in Odisha but none were severe.

M J Raju
Qualified Person

A K Samantray
Qualified Person

P Behera
Qualified Person



Disaster Management

If any emergency arises in the mines due to Blasting, fire, inundation, cyclone etc, one shall inform security in-charge. Immediately after receiving the emergency call security will blow the emergency alarm. The key personnel of the mines will reach the site of emergency and check the area thoroughly, evaluate the situation and action will be taken accordingly. The lessee shall depend for help of nearest State fire department for rescue, if any high-risk accident occurs.

Evacuation Measures in case of Emergency

A. Disaster due to blasting:

Any disaster occurs during blasting, the incharge of blasting i.e Asstant Manager will be the responsible person to intimate the mine official and to take the necessary rescue operations.

B. Disaster due to Fire :

In case of fire within the lease area, it is the responsibility of the person witnessed to inform the fire fighting station, security main gate, Mines Manager. On receipt of the information, I/C Security will rush to the spot and assess the situation, make necessary arrangements for rescue operations for the affected persons and call the fire brigade and inform the Govt authorities like District administration & Police. Security personnel will guide the fire brigade to the site of emergency.

8.5 Care and maintenance during temporary discontinuance:

Following care and maintenance measures are to be carried during the temporary discontinuance of mine.

1. Checking and maintenance of fencing around quarry, gates, barricades, retaining wall, garland drain etc.
2. Regular inspection of Mine workings & benches.
3. Provision of adequate Fire fighting devices at required places.
4. Checking & maintenance of Pumps & pipelines.
5. Electrical circuits shall be checked and maintained on regular basis.

M J Raju
Qualified Person

A K Samantray
Qualified Person

P Behera
Qualified Person

8.6 Financial Assurance

Sl No	Head	Area put on use at start of Plan Period (Ha)	Additional requirement during Plan period (Ha)	Total Area (Ha)	Area considered as fully reclaimed & rehabilitated (Ha)	Net area considered for calculation (Ha)
1	Area under Mining	28.830	7.328	36.158	0.000	36.158
2	Storage of topsoil	0.000	0.000	0.000	0.000	0.000
3	Overburden Dump & Subgrade Dump	49.590	2.093	51.683	0.000	51.683
4	Mineral storage	11.192	(-) 3.922	7.270	0.000	7.270
5	Infrastructure (Workshop, Admn Building etc)	13.010	(-) 5.135	7.875	0.000	7.875
6	Roads	3.180	0.245	3.425	0.000	3.425
7	Railways	0.000	0.000	0.000	0.000	0.000
8	Tailing pond	0.000	0.000	0.000	0.000	0.000
9	Effluent Treatment Plant, Settling Pond, Pipe lines etc.	5.660	(-) 2.036	3.624	0.000	3.624
10	Mineral Separation Plant	0.000	1.110	1.110	0.000	1.110
11	Township area	1.050	0.000	1.050	0.000	1.050
12	Others to specify A. Magazine	0.110	0.000	0.110	0.000	0.110
	B. Safety Zone	4.138	0.000	4.138	0.000	4.138
	C. Dry Tailing Storage Area	0.000	0.317	0.317	0.000	0.317
Grand total		116.760	0.000	116.760	0.000	116.760

अनुमोदित
APPROVED
क्षेत्रीय खान नियंत्रक
REGIONAL CONTROLLER OF MINES
भारतीय खान ब्यूरो
INDIN BUREAU OF MINES

This being a Category "A" (Fully Mechanized) Mine, financial assurance for 116.76 Ha is calculated at the rate of Rs 3,00,000/- per Ha. This amounts to Rs 3,50,28,000/- (Rupees Three Crores Fifty Lakhs and Twenty Eight Thousand) only.

M J Raju
Qualified Person

A K Samantray
Qualified Person

P Behera
Qualified Person

Financial assurance for an amount of Rs. 3,50,28,000/- (Rupees Three Crore Fifty Lakhs and Twenty Eight Thousand only), vide Bank Guarantee no 0665718BG0000135, dated: 22.10.2018 is enclosed as Annexure XXVI.

(C R Ray)
Nominated Owner

M J Raju
Qualified Person

A K Samantray
Qualified Person

P Behera
Qualified Person

भारतीय खान ब्युरो, भुवनेश्वर
INDIAN BUREAU OF MINES, BHUBANESWAR
GOVT. OF INDIA

PART B

9.0 Certificates / Undertakings/ Consents

M J Raju
Qualified Person

A K Samantray
Qualified Person

P Behera
Qualified Person

9.0 Certificates / Undertakings/ Consents (As detailed below)

A. CONSENT LETTER/ UNDERTAKING/ CERTIFICATE FROM THE APPLICANT:

01. The Review of Mining Plan in respect of Sukinda Mines (Chromite) over an area of 116.76 Hacts in Village: Kaliapani, PO: Kalaranglatta, Dist: Jajpur, Odisha under Rule 17(2) of Minerals (Other than Atomic and Hydro Carbons Energy Minerals) Concession Rule, 2016 and Rule 23 of MCDR-2017 has been prepared by qualified persons, Sri A K Samantray, Sri M J Raju and Sri P Behera.

This is to request the Regional Controller of Mines, Indian Bureau of Mines, Bhubaneswar, to make any further correspondence regarding any correction of the Review of Mining Plan with the said qualified person at his address below.

Sri A K Samantray	**Sri M J Raju**	**Sri P Behera**
Address: Senior Manager (Mines) Indian Metals & Ferro Alloys Ltd, IMFA Building, Bomikhal,Rasulgarh, Bhubaneswar – 751010, Odisha Phone: 9937297144, Fax:0674-2580020, Email: ashishsamantray@imfa.in Mobile No: 9937297144	Address: Dy. General Manager-Geology Indian Metals & Ferro Alloys Ltd, IMFA Building, Bomikhal, Rasulgarh, Bhubaneswar – 751010, Odisha Phone: 9777575711, Fax:0674-2580020, Email: mjraju@imfa.in Mobile No: 9777575711	Address: Vice President (Mines) Indian Metals & Ferro Alloys Ltd, IMFA Building, Bomikhal, Rasulgarh, Bhubaneswar – 751010, Odisha Phone: 9937058102, Fax:0674-2580020, Email: pbehera@imfa.in Mobile No: 9937058102

We hereby undertake that all modifications / updating as made in the said Review of Mining Plan by the said qualified person be deemed to have been made with our knowledge and consent and shall be acceptable on us and binding in all respects.

02 It is certified that the CCOM Circular No-2/2010 will be implemented and complied with when an authorized agency is approved by the State Government.

M J Raju
Qualified Person

A K Samantray
Qualified Person

P Behera
Qualified Person

03 It is certified that the Progressive Mine Closure plan of Sukinda Mines (Chromite) of M/s Indian Metals & Ferro Alloys Ltd over an area of 116.76 Hacts complies with all statutory rules, Regulations, Orders Made by the Central or State Government, Statutory organization, Court etc which have been taken into consideration and wherever any specific permission is required the lessee will approach the concerned authorities.

The information furnished in the Review of Mining Plan and Progressive Mine Closure plan is true and correct to the best of my knowledge and records. It is to undertake that all the measures proposed in this Progressive Mine Closure Plan will be implemented in a time bound manner as proposed.

