

Power Grid Corporation Of India Ltd
(A Government of India Enterprise)

STANDARD TECHNICAL SPECIFICATION FOR SITE LEVELLING

1.0.0. GENERAL

1.1.0. Introduction

These Specifications shall apply to all such works as are required to be executed under the Contract or otherwise directed by the Engineer-in-Charge. In every case the work shall be carried out to the satisfaction of the Engineer-in-Charge and conform to the location, lines, grades and cross-sections shown on the drawings or as indicated by the Engineer-in-Charge. The quality of work and materials shall comply with the requirements set forth in the succeeding sections. Where the drawings and Specifications describe a portion of the work in only general terms, and not in complete details, it shall be understood that only the best general practice is to prevail, materials and workmanship of the best quality are to be employed and the instructions of the Engineer-in-Charge are to be fully complied with.

1.1.1. Scope of Work

The scope of work covered under this specification is as follows:

- (i) Site Clearance
- (ii) Site levelling;

The work to be performed under these specifications consists of providing all labour, supervision, materials, scaffolding, power, fuel, construction equipments, tools and plants, supplies, transportation, storage, insurance, royalty and all incidental items not shown or specified by reasonably implied or necessary for successful completion of work including contractor's supervision and in strict accordance with drawing and specifications.

The scope may however vary based on the specific requirement of various works/site, which shall be specified by the Owner in the form of addendum/modifications.

1.2.0. Definition:

The words like Contract, Contractor, Engineer-in-Charge, Drawings, Corporation, works, Site used in these Specifications shall be considered to have the meaning as understood from the definition of these terms included in the General Conditions of Contract.

1.3.0. General Rules for the measurement of works for payment

1.3.1 .General

All measurements shall be made in the metric system. Different items of work shall be measured in accordance with the procedures set forth in the relevant sections read in conjunction with the General Conditions of Contract.

All measurements and computations, unless otherwise indicated, shall be carried nearest to the following limits:

(i) Length and breadth	...	10 mm
(ii) Height, depth or thickness of work.	...	5 mm
(iii) Areas	...	0.01 Sq. metres.
(iv) Cubic contents.	..	0.01 Cu. metres.

In recording dimensions of work the sequence of length, width and height or depth or thickness shall be followed.

1.4.0. Scope of Rates for Different Items of Work:

The contract unit rates for different items of work shall be for payment in full for completing the work to the requirements of the Specifications including full compensation for all the operations detailed in the relevant sections of these Specifications under 'Rates'. The rates are to be considered as the full inclusive rate for finished work covering all labour, tools, equipments, materials, wastage, temporary work, plant, overhead charges and profit as well as the general liabilities, obligations and risks arising out of the General Conditions of Contract.

2.0.0 SITE CLEARANCE:

2.1.0 Jungle Clearance :-(Clearing and Grubbing)

2.1.1 Description:

The work shall consist of numbering of trees, removing and disposing of all materials such as trees, bushes, woods, shrubs, grass, stumps, rubbish, rank vegetation, roots, foreign materials, etc., which in the opinion of

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the Engineer-in-Charge are unsuitable for incorporation in the works, from within the limits and such other areas as may be specified on the drawings or directed by the Engineer-in-Charge. Clearing and grubbing shall be performed in advance of earthwork operations and in accordance with the requirements of these Specifications.

2.1.1.1 Cutting of Trees:

All trees up to a girth (perimeter) of 30 cm measured at one metre above the ground level shall also be cut and useful portion of the trees so cut shall be stacked at a suitable place as directed by the Engineer-in-Charge and shall be considered incidental to clearing and grubbing operations. Trees having girth above 30 cm are also to be cut and stacked separately as directed by Engineer-in-charge

2.1.1.2 The roots of trees shall be dug up to 60 cm below the ground level or 15 cm below formation level whichever is lower and after removal of all vegetable and organic matter from the holes so formed by removal of the roots, holes and hollows shall be filled with good earth in layer of 20 cm, well rammed, consolidated and levelled.

Where roots still exists at 60 cm depth, the same shall be excavated and further removed completely as directed by the Engineer-in-Charge. The serviceable and unserviceable materials obtained from the site clearance shall be removed from the area and disposed of to a place as per the directions of the Engineer-in-Charge. All unserviceable and serviceable materials obtained from the site clearance shall be the property of Corporation.

