**Standard Operating Procedure**

**Explosives and Blasting Operation**



**ODISHA MINING CORPORATION LTD.**

**KODINGAMALI BAUXITE MINE**



**Authorized By**

1. **Purpose:** This Procedure is to establish and ensure safe handling of Explosives & Blasting operation in mines.
2. **Responsibility**: Blasting in charge /Blaster

Mining mate, Blaster I/C and Asst. manager mining shall be responsible for implementation of the procedure in mine.

1. **Accountability:** Asst. Manager (Mining)

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| 1. **PPE:** 2. Safety helmet 3. Safety shoe 4. Rubber Gloves 5. Nose Mask 6. Fluorescent jacket 7. Safety goggles. | **Tools:**   1. Red Flag 2. Ohms meter 3. Exploder 4. Short firing cable 5. Stemming Rod 6. Whistle 7. Hooter 8. Crimper 9. Knife | **Training needs:**   1. Usage of tools and Nature of Hazards 2. Method of charging & stemming. 3. Usage of PPEs |

1. **Procedure:**

**I) Duties and responsibilities of Assistant Manager (Blasting)**

1. Assistant Manager (Blasting), having second class Manager certificate provided by DGMS is responsible for control and supervision of all blasting activities at mines e.g. handling & charging of explosives, stemming of blast holes, clearance before firing, firing of blast holes, and to keep the records of indent ,consumption & return of explosives and all accessories..
2. He is responsible for advance planning of drilling as per requirement.
3. The Asst. Manager should all work is carried out in accordance with the provisions of the act and of these regulations and orders made there under.
4. The assistant manager shall subject to the order of the manager, visit and examine the working under his charge, or part thereof, on every working day.
5. In the absence of the manager, the assistant manager shall have the same responsibility, discharge the same duties and be subject to the same liabilities as the manager but not as to exempt manager there from.

**II) Duties and Responsibilities of Blaster**

1. Blaster, having blaster certificate given by DGMS, shall carry out his duties in accordance with the provisions of the regulations and of any orders made there under with respect to the transport and use of explosives.
2. He shall be responsible for the observance by his assistants, if any, of such provisions and of any direction with a view to safety, which may be given to them by a superior official.
3. He shall not hand over any explosive to any unauthorized person.
4. He shall be present when the holes are being charged and stemmed and shall himself fire the shots.
5. He shall be responsible when a shot has misfired for seeing that the place is adequately fenced, that the provisions of Regulation 167 are strictly observed and that the procedures for dealing with misfire as described in this text are strictly followed.
6. After blasting, the blaster should–
   1. Return the entire unused explosive to magazine, and Record in a bound-paged book, the quantity of explosive taken, used and returned, the benches where shots were fired and the number of shots fired by him and misfires, if any. Every such entry should be signed and dated by him.

**III) Duties and Responsibilities of Magazine In charge**

1. He shall, subject to the orders of superior officials, be responsible for the proper receipt, storage and issue of explosives in and from the magazine.
2. He shall maintain such records of explosives so received, stored and issued as are required by the rules made under Indian Explosives Act, 1884 and under the Act and the Regulations and orders made there under.
3. He shall issue explosives only to the blaster or assistant manager blasting upon written requisition signed by them. When such explosives are returned to the magazine, he shall re-issue such explosive before issuing fresh stock.
4. He shall record in a bound paged book kept for the purpose; the names of various competent persons and the quantity and nature of explosives issued to each of them and shall similarly record the quantity and nature of explosives returned to the magazine by each person.
5. He shall not allow any unauthorized person to enter the magazine.
6. He shall, if he discovers any shortage of explosives in the magazine, forthwith inform the Manager in writing.

**IV) Receive of Explosives**

1. Firstly, when any vehicle carrying explosives is reached at security check-post at mine entry, it is informed to manager (mines) or any other responsible person. Then an inward gate pass is made for vehicle to enter in the mine premises.
2. Then explosives are unloaded to explosive magazine and matched with order given.
3. Then invoice is signed by the manager (mines) or any other responsible person as a token of receipt.