04. The provisions of Mines Act, Rules and Regulations made there under have been observed in the Review of Mining Plan over an area of 116.76 hectares in Jajpur district in Odisha state belonging to Sukinda Mines (Chromite), and where specific permissions are required, the applicant will approach the D.G.M.S. Further, standards prescribed by D.G.M.S. in respect of miners' health will be strictly implemented.

Place: Bhubaneswar
Date: 24.10.2018

Chitta Ranjan Ray
Designation: Nominated Owner
M/s Indian Metals & Ferro Alloys Ltd

M J Raju
Qualified Person

A K Samantray
Qualified Person

P Behera
Qualified Person

CERTIFICATE FROM QUALIFIED PERSON

The provisions of the Mineral Conservation and Development Rules, 2017 have been observed in the preparation of the Review of Mining Plan for Sukinda Mines (Chromite) over an area of 116.76 Hacts, of M/s Indian Metals & Ferro Alloys Ltd, in Village: Kaliapani, P.O: Kalarangiatta, District: Jajpur of Odisha State and whenever specific permissions are required, the applicant will approach the concerned authorities of Indian Bureau of Mines.

The information furnished in the Review of Mining Plan is true and correct to the best of our knowledge.

A K Samantray	M J Raju	P Behera
Qualified Person	Qualified Person	Qualified Person

Place: Bhubaneswar
Date: 24.10.2018

M J Raju	A K Samantray	P Behera
Qualified Person	Qualified Person	Qualified Person

Enclosure VI
Land Use at Conceptual Stage

Land Use	By the end of Conceptual Period (in ha.)		
	Forest	**Non-Forest**	**Total**
Area under mining	42.437	0.000	42.437
Overburden dump & subgrade dump	50.663	1.020	51.683
Mineral Storage	0.810	0.000	0.810
Infrastructure	8.788	0.162	8.95
Roads	2.870	0.050	2.92
ETP, settling pond, pipeline etc	3.235	0.000	3.235
Township	1.050	0.000	1.050
Safety Zone	3.660	0.478	4.138
COB Plant	1.110	0.000	1.110
Others (Magazine)	0.110	0.000	0.110
Others (Dry Tailing Storage Area)	0.317	0.000	0.317
Total	**115.05**	**1.710**	**116.76**

Enclosure VII

Relevant pages of approved review of mining plan

SUKINDA MINES (CHROMITE)

(Over an area of 116.76 Ha in village Kaliapani, Jajpur District, Odisha)

REVIEW OF MINING PLAN

(For the period from 2019-20 to 2023-24)

Under Rule 17(2) of Minerals (Other than Atomic and Hydro Carbons Energy Minerals) Concession Rule, 2016,

PROGRESSIVE MINES CLOSURE PLAN

Under Rule 23 of Mineral Conservation and Development Rules, 2017

Lessee Details	M/s Indian Metals & Ferro Alloys Limited IMFA Building, Rasulgarh, Bhubaneswar District: Khurda, State: Odisha, Pin code: 751010 E-mail: mail@imfa.in Phone: (0674) 2580100/125 Fax No: (0674) 2580145/ 020
Lease Area: 116.76 Hacts Forest Area: 115.05 Hects Non Forest Area: 1.71 Hects	The entire ML area was Non Forest as per Hal records. As per Sabik records the land schedule of the ML area consists of 115.05 Ha of Forest Land and 1.71 Ha of Non Forest Land. Persuance to MoEF&CC circular No. F.No.8-78/1996-FC, dated 10.03.2015, lessee has obtained forest clearance (stage II) over 115.05 ha of forest land from Ministry of Environment, Forest & Climate, vide letter no: 8-16/2016-FC, dated 22.06.2018.
Category of Mine: Fully Mechanised Category - "A"	Date of Execution of the ML Area: 04.09.1999 Date of Expiry of the ML Area: 03.09.2049 Lease Period: 50 Years
Registration no under Rule 45 of MCDR 2017: IBM/4200/2011 Mine Code No: 11ORI19014	

TEXT

Prepared by

Sri A K Samantray, B.E & M. Tech in Mining Engineering

Sri M J Raju, M. Sc (Tech) Applied Geology

Sri P Behera, Degree in Mining Engineering

imfa

INDIAN METALS & FERRO ALLOYS LIMITED

IMFA Building, Rasulgarh, Bhubaneswar – 751 010

OCTOBER, 2018

भारतीय खान ब्यूरो INDIAN BUREAU OF MINES BHUBANESWAR GOVT. OF INDIA

Reclamation and Rehabilitation:

A. Mined out area over Band I

During this Plan period, the present opencast mining in Band I is proposed to continue till ultimate pit limit of (-)2 mRL is reached. After completion of opencast mining, the mined out area of Band I shall be back-filled by overburden being generated during opencast mining of Band II and waste being generated from underground developments of Band I. Opencast working in band II is proposed to start from 2023-24. Accordingly, backfilling in mined out areas of Band I quarry shall also commence from 2023-24. Mined out quarry of Band I is proposed to be backfilled upto 114 mRL and can accommodate about 70 L CuM of overburden. Reclaimed area in mined out area of Band I shall be utilised for mineral storage & processing. A portion of reclaimed area (backfilled upto 136mRL) in mined out area of Band I shall be utilised for development of infrastructure purpose. After cessation of mining activities, rehabilitation of the back-filled area over Band-I shall be done by planting local species.

Trial of opencast mining by grab is proposed in 2019-20. Based on the results of the trial mining, the method shall be proposed for extraction of chrome ore in other areas of the Band I opencast quarry, where the conventional opencast would have reached it's ultimate limits. Upon implementation of opencast mining by grab, the opencast mining in Band II shall be deferred by few years.

B. Mined out area over Band II:

Mined out area of Band II is proposed to be reclaimed upto 78mRL by rehandling overburden from dumpyard & waste being generated from underground workings of Band I. In the conceptual end the backfilled areas of Band II is proposed to be rehabilitated by planting local species.

The above details are shown in the conceptual plan & section. Refer plate no: SMC/15 & SMC/16.

M J Raju
Qualified Person

A K Samantray
Qualified Person

P Behera
Qualified Person

B. UNDERGROUND WORKING

Leaving a safe parting of 248 mtrs below ultimate opencast pit limit of Band I i.e. (-)2mRL, underground workings is proposed to be commenced from 2021-22 after getting all statutory clearances. As per guidelines of the Geo-technical report prepared by National Institute of Rock Mechanics (NIRM) (refer Annexure XXI), detailed mine planning for underground mining has been done for Band I from -250mRL and below.

As per NIRM report, the wall rock, namely, serpentinite, which are in contact are weak till -125 to -150 mRL, and the ore body is also weak till -175 to -200 mRL. NIRM has developed 3D numerical models and the extraction sequence was simulated. Output in the form of displacement and safety factors was obtained from the models, and the results of parametric study were compared. It is observed that the displacements were higher in the elevations between -175 mRL and -225 mRL and reduced significantly beyond -250 mRL. This can be attributed to the fact that the strength of the ore body is less from -100 mRL to -250 mRL (GSI : 25 - 35), and it improved considerably beyond -250 mRL (GSI : 40 - 60). Hence, it is proposed to commence the underground development and mining below (-)250mRL.

i) Mode of Entry – Production (Circular) Shaft & Service (Rectangular) Shaft

It is proposed to have two vertical shafts. One to be used for production and another for services. The depth of the production shaft & service shaft is proposed to be 705mtrs & 645mtrs respectively. The location of shafts have been choosen by gravity distance consideration. As there is no space on the footwall side and the dip of the ore body is more than 80 degree, hence hanging wall location of shafts have been chosen. The distance between two shafts shall be 30 mtrs. Both the shafts shall be inter connected at regular intervals, to establish fresh air base as close to the working place as practically possible during sinking.