2.1.1.3 Trees of girth larger than 30 cm shall be numbered with white paint on a black background and the number shall be such that the trees are easily identifiable. After the numbering, the Engineer-in-Charge shall indicate the trees which are to be cut and removed. After the written approval of the Engineer-in-Charge, all such trees which are required to be felled shall be cut by using suitable instruments and the trees so cut shall be stacked at suitable locations as directed by the Engineer-in-Charge. The roots of the trees cut shall be completely removed. This item shall include removal of roots up to 100 cm below the ground level or 50 cm below the formation level whichever is lower. After the trees are cut and roots are taken out, holes and hollows shall be cleaned of all organic and vegetable matter and shall be filled with good earth in layers of 20 cm well rammed, consolidated and levelled. The trunk and branches of trees shall be cut into suitable pieces and removed to stack at suitable locations as directed by the Engineer-in-Charge.

2.1.2 Preservation of Property/Amenity;

Trees, shrubs, any other plants, pole lines, fences, signs, monuments, buildings, pipelines, sewers and all facilities within or adjacent to the works being carried out which are not to be disturbed shall be protected from injury or damage. The Contractor shall provide and install at his own expenses, suitable safeguards approved by the Engineer-in-Charge for this purpose.

2.1.3. Methods, Tools, and Plants:

Only such methods, tools and plants as are approved by the Engineer-in-Charge and will not effect the property to be preserved shall be adopted for the work. All trees, stumps, etc. falling within excavation and fill lines shall be cut to such depth below ground level that in no case these fall within 0.5 metre of the ground level. Also, all vegetation such as roots, undergrowth, grass and other deleterious matter unsuitable for incorporation in the filling shall be removed between fill lines to the satisfaction of the Engineer-in-Charge. On areas beyond these limits, trees and stumps required to be removed shall be cut down to below ground level so that these do not present on unsightly appearance.

All excavations below the general ground level arising out of the removal of trees, stumps, etc. shall be filled with suitable material and compacted thoroughly so as to make the surface at these points conform to the surrounding area.

2.1.4. Disposal of Materials:

All materials arising from clearing and grubbing operation shall be the property of corporation and be disposed of by the Contractor as hereinafter provided or directed by the Engineer-in-Charge within the lead specified in the BOQ.

Trunks and branches of trees shall be cleaned of limbs and tops and stacked neatly at places as indicated by the Engineer-in-Charge. Also boulders, stones and other materials usable shall be neatly stacked.

All products of clearing and grubbing which in the opinion of the Engineer-in-Charge cannot be used or auctioned shall be cleared away to waste areas and burnt, if so desired, at locations away from

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the limits as specified in the BOQ in a manner as directed by the Engineer-in-Charge. Care shall be taken to see that unsuitable waste materials are disposed of in such a manner that there is no likelihood of these getting mixed up with the materials meant for filling.

2.1.5. Measurement for Payment:

Site clearance as described above, includes removal of trees, bushes, woods, shrubs, grass, stumps, rubbish, rank vegetation, roots, other organic matter, etc. The unit of measurement shall be in Sq.m.

Cutting of trees equal to or less than 30 cm in girth shall be considered incidental to the clearing and grubbing operations.

Cutting of trees above 30 cm in girth shall be paid for in terms of number according to the sizes given below:

- (i) Above 30 cm to 60 cm
- (ii) Above 60 cm; to 120 cm
- (iii) Above 120 cm to 240 cm
- (iv) Above 240 cm.

For this purpose, the girth shall be measured at a height of one metre above the ground level. The useful portion of the trees so cut shall be stacked at a suitable place as directed by the Engineer-in-Charge.

2.1.6. Rates:

2.1.6.1. The contract unit rates for the various items of clearing and grubbing shall be paid in full for carrying out the required operations including cutting, removal and stacking at a place as directed by the Engineer-in-Charge, full compensation for all labour, materials, tools, equipment and incidentals necessary to complete the work. These will also include excavation and backfilling, where necessary, and for handling, salvaging, piling and disposing of the cleared materials within all lifts and up to a lead of 1000 metres beyond the levelling boundary.

2.1.6.2. The contract unit rate for cutting, removal and stacking of trees above 30 cm in girth shall include removal of stumps as well.