**Priming & Loading of Explosives into Drill Holes**

**I) General Precautions**

1. The blasting in charge should not use any explosive material unless completely familiar with safe procedures for their use.
2. Do not allow metallic slitters to come in contact with any metallic fasteners when opening packages of explosive material.
3. Close partially used package of explosive material.
4. Before using explosive, visually examine them for any visible defects and do not use any defective explosive.
5. Use cartridges only in the form in which they are received.
6. Do not throw, drop down, roll or pull along the ground or floor packages containing explosives.
7. Do not stack more explosive material than are needed near working areas.
8. The blaster should use only the following tools or appliances provided to him-
9. Tool made entirely of wood for charging and stemming holes.
10. Scrapper made of wood for cleaning out holes.
11. When fuses are used, a knife for cutting off fuse and also a pair of crimpers for crimping detonators.
12. When using detonators, a picker made of wood for priming cartridges.
13. Do not keep detonator in a case that contains other explosive materials or tools.
14. Do not take out detonator from the container unless it is required for immediate use.
15. Do not insert anything except safety fuse in an ordinary detonator.
16. Do not attempt to investigate the contents of a detonator or try to pull the wires, fuse or detonating cord out of any detonator or delay device.
17. Do not handle explosives during electric storm. All persons should retire to a place of safety.
18. Do not use any explosive material for any purpose other than instructed by the manufacturer.
19. Do not use cell phone or other radio transmitters
20. within magazine campus or
21. within 30m of the blasting site or
22. During handling of explosive materials.

**II) Preparation of Primer**

1. The detonators should be completely encased in the explosive and so secured that in loading no tension will be placed on the wires, safety fuse, or detonating cord at the point of entry into the detonator.
2. Do not force detonator into the explosive material. Insert the detonator in a hole made with a wooden picker.
3. Do not make primer in a magazine or near other large quantities of explosive material and don’t make more than are necessary for immediate needs.

**III) Charging**

1. Drill holes should be charged only after they are thoroughly cleaned.
2. Each drill hole should be checked carefully to assure that it is in safe condition for loading.
3. Do not force explosive material in the drill hole when it gets stuck up either because of insufficient diameter, obstruction or due to some obstruction in the drill hole or the cartridge having fallen diagonally.
4. Do not slit, drop, deform or tamp the primer and do not drop another cartridge directly on the primer drill hole.
5. The blasting in charge should, to the best of his judgment, ensure that no charge in a drill hole is overcharged or undercharged, having regard to the task to be performed.

**IV) Stemming**

1. Carefully and sufficiently stem every drill hole so as to prevent a shot from blowing out. Use only drill cutting or soft clay as stemming.
2. While stemming, care should be taken not to damage detonating cord or non-electric leads or wires of detonators.
3. While charging or stemming, do not use tools, scrapers, etc. made of metal. Only use the appropriate tools provided for the purpose.

**V) Shot firing of holes**

**(As per reg. no. 161-166 of MMR-1961)**

1. Blasting operations are governed by a number of regulations / byelaws issued by DGMS, all these provisions are fully complied.
2. Complete blasting operation is carried out under the strict supervision of Asst. Manager (mines) having First class/Second class Manager Certificate given by DGMS.
3. Required quantity of explosives and accessories in a particular drilling pattern is calculated by the blasting in-charge.
4. The blasting parameters like spacing, burden, depth, sub-grade, charge per hole, delay pattern, firing pattern etc. have been established after careful studies at the mine by different agencies. All these parameters can be changed according the strata condition.
5. Charging: Charging is done by high explosive. Stemming is done by drill hole cutting.
6. Down the hole delays and trunk line delays are given in each hole and hole to hole respectively to control ground vibration.
7. Blasting shelters is provided for taking shelter.
8. NON ELECTRIC DETONATOR (RAYDET in our case) is used to provide delay in blasting pattern.
9. Complete evacuation of the area falling within 300 m. of the blast site is done by sounding sirens and deputing guards to avoid any exposure of human beings and animals etc. to the dangers associated with blasting.