M J Raju
Qualified Person

A K Samantray
Qualified Person

P Behera
Qualified Person

Enclosure VIII
Cumulative impact due to all activities

AIR QUALITY DISPERSION REPORT

For

EXPANSION OF SUKINDA MINES (CHROMITE)

At

Village: Kaliapani, Tehsil- Sukinda, District: Jajpur, State: Odisha

Lease Area: 116.76 Ha

Developed by

M/s Indian Metals and Ferro Alloys Ltd.

Prepared by:

M/s PERFACT ENVIRO SOLUTIONS PVT. LTD.
501 -507 Nn Mall, Sector 3 Rohini
New Delhi – 110085
Ph.no - 011 –49281360

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1. INTRODUCTION

The ambient air quality Ground Level Concentration (GLC) of the area near any project is impacted due to air pollution sources in the project. The air pollution sources are of two types:

- Point Sources – Chimneys/ Stacks/ ducts/ Vents
- Non-Point Sources – Vehicles, machinery, blasting, drilling etc.

The emissions from these sources spread or disperse in the air and cause increase in the pollution level in ambient air. This causes an increase in Ground Level Concentration (GLC). This increase in GLC can be predicted for proposed project using Air Dispersion Modelling. In this study, AERMOD developed by Lakes Environmental Inc. is used to calculate incremental Ground Level concentrations (GLC) for the proposed sources of air pollution in the current expansion, for Particulate emissions, Gaseous emissions (NO_x & SO_2).

2. METHODOLOGY

2.1. Modeling procedure

The American Meteorological Society (AMS)/Environmental Protection Agency (EPA) Regulatory Model Improvement Committee (AERMIC) was formed to introduce state-of-the-art modeling concepts into the EPA's air quality models. Through AERMIC, a modeling system, AERMOD, was introduced that incorporated air dispersion based on planetary boundary layer turbulence structure and scaling concepts, including treatment of both surface and elevated sources, and both simple and complex terrain.(Epa and OAR 2016)

There are two input data processors that are regulatory components of the AERMOD modeling system: AERMET, a meteorological data preprocessor that incorporates air dispersion based on planetary boundary layer turbulence structure and scaling concepts, and AERMAP, a terrain data preprocessor that incorporates complex terrain using USGS Digital Elevation Data.

The pollutants released into the atmosphere will disperse in the downwind direction and finally reach the ground at a farther distance from the source. The concentration of ground level concentrations mainly depends upon the strength of the emission source and micrometeorology of the study area.

The AERMOD is actually a modeling system with three separate components: AERMOD (AERMIC Dispersion Model), AERMAP (AERMOD Terrain Preprocessor), and AERMET (AERMOD Meteorological Preprocessor). Special features of AERMOD include its ability to treat the vertical in homogeneity of the planetary boundary layer special treatment of surface releases, irregularly-shaped area sources, a plume model for the convective boundary layer, limitation of vertical mixing in the stable boundary layer, and fixing the reflecting surface at the stack base.

The AERMET is the meteorological preprocessor for the AERMOD. Input data can come from hourly cloud cover observations, surface meteorological observations and twice-a-day upper air soundings. Output includes surface meteorological observations and parameters and vertical profiles of several atmospheric parameters.

The AERMAP is a terrain pre-processor designed to simplify and standardize the input of terrain data for the AERMOD. Input data include receptor terrain elevation data. Output includes, for each receptor, location and height scale, which are elevations used for the computation of airflow around hills. The input file for the AERMOD model makes use of a keyword/parameter approach to specifying the options and input data for running the model.

For Air Dispersion Modelling following methodology shall be used:

AERMOD uses Gaussian plume dispersion modelling parameters, the generalised equation is given below:

$$c = \frac{Q}{2\pi u \sigma y \sigma z} exp\left(-\frac{1}{2}\frac{Y^2}{\sigma^2 y}\right)\left\{exp\left[-\frac{1}{2}\frac{(z-h^2)}{\sigma^2 z}\right] + exp\left[-\frac{1}{2}\frac{(z+h^2)}{\sigma^2 z}\right]\right\}$$

Where

c = concentration at a given point (g/m^3)

Q = emission rate (g/s)

u = wind speed (m/s)

σ_y = dispersion parameter in the horizontal (lateral) direction (m)

σ_z = dispersion parameter in the vertical direction (m)

x = direction of the wind ($x = 0$ at the source; $x > 0$ downwind).

y = horizontal direction perpendicular to the wind ($y = 0$ at the center of the plume; positive on your left when you look downwind).

z = vertical direction ($z = 0$ at the surface and positive above the surface).

As well as the effective source height h. They all have meters as units.

Plume Rise

Plume rise Δh has been determined according to Brigg's formula (CPCB guideline)

$$\Delta h = 21.425 \frac{F^{3/4}}{U_s} \quad \text{for } F<55$$

and

$$\Delta h = 38.71 \frac{F^{3/5}}{U_s} \quad \text{for } F>55$$

$$F = g V_s D^2 (T_s - T_a)/4T_s$$

Where

U_s = wind speed at stack level (m/s)

V_s = stack gas velocity (m/s)

T_s = stack gas temperature (K)

T_a = ambient temperature (K)

F = Buoyancy flux parameter (m^4/s^3)

Δh = Plume rise (m)

D = Diameter of the stack (m)

g = acceleration due to gravity, 9.807 (m/s^2)

2.2. EXTRAPOLATION OF WIND SPEED

Wind speed at stack level is calculated by power law as given below.

$U_{stack} = U_{10}(\text{Stack height}/10)^{p}$

Where U_{10} is the wind speed at 10 meter level and p is the power law coefficient (0.07, 0.07, 0.10, 0.15, 0.35 and 0.55 for stability classes A,B,C,D,E and F respectively) as per Irwin for rural areas (USEPA, 1987).

2.2.1. Stability Classification

Hourly stability is determined by wind direction fluctuation method as suggested by Slade (1965) and recommended by CPCB (PROBES/70/1997-1998).

$\sigma_\theta = W_{dr}/6$

σ_θ, is standard deviation of wind direction fluctuation, W_{dr} is the overall wind direction fluctuation or width of the wind direction in degrees. The table for stability classes is given as under.

Stability Class	σ_θ (degree)
A	> 22.5
B	22.4 – 17.5
C	17.4 – 12.5
D	12.4 – 7.5
E	7.4 – 3.5
F	< 3.5

2.2.2. Dispersion Parameters

Dispersion parameters σ_y and σ_z for open country conditions (Briggs, 1974) are used as the project is located on a flat terrain in a rural area. Atmospheric dispersion coefficients vary with downwind distance (x) from emission sources for different atmospheric stability conditions. (CPCB – PROBES/70/1997-98).