3.0.0. SITE LEVELLING WORK:

3.1.1. Description:

Excavation shall consist of excavation, filling and other levelling operations, removal and satisfactory disposal of all materials necessary for achieving desired formation level, if required, in accordance with the requirements of these specifications and the lines, grades and cross-sections shown in the drawings or indicated by the Engineer-in-Charge. The work shall include the hauling and stacking of or the hauling to levelling site, of suitable materials as required, as also the disposal of unsuitable materials in specified manner; and the trimming and finishing of works.

The work to be performed under the specification consist of providing all labour, supervision, materials, scaffolding, power, fuel, mechanical implements, tools and plants, supplies, transportation, storage, insurance, royalty and all incidental items not shown or specified but reasonably implied or necessarily implied for successful completion of the work, and in strict accordance with the drawings and specifications. The nature of work shall generally involve site clearance, excavation in all kinds of soils, soft/disintegrated rock, hard rock, dewatering, transporting of excavated earth, filling, consolidation of earth, levelling benching, giving slopes and making formations as per drawings and instructions of the Engineer-in-Charge. This work also includes cutting of diversion channel to prevent the area from flooding and construction of kuchcha surface drains for drainage of the area. The drawing attached to the tender document provides a general idea about the work to be performed under the scope of this contract. This is a preliminary drawing for tender purpose only and is by no means the final drawings or show the full range of the work under the scope. The work shall be executed according to "Released for Construction", drawings with additions, alterations and modifications made from time to time as required or approved by the Engineer-in-Charge and also according to any other drawings that would be supplied to the Contractor progressively during the execution of the Contract.

3.1.2. Classification of Excavated Materials:

All materials involved in excavation shall be classified by the Engineer-in-Charge in the following groups:

3.1.2.1. All kind of Soils and soft/disintegrated rock

The material which can be quaried/ excavated with pick, shovel, jumpers, scarifiers, crowbars and other mechanical implements. All materials involved under this classification are as below:

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All kind of soils : It includes various types of soils, plain concrete below ground level, single and river or nallah bed boulders, soling of road, paths and hard core, macadam surface of any description, stone masonry below the ground level, soft conglomerate and laterite stone which can be detached from the matrix with picks and shovel.

Soft/disintegrated Rock (Not requiring blasting): Rock and boulders which may be quarried or split with crow bars. It includes lime stone, sand stone, hard conglomerate.

3.1.2.2. Hard Rock:

All kind of rocks which can be excavated by machines and requires blasting, chiselling in edging or in another agreed method. This can be classified under the following categories:

(a) Hard Rock (Requiring Blasting)

This shall comprise:

- (i) Any rock for the excavation of which the use of mechanical plant or blasting is required;
- (ii) Reinforced cement concrete (reinforcement cut through but not separated from the concrete) below ground; and
- (iii) Boulder requiring blasting.

(b) Hard Rock (Blasting Prohibited)

Hard rock requiring blasting as described under (a) above but where blasting is prohibited for any reason and excavation has to be carried out by chiselling, wedging or any other agreed method.

3.1.2.3 Authority for Classification:

The classification of excavation shall be decided by the Engineer-in-Charge and his decision shall be final and binding on the Contractor. Merely the use of explosives in excavation will not be considered as a reason for higher classification unless blasting is clearly necessary in the opinion of the Engineer-in-Charge. All the excavated material shall be the property of the Corporation.

3.1.3 Site Levelling Operations:

3.1.3.1 Setting out and marking profiles.

After the site has been cleared as per Clause 2.1.0, the limits of site levelling shall be set out true to lines, curves, slopes, grades and sections as shown on the drawings or as directed by the Engineer-in-Charge. The Contractor shall provide all labour, survey instruments and materials such as strings, pegs, nails, bamboos, stones, lime, mortar, concrete, etc., required in connection with the setting out of works and establishment of bench marks. A grid system of co-ordinates shall be established by the Contractor at the site. The Contractor shall be responsible for the maintenance of permanent reference pillars, bench marks and other marks and stakes as long as in the opinion of the Engineer-in-Charge they are required for the work. All such marks/pillars shall be removed by the Contractor at his own cost as soon as the purpose is over.

Masonry pillars shall be erected at suitable places in the area to serve as bench marks for the execution of the work. These bench marks shall be connected with G.T.S. of any other permanent bench mark approved by the Engineer-in-Charge. Necessary profiles with pegs, bamboos and strings or "*Burgeis*" shall be made to show the correct formation levels before the work is started and the same shall be approved by the Engineer-in-Charge. The contractor shall supply all labour, tools, equipment, materials, safeguards and incidentals necessary for