**VI) When Blasting With Electric Detonator**

1. Before using the electric detonator, test their circuits for continuity using only the ohmmeter provided for the purpose.
2. Fire the shots only by means of shot firing apparatus (Exploder) provided for the purpose and do not fire more than 80 detonators at any one time by the exploder.
3. If the exploder fails to fire all the shots in a properly connected circuit, the blaster should return the apparatus to the manager or assistant manager blasting as soon as possible. He should not use it again unless it has been tested on the surface and found to be in safe working order.
4. Do not use current from a signaling, lighting, or power circuit for firing electric detonator.
5. The blaster should retain the key of exploder in his possession throughout his shift.
6. Do not fire electric blasting caps with more or less current than recommended by the manufacturer.
7. Do not use electric blasting caps made by different manufacturers in the same circuit.
8. Make sure that wire ends are cleaned before connecting.
9. Do not keep electric wires or cables near electric blasting caps or other explosive material, except at the time and for firing the blast.
10. Completely insulate firing circuits from ground or other conductors.
11. Following precautions should be taken during lighting/electric storm –
    1. Do not handle explosive, particularly detonators.
    2. If charging operations have commenced, work should be discontinued until the storm has passed.
    3. If the blast is to be fired electrically, all exposed wires shall be coiled up and if possible placed in the mouth of the holes or kept covered by something other than a metal plate.
    4. If firing circuit has been set up before the thunderstorm came on, the persons at the site should withdraw at the earliest and blast should be fired off immediately.
12. Keep electric cap wires or lead wires disconnected from exploder and short-circuited until ready to fire.

**VII) When Blasting With Non-Electric Detonators**

1. Handle non-electric detonators with the same respect given to other explosive material.
2. Discontinue operations in surface blast areas during electrical storms.
3. Do not hold non-electric leads during firing. Personal injury or death may result.
4. Emphasize proper hook up procedures and safety precautions.
5. Do not use tubing leads for any purpose other than instructed by the manufacturer.

**VII) Safety Procedures before Firing**

1. Fire drill holes only after they are properly charged and stemmed.
2. Fire all the holes charged on any one day on the same day.
3. As far as possible, firing should be done after the A shift ends and before the B shift begins.
4. Before firing, care should be taken to see that no explosive material is left near the blasting site and that all the equipment and machinery have been removed to a safe place.
5. Before firing, again inspect the holes and see that all the holes have been connected properly in the circuit and that the delay sequence is correct.
6. When firing with electric detonator, the blaster should take the following precautions:
   1. Use a well-insulated cable of sufficient length to permit him to take proper shelter in the blasting shelter and in no case this cable should be less than 50 Mt in length.
   2. Before coupling the cable to exploder, couple up the cable himself to detonator leads.
   3. Take care to prevent cable from coming into contact with any power or lighting cable or other electrical apparatus.
   4. Take precautions to protect the cable, exploder, and other apparatus from injury. Test the circuit either for electrical resistance or for continuity before connecting it to the exploder. Such a test should be made with an ohmmeter specifically provided for the purpose.
   5. If the continuity is not detected in the circuit, then the detonators, circuit, and blasting cable should be thoroughly checked and the defect should be remedied.
   6. Himself couple the cable to exploder and before doing so, see that all persons in the vicinity have taken proper shelter.
   7. Keep both the ends of firing cable short-circuited till they are required for making connections.
   8. Always keep the exploder on a dry platform.