2.2.3. Rural Conditions

Table 1: Stability classification

Stability Class	σ_y	σ_z
A	$0.22x(1+0.0001x)^{-.5}$	0.20x
B	$0.16x(1+0.0001x)^{-.5}$	0.12x
C	$0.11x(1+0.0001x)^{-.5}$	$0.08x(1+0.0002x)^{-.5}$

D	$0.08x(1+0.0001x)^{-.5}$	$0.06(1+0.0015x)^{-.5}$
E	$0.06x(1+0.0001x)^{-.5}$	$0.03x(1+0.0003x)^{-1}$
F	$0.04x(1+0.0001x)^{-.5}$	$0.16x(1+0.0003x)^{-1}$

2.3. INPUT DATA

2.3.1. About the project and emission details

The proposal of M/s Indian Metals & Ferro Alloys is for enhancement in production from 3.51 Lakh TPA to 6.0 Lakh TPA, change in technology from opencast to both opencast & underground mining and establishment of Chrome Ore Beneficiation plant of 40 TPH feed capacity consisting of crushing & wet section from the mining lease area spread over 116.76 ha situated at Village: Kaliapani, Tehsil: Sukinda, Distt: Jajpur, Orissa .

Topography of the area comprises hilly and undulating terrain. The highest elevation in the area is 185 mRL and the minimum is 110 mRL. Overall regional slope is from south to north.

2.3.2. Location of the project

Table 2 : Location of the project site

Latitude	**Longitude**	**Elevation**
21°01’45.51″N to 21°02’33.81″ N	85°45′35.91″E to 85°46′42.03″ E	110 mRL to 185 mRL

Figure 1: Closed eye view of the proposed project

2.3.3. Sources

A Table showing all the sources of Air Pollution (Incremental i.e. Proposed due to the proposed project) are given; other air pollutants sources have not been considered in the model because their impact has been already incorporated in baseline concentrations (Onsite and Buffer zone). Proposed project will have 1 x 62.5, 1 x 82.5, 1 x 200, 1 x 250 kVA DG sets, pit and a Crushing and screening plant of 40 TPH feed capacity.

The emission factors have been calculated using the experimental/ practically computed (As per USEPA).

Table 3: Points source and stack details

S. No.	DG sets proposed	Nos.	Stack Height (from reference level)	Location of DG sets
1.	750 kVA	01	6.0 meters	Surface
2.	250 kVA	01	6.0 meters	Surface
3.	200 kVA	01	6.0 meters	Surface

4.	82.5 kVA	01	6.0 meters	Surface
5.	62.5 kVA	01	6.0 meters	Surface

2.3.4. Emission characteristics of point and non point source

Table 4: Point and nonpoint sources

S.No	Parameter	DG Sets					Crushing & screening plant	Non-point source (mineral storage area to public road)
	Capacity	**1 x 750**	**1 x 250**	**1 x 200**	**1 x 82.5**	**1 x 62.5**		**Vehicular emission**
1	No. of units operative at any point of time	Standby	Standby	Standby	Standby	Standby	Operational(proposed)	Operational
2	Hours of operation	4 hours	4 hours	4 hours	4 hours	4 hours	24 hours	14-16 hours
3	Exhaust diameter(m)	0.3	0.3	0.3	0.3	0.3	0.3	10- 15 cm
4	Stack height (m)	6	6	6	6	6	10	1 m for bus 0.5 m for car/two wheeler
5	Exhaust gas temperature (ºC)	510	450	410	410	410	510	-
6	Exhaust gas velocity (m/s)	10	10	10	10	10	10	-
7	**Emission of pollutants (g/s)**							
a	Particulate matter (PM_{10})	0.245	0.22	0.22	0.15	0.15	0.14	0.05
b	Particulate matter ($PM_{2.5}$)	0.129	0.18	0.18	0.08	0.08	0.07	0.03
c	Oxides of	0.354	0.30	0.30	0.25	0.25	-	0.0228

	Nitrogen (NO_2)							
d	Sulphur dioxide (SO_2)	0.07	0.06	0.06	0.03	0.03	-	0.007

2.3.5. Emission characteristics of Point source- Pit

Release Height (m)	**Height of X Side (M) (Length)**	**Height of Y Side (M) (Width)**	**Volume m^3**	**Ultimate Depth Of Pit (m)**	**PM_{10} Emission Rate (g/s)**	**$PM_{2.5}$ Emission Rate (g/s/)**	**NO_x Emission Rate (g/s/)**	**SO_2 Emission Rate (g/s)**
0.01	800	11.77	5796000	10	1.143e-06	7.434e-06	2.66e-005	3.186e-06

2.3.6. Meteorological Data

Meteorology plays an important factor toward regulation of ambient air quality. Variability of pollutant concentrations in a location has different characteristics based on the prevalent meteorological conditions as it encompasses many atmospheric processes that control or strongly influence the evolution of emissions of chemical species, aerosols and particulate matter (Banerjee, Barman, and Srivastava 2011).24 Hourly meteorological data project site for period of one year (January 2019 -December 2019) in respect of wind speed, wind direction, temperature and cloud amount are utilized in this study which were collected by M/s Perfact Researchers Pvt Ltd. Mean mixing heights for each hour for each region are extracted from the IMD data and AERMOD Upper air estimator data. These data are used in air quality modelling software.

2.3.7. Ambient Air Quality Standards and Background Concentrations

Ambient air quality standards promulgated by Central Pollution Control Board (CPCB) for different areas are as follows:

Table 5: Ambient Air Quality Standards(as per CPCB)

S. No	Pollutant $\mu g/m^3$	Time Weighted Average	Concentration in Ambient Air	
			Industrial, Residential, Rural and Other Area	Ecologically Sensitive Area(Notified by Central Government)
1.	Sulphur Dioxide(SO_2),	Annual* 24 hours**	50 80	20 80
2.	Nitrogen Dioxide(NO_2),	Annual* 24 hours**	40 80	30 80
3.	Particulate Matter (size less than 10µm) or PM_{10}	Annual* 24 hours**	60 100	60 100
4.	Particulate Matter (size less than 2.5µm) or $PM_{2.5}$	Annual* 24 hours**	40 60	40 60

*Annual arithmetic mean of minimum 104 measurements in a year at particular site taken twice a week 24 hourly at uniform intervals**24 hours monitored values, shall be compiled 98% of the time in a year, 2% of the time, they may exceed the limits but not on two consecutive days of the morning. The above standards are for a sampling period of 24 hours.

Table 6: Baseline concentration of air pollutants at the project site and nearby villages falling under 10 Km radius area from the site.

Station No.	Location	Mean Baseline Values for PM_{10} in $\mu g/m^3$	Mean Baseline Values for $PM_{2.5}$ in $\mu g/m^3$	Mean Baseline Values for $SO_2 \mu g/m^3$	Mean Baseline Values for NO_2 $\mu g/m^3$
1	Onsite (Main Gate)	27.3	14.3	5.5	13.3
2	Onsite (Site Office)	27.8	14.6	5.6	13.5
3	Onsite (Near ETP)	26.8	14	5.4	14.4
4	Onsite (Near Lab)	26.3	13.8	5.3	12.8
5	Onsite (Near Electrical substation)	25.8	13.5	5.2	12.5
6	Ostia	28.5	14.8	5.6	14.4
7	Chingudipal	30.9	16.2	6.2	15
8	Saruabil	32.5	17	6.5	15.8
9	OMC Colony	32	16.7	6.4	15.5
10	Mohulakhal	33.5	17.6	6.7	16.3
11	Giringamali	34.5	18	6.7	16.9
12	Ransol	33	17.3	6.6	16
13	Garamian	34	17.8	6.8	16.5

2.4. PLAN AND FRAMEWORK OF COMPUTATIONS

2.4.1. Selection of Locations

The locations have been selected around the project site covering an area of 10 km radius from the centre of the project site. The entire area has been put on grid network and grid spacing has been taken as 250 m.

2.4.2. Plan of Computation

The emission rate, dispersion coefficients and other input data being now available; it was planned to compute the following:

- The 24-hourly averaged incremental concentration with hourly data.
- The identification of grid point having peak concentration for the incremental values.
- Preparation of isopleths for various pollutants.

2.4.3. Input parameters for air quality modeling:

Table 7: The input parameters for air quality modeling (AERMOD)

Input		**Description**
Modelling Software Used		AERMOD View-Version 9.8.3
Control Pathway		
Terrain		Elevated
Dispersion Coefficient		Rural
Meteorology Pathway		
1	Met Input Data	AERMET Meteorological data of one year (January 2019 to December 2019)
2	Latitude:	Plant Location as shown earlier
3	Longitude:	
4	Datum	WGS 84
5	Base Elevation:	0 m from the sea level

Receptor	Uniform Cartesian Grid 1 with 100 m receptor spacing
Source Pathway (Emission Sources)	DG Emissions- 4 hrs per day; Stationary Emission Sources- 24 hr per day. Vehicular emissions - 14-16 hr per day

2.5. MODEL OUTPUT FILES

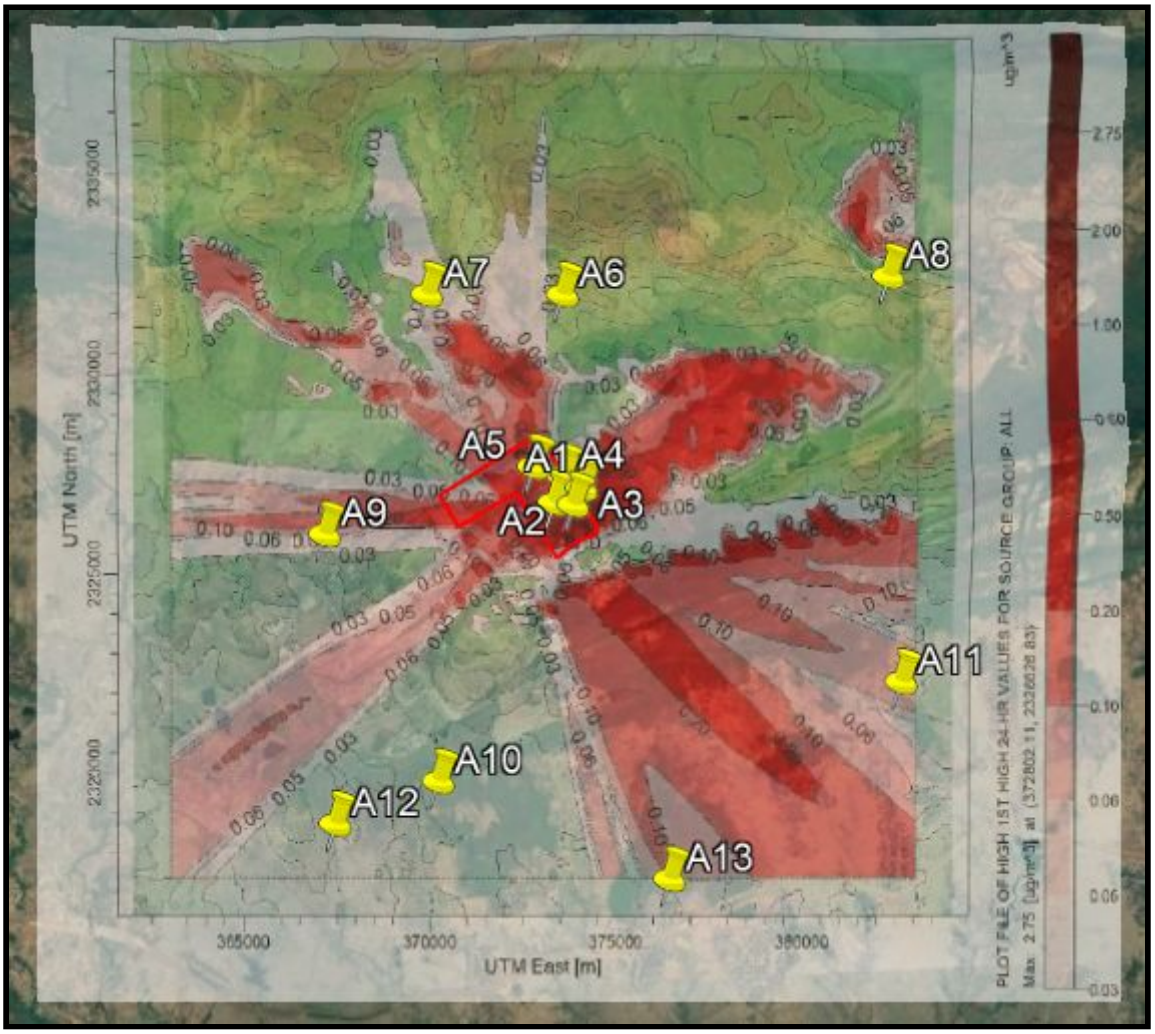

Figure 2: Predicted incremental isopleth of maximum GLCs ($PM_{2.5}$ dispersion)

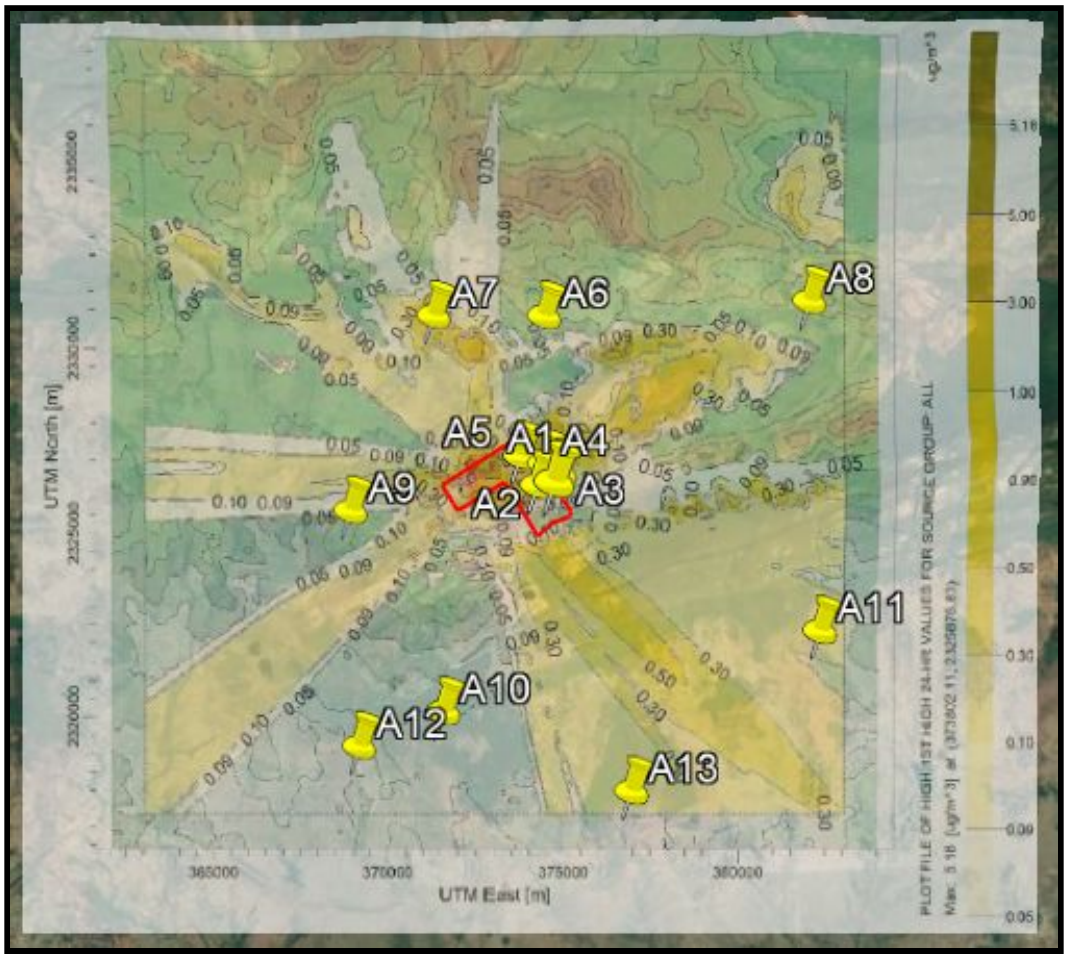

Figure 3: Predicted incremental isopleth of maximum GLCs (PM_{10} dispersion)

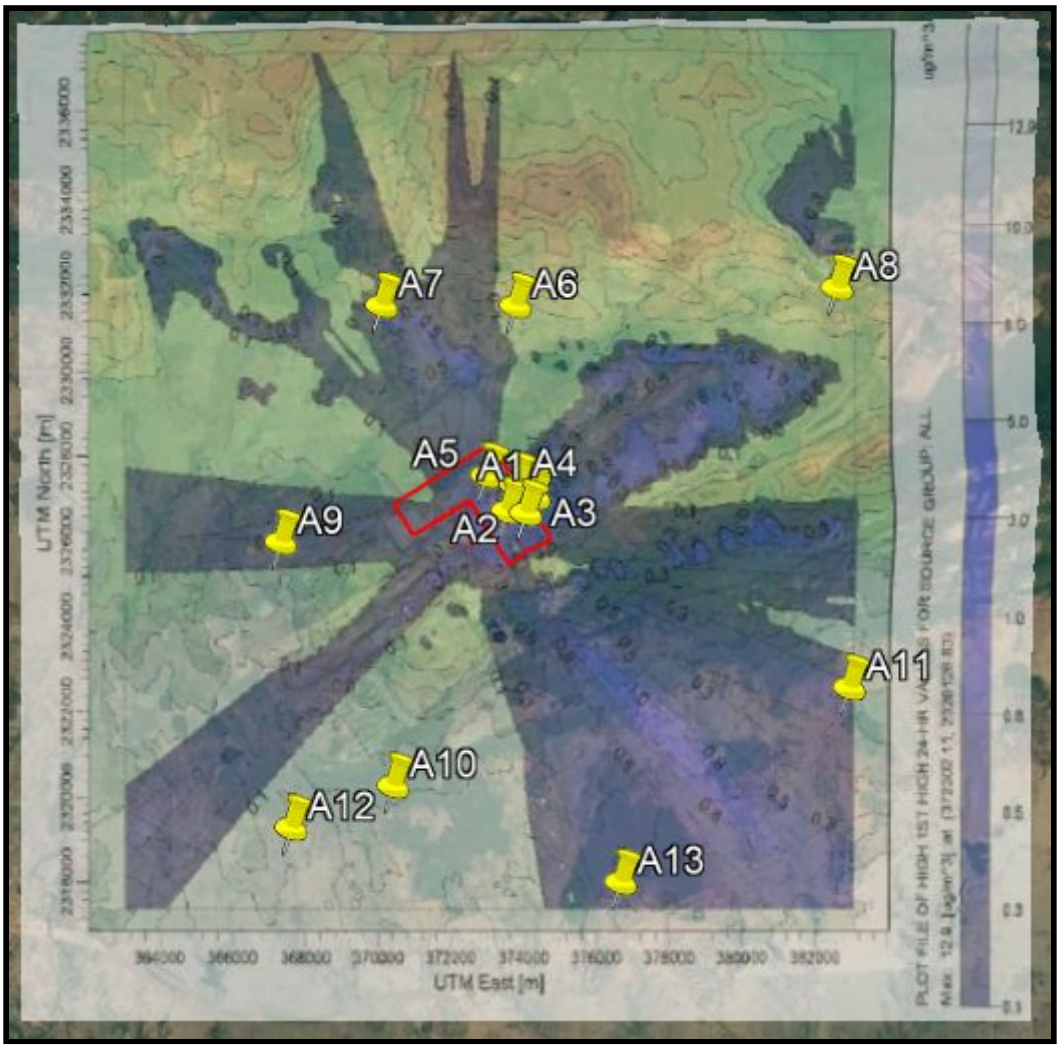

Figure 4: Predicted incremental isopleth of maximum GLCs (NO_2 dispersion)