**Safety Procedures during Firing**

**I) General Precautions**

1. The assistant manager blasting and the blaster should make certain that all persons, vehicles, equipment and surplus explosive material are in a safe place, that all access routes into the blast area have been posted with guards and that the warning hooter has been sounded.
2. Blaster should fire only after getting a positive signal from the assistant manager blasting.
3. Do not fire a blast from a position in front of the blast.
4. Blaster should fire only from the blasting shelter at a sufficient distance not less than 50 meters from the blast.
5. Before entering the blasting area after firing, the blaster should take out the key from the exploder and short circuit the ends of the cable after disconnecting it from the exploder.
6. Only permissible explosive authorized for mines to be used,
7. Drilling and Blasting Operation shall not be carried out simultaneously
8. Angled bore holes are not to be drilled beyond rib lines
9. Sufficient burden parallal to loaded boreholes to be ensured
10. Misfires/Scoket to be handled as per protocol mentioned.
11. Blast hole design during every blast shall be recorded with layout design and explosive used.
12. All entry to mines during blasting to be sealed by posting guards.

**II) Taking Shelter**

1. **In case the danger zone (area falling within a radius of 500 meters from the place of firing) does not lie within a public road, adopt the following procedure at the time of firing**:
   1. The assistant manager blasting and blaster should make sure that all the persons and machinery have been withdrawn from the danger zone.
   2. The assistant manager blasting and blaster should see that the guards with red flags have been posted at locations (outside the danger zone) from where persons may enter the danger zone.
   3. When the Assistant manager (blasting) and blaster are assured that all the persons including the guards have taken proper shelter and are outside the danger zone, blaster should give efficient warning signal for taking blast. After this, he will again inspect the danger zone to fire the blast holes and finally he should fire.
   4. After firing, the blaster along with Assistant manager (blasting) should enter the place for inspection for any misfire only after the area is free from dust, smoke or fumes and is safe in every respect. If there is no misfire, he should wave the green flag to guards and blow 1 long siren as a signal for all clear.
   5. No other person should be allowed to enter the area before the blaster along with Assistant manager (blasting) makes a careful examination of the blasted site.
   6. Guards posted at all access routes into the blast area should remain at their respective places till the examination has been made, the place has been declared safe and an all clear signal has been given.
   7. If there is a misfire, the blaster should wave the red flag. In such a case, the all clear siren will not be blown. The guards will remain stationed at their respective locations and will not allow any person to enter the danger zone.
2. **In case the danger zone (area falling within a radius of 500 meters from the place of firing) lies within a public road, adopt the following procedure at the time of firing:**
   1. Competent persons with proper communication systems should be posted outside the danger zone at extreme ends on both the sides of public road.
   2. The assistant manager blasting and blaster should make sure that all the persons and machinery, other than on or near the public roads, have been withdrawn from the danger zone.
   3. The assistant manager blasting and blaster should make sure that the guards with red flags have been posted at locations (outside the danger zone) from where persons may enter the danger zone.
   4. The assistant manager blasting will then communicate with the persons posted at the respective roads to pull down the road barrier and stop all the movement of vehicular traffic, cyclists, pedestrians and any other kind of traffic including animals.
   5. Assistant manager blasting will, after assuring that the danger zone lying within the public road is absolutely clear, give efficient warning signal for taking blast. After this, he will again inspect the danger zone and permit the blaster to fire.
   6. After firing, the blaster along with Assistant manager (blasting) should enter the place for inspection for any misfire only after the area is free from dust, smoke or fumes and is safe in every respect. If there is no misfire, he should wave the green flag to guards and blow 1 long siren as a signal for all clear.
   7. No other person should be allowed to enter the area before the blaster along with Assistant manager (blasting) makes a careful examination of the blasted site.
   8. Guards posted at all access routes into the blast area should remain at their respective places till the examination has been made, the place has been declared safe and an all clear signal has been given.
   9. If there is a misfire, the blaster should wave the red flag. In such a case, the all clear siren will not be blown. The guards will remain stationed at their respective locations and will not allow any person to enter the danger zone.
   10. However, in case of partial misfire, the road should be cleared for traffic. For relieving misfire by firing, precautions for taking shelter as detailed above should again be taken.