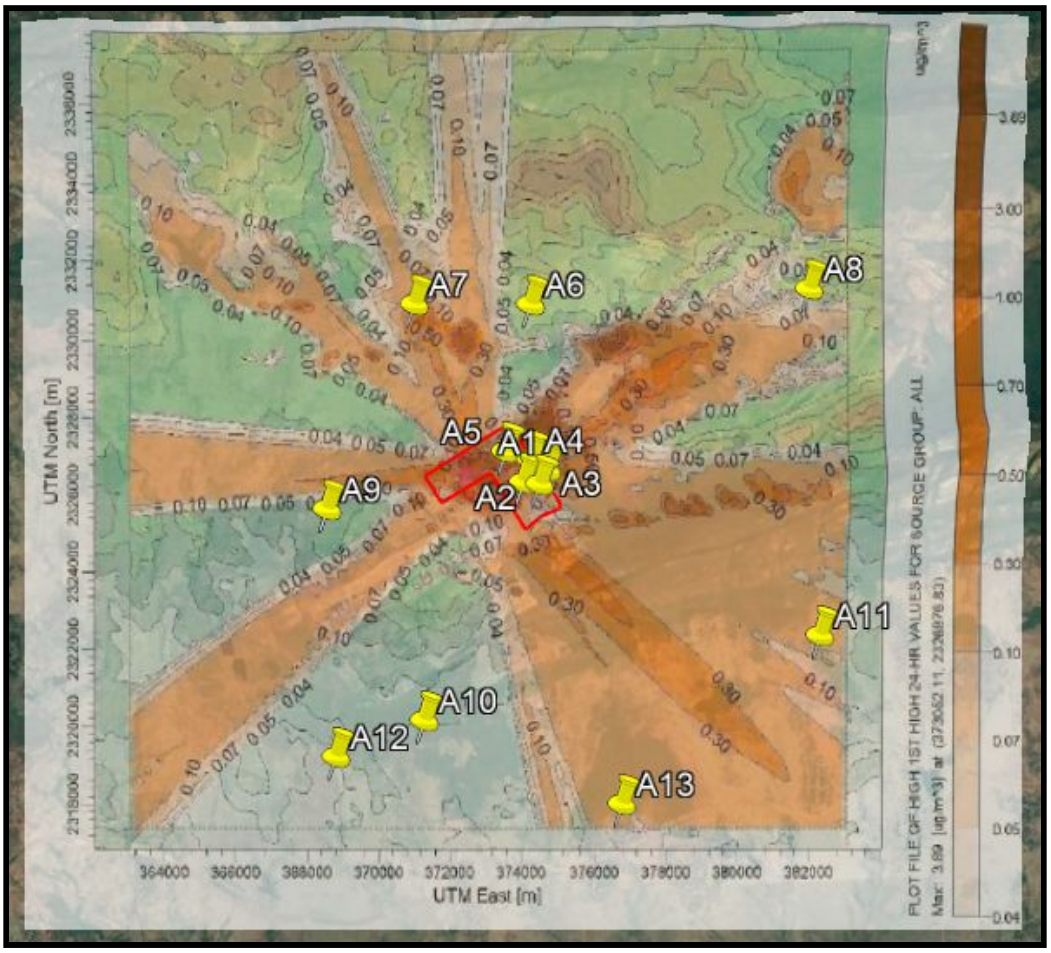

Figure 5: Predicted incremental isopleth of maximum GLCs (SO_2 dispersion)

2.6. RESULT AND DISCUSSIONS

2.6.1. PREDICTED AMBIENT AIR QUALITY FOR IMPACT OF PM2.5

With available ambient air quality data and incremental concentrations computed through mathematical modelling the following post project ambient air quality has been predicted. The maximum GLC for $PM_{2.5}$ modelling will be 2.75 µg/m^3**.**

TABLE 5: PM2.5 DISPERSION RESULTS

Location	Background Concentration PM2.5 (µg/m3)	Predicted Incremental Concentration PM2.5 (µg/m3)	Post Project Air Quality PM2.5 (µg/m3)	NAAQS (µg/m3)

Onsite (Main Gate)	14.3	2.37	16.67	60
Onsite (Site Office)	14.6	2.37	16.97	60
Onsite (Near ETP)	14	2.37	16.37	60
Onsite (Near Lab)	13.8	2.37	16.17	60
Onsite (Near Electrical substation)	13.5	2.37	15.87	60
Ostia	14.8	0.06	14.86	60
Chingudipal	16.2	0.15	16.35	60
Saruabil	17	0.03	17.03	60
OMC Colony	16.7	0.16	16.86	60
Mohulakhal	17.6	0.20	17.80	60
Giringamali	18	0.10	18.10	60
Ransol	17.3	0.05	17.35	60
Garamian	17.8	0.20	18.00	60

2.6.2. PREDICTED AMBIENT AIR QUALITY FOR IMPACT OF PM10

With available ambient air quality data and incremental concentrations computed through mathematical modelling the following post project ambient air quality has been predicted. The maximum GLC for PM_{10} modelling will be 5.18 µg/m^3**.**

TABLE 6: PM10 DISPERSION RESULTS

Location	Background Concentration PM10 (µg/m3)	Predicted Incremental Concentration PM10 (µg/m3)	Post Project Air Quality PM10 (µg/m3)	NAAQS (µg/m3)
Onsite (Main Gate)	27.3	3.5	30.8	100
Onsite (Site Office)	27.8	3.5	31.3	100
Onsite (Near ETP)	26.8	3.5	30.3	100
Onsite (Near Lab)	26.3	3.5	29.8	100

Onsite (Near Electrical substation)	25.8	3.5	29.3	100
Ostia	28.5	0.20	28.7	100
Chingudipal	30.9	0.40	31.3	100
Saruabil	32.5	0.70	33.2	100
OMC Colony	32	0.95	32.95	100
Mohulakhal	33.5	0.20	33.7	100
Giringamali	34.5	0.40	34.9	100
Ransol	33	0.20	33.2	100
Garamian	34	0.70	34.7	100

2.6.3. PREDICTED AMBIENT AIR QUALITY FOR IMPACT OF NO2

With available ambient air quality data and incremental concentrations computed through mathematical modelling (Gaussian Plume) the following post project ambient air quality has been predicted. The maximum GLC for NO_2modelling will be 12.9 µg/m^3 which would be on road**.**

TABLE 7: NO2 DISPERSION RESULTS

Location	Background Concentration NO2 (µg/m3)	Predicted Incremental Concentration NO2 (µg/m3)	Post Project Air Quality NO2 (µg/m3)	NAAQS (µg/m3)
Onsite (Main Gate)	13.3	11.45	24.75	80
Onsite (Site Office)	13.5	11.45	24.95	80
Onsite (Near ETP)	14.4	11.45	25.85	80
Onsite (Near Lab)	12.8	11.45	24.25	80
Onsite (Near Electrical substation)	12.5	11.45	23.95	80
Ostia	14.4	9.00	23.4	80

Chingudipal	15	6.5	21.5	80
Saruabil	15.8	4.00	19.8	80
OMC Colony	15.5	2.00	17.5	80
Mohulakhal	16.3	2.00	18.3	80
Giringamali	16.9	0.90	17.8	80
Ransol	16	0.40	16.4	80
Garamian	16.5	0.50	17	80

2.6.4. PREDICTED AMBIENT AIR QUALITY FOR IMPACT OF SO2

With available ambient air quality data and incremental concentrations computed through mathematical modelling (Gaussian Plume) the following post project ambient air quality has been predicted. The maximum GLC for SO_2 modelling will be 3.89 µg/m^3**.**

TABLE 8:S02 DISPERSION RESULTS

Location	Background Concentration SO2 (µg/m3)	Predicted Incremental Concentration SO2 (µg/m3)	Post Project Air Quality SO2 (µg/m3)	NAAQS (µg/m3)
Onsite (Main Gate)	5.5	0.6	6.1	80
Onsite (Site Office)	5.6	0.6	6.2	80
Onsite (Near ETP)	5.4	0.6	6	80
Onsite (Near Lab)	5.3	0.6	5.9	80
Onsite (Near Electrical substation)	5.2	0.6	5.8	80
Ostia	5.6	0.2	5.8	80
Chingudipal	6.2	0.4	6.6	80
Saruabil	6.5	0.37	6.87	80
OMC Colony	6.4	0.35	6.75	80
Mohulakhal	6.7	0.08	6.78	80
Giringamali	6.7	0.30	7	80

Ransol	6.6	0.26	6.86	80
Garamian	6.8	0.20	7	80

2.7. MITIGATION MEASURES

Following mitigations will be implemented during the proposed project:

- Green areas will be developed within the premises. Plantation all around the periphery of the plot will be done.
- Proper traffic management will be done, within the premises for smooth traffic management.
- Proper stack height of 6 m from the reference level shall be provided in order to minimize the GLC for DG sets.

2.8 DATA INTERPRETATION

The emission sources are broadly categorized as point, line and area sources, covering industrial, vehicular and domestic sources, respectively. However, for the present study, air pollution inventorization was only developed for point and line sources to establish the contribution of project site and vehicular pollution to the regional burden of air pollution. (Banerjee et al. 2011).

The ambient air quality standards and one hourly GLC values to run AERMOD for different hours of the day have been used for calculating average 24 hourly GLC of the day. It is evident from the table above that the maximum predicted increase in GLC of PM_{10} and $PM_{2.5}$ due to emission of the stack is 5.18 and 2.75 µg/m^3 respectively. Maximum predicted increase of SO_2 is found to be 3.89 µg/m^3, and NO_2 is found to be 12.9 µg/m^3.From the results generated by AERMOD in the form of Isopleth and results of same in table above show that the post-project air quality for PM_{10}, $PM_{2.5}$ SO_2& NO_2 is within the limits for the core zone and buffer zone as per the Ambient Air Quality standard NAAQS. The maximum GLC does not have a significant impact on environment/ ambient air quality on sensitive receptors of

the project. Appropriate Measures will be identified and proper installation of air control devices will be done to control the source and impact of air pollution.

3. REFERENCES

1. Banerjee, T., S. C. Barman, and R. K. Srivastava. 2011. "Application of Air Pollution Dispersion Modeling for Source-Contribution Assessment and Model Performance Evaluation at Integrated Industrial Estate-Pantnagar." *Environmental Pollution* 159 (4): 865–75.
2. Epa, U. S., and OAR. 2016. "Air Quality Dispersion Modeling - Preferred and Recommended Models,"November.https://www.epa.gov/scram/air-quality-dispersion-modeling-preferred-and-recommended-models.

Enclosure IX
Land Schedule

Certified that status of total land involved in the project (both forest & non-forest) as given in the Table below is as per Government records as on 25.10.1980.

Abstract of Hal & Sabik land schedule as per Sabik Working Khatian of M/s Indian Metals & Ferro Alloys Limited for Sukinda Mines (Chromite), Kaliapani under Sukinda Tahasil of Jajpur District.

Sl No.	Name of the Village	Hal Land Particulars				Name of the Village	Sabik Land Particulars (as on 25.10.1980)		
		Non-Forest	Forest	Total			Non-Forest	Forest	Total
1	Kaliapani	Ac. 288.52 or 116.76 Ha.	-	Ac. 288.52 or 116.76 Ha.		Kaliapani	Ac. 4.23 or 1.71 Ha.	Ac. 284.29 or 115.05 Ha.	Ac. 288.52 or 116.76 Ha.

10/2/16
Revenue Inspector
Kankadapal

16/2/16
TAHASILDAR
SUKINDA

Certified that status of total land involved in the project (both forest & non-forest) as given in the Table below is as per the Government records as on 25.10.1980.

Hal & Sabik Co- relation land schedule of M/s- Indian Metals & Ferro Alloys Ltd. for Sukinda Mines (Chromite), Kaliapani under Sukinda Tahasil of Jajpur District.

Name of the Village	HAL LAND SCHEDULE						SABIK LAND SCHEDULE (As on 25.10.1980)					
	Khata No.	Status	Plot No.	Kisam	Total Area of the plot. (in Ac.)	Leased area. (In Ac.)	Khata No.	Status	Plot No.	Kisam	Total Area of the plot. (in Ac.)	Leased area. (In Ac.)
1	2	3	4	5	6	7	8	9	10	11	12	13
Kaliapani	7	Sthitiban	628	Biali	0.22	0.22	23	Sthitiban	217(p)	Taila	3.19	0.22
	49	Sthitiban	629	Sarada-III	0.66	0.66	19	Sthitiban	218(p)	Taila	1.61	0.66
	55	AAA	502	Patharbani	1.11	1.11	40	Anabadi	428(p)	Saljungle	52.50	1.11
	55	AAA	627(p)	Patharbani	65.40	63.15	40 40 40 11	Anabadi Anabadi Anabadi Sthitiban	428(p) 429(p) 430(p) 216(p)	Saljungle Rasta Saljungle Taila	52.50 1.38 186.00 4.39	36.41 0.56 26.00 0.18 **Ac. 63.15**
	55	AAA	641(p)	Patharbani	12.45	0.25	40	Anabadi	428(p)	Saljungle	52.50	0.25
	55	AAA	888(p)	Patharbani	66.38	13.10	40 40 41	Anabadi Anabadi Sarba sadharan	435(p) 437(p) 436(p)	Saljungle Saljungle Rasta	120.00 567.00 2.44	6.52 5.78 0.80 **Ac.13.10**
	55	AAA	889(p)	Patharbani	93.08	60.58	41 40 40	Sarba sadharan Anabadi Anabadi	436(p) 437(p) 435(p)	Rasta Saljungle Saljungle	2.44 567.00 120.00	0.40 52.98 7.20 **Ac.60.58**
	55	AAA	894(p)	Patharbani	221.40	108.80	40	Anabadi	439(p)	Saljungle	277.50	108.80
Total area in Ac.						**247.87**	**Total area in Ac.**					**247.87**

P.T.O

Name of the Village	Khata No.	Status	Plot No.	Kisam	Total Area of the plot. (in Ac.)	Leased area. (In Ac.)	Khata No.	Status	Plot No.	Kisam	Total Area of the plot. (in Ac.)	Leased area. (In Ac.)
1	2	3	4	5	6	7	8	9	10	11	12	13
B.F.	-	-	-	-	-	-	-	-	-	-	-	**247.87**
Kaliapani	55	A.A.A.	895(p)	Patharbani	80.63	5.80	40	Anabadi	466(p)	Saljungle	Ac.540.00	5.80
	55	AAA	627/1011 (p)	Patharbani	108.33	31.90	40	Anabadi	426	Saljungle	Ac.102.50	31.90
	56	Sarba sadharan	691(p)	Rasta	2.26	0.27	40	Anabadi	428(p)	Saljungle	Ac.52.50	0.27
	56	Sarba sadharan	892(p)	Rasta	3.34	0.36	41	Sarba sadharan	438(p)	Rasta	Ac.3.34	0.36
	56	Sarba sadharan	627/1010(p)	Rasta	1.22	0.90	41	Sarba sadharan	427(p)	Rasta	Ac.1.22	0.90
	57	Rakhit	488(p)	Unnata Jojana Jogya	3.35	0.55	40	Anabadi	428(p)	Saljungle	Ac.52.50	0.55
	58	Nirmana & paribahand eptt.	630(p)	Rasta	3.11	0.72	40	Anabadi	428(p)	Saljungle	Ac.52.50	0.72
	58	Nirmana & paribahand eptt.	883(p)	Rasta	2.84	0.15	41	Sarba sadharan	436(p)	Rasta	Ac.2.44	0.15
Total Area in Ac.						**288.52**		**Total Area in Ac.**				**288.52**
						or **116.76 Ha.**						or **116.76 Ha.**

Total ML area :- 116.76 Ha.
Total Forest area as per Hal record :- Nil
Total Non-Forest area as per Hal Record. :- 116.76 Ha.
Total Forest area as per Sabik Record (as on 25.10.1980) :- 115.05 Ha.
Total Non-Forest area as per Sabik Record (as on 25.10.1980):- 1.71 Ha.

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Revenue Inspector
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10/2/16
TAHASILDAR
SUKINDA