**Transportation of Explosives**

1. Transport explosive from magazine to the site of blasting only in daylight and in the original packing cases.
2. Quantity of explosives transported at one time to the site of blasting shall not exceed the actual quantity required for use in one round of shots and not more than 30 minutes before the commencement of charging of the holes.
3. Use only the approved explosive van for the transport of explosive from magazines.
4. A jeep may be used for transport of detonators subject to the following conditions –
5. Not more than 200 detonators are transported in a vehicle at a time.
6. Detonators are packed suitable in a wooden box.
7. The wooden box containing detonators is placed inside an outer metal case, which shall be suitably bolted to the floor of the vehicle, so that the container is not displaced while the vehicle is in motion.
8. No person shall ride on the rear portion of the vehicle.
9. Explosive van shall be provided with two fire extinguishers – one of carbon tetrachloride type for petroleum fire & the other of Carbon dioxide under pressure type for electrical fire suitably placed for immediate use.
10. Do not overload explosive van.
11. Secure explosives carried on vehicles so as to prevent any part of the load from becoming dislodged.
12. Only the driver and the helper shall ride on the explosive van.
13. Do not leave vehicle loaded with explosives unattended.
14. Stop the engine of the explosive van and set the brake securely before it is loaded or unloaded or left standing.
15. Arrange transfer of explosive from the magazine in such a way that no undue delay occurs between the time the explosives leave the magazine and the time they reach the blasting site.
16. Do not drive explosive van at a speed exceeding 25 km /hr.
17. Do not take vehicle loaded with explosives into the workshop and do not park in congested places.
18. Do not refuel vehicle transporting explosives except in emergency and only when its engine is stopped and other precautions are taken.
19. Do not attach trailer to the vehicle transporting explosives.
20. Do not carry any other goods with explosives.
21. Before any repair or alterations are made in any part of the explosive van, precautions should be taken to remove any explosive or remnant and the space in which such explosive has been carried should be thoroughly washed out to ensure that no remnant of explosive remains there in.
22. All operations connected with the transport of explosives should be conducted under the personal supervision of an Assistant Manager placed in charge of blasting operation.
23. ANFO shall be also transported in the same manner in which transport of high explosives is done.

**Dealing with misfire**

**(As per reg. no 167 of MMR-1961)**

1. Firstly, the place of misfire shall be marked with a red flag.
2. If the misfire contains a detonator, not exploded, it shall be removed carefully and holes shall be fired with a new detonator.
3. If the misfire is due to a faulty cable, or a faulty connection, the shot shall be fired, after the defect is remedied.

Except the above two cases, the relieving shot, not closer than 3 m, parallel and of equal depth to the misfired hole, shall be drilled, charged and fired. Then a careful search for booster and detonator, if any, shall be made in the presence of blasting in charge. If a misfired hole is not dislodged, the above procedure shall be repeated.

**Pilferage of Explosives**

**I) check at the Magazine**: To check for pilferage of explosives, the original explosive boxes shall be opened in the magazine in the presence of an assistant manager or any other competent person, specially authorized by the manager (mines) for the purpose. Explosive shall be kept in these boxes properly locked. Quantity issued/return shall be booked in entry sheets kept with explosives in magazine and in the requisition slip signed by blasting in charge. Further, this quantity shall be entered in a bound paged book signed by Assistant Manager (Blasting) and countersigned by Manager (mines).Periodically; physical verification of explosives shall be done by Assistant Manager (mines) or Magazine In charge or any other person authorized by manager(mines).Magazine shall be well guarded and locked properly. It shall be opened by the persons only authorized by manager mines.

**II) Code of Signals:**

1. **First Siren (Before 30 minutes of Blasting**): for 30 seconds, three times

Vacate the blasting danger zone area, blasting will be going on.

1. **Second Siren(All clear siren)**:for 40 seconds

Blasting is over. All persons can came out from shelters and move to their destinations.

**Emergency:**

1. In case of Emergency, inform mines manager (8763017844) as well as on spot call Emergency No. (7440015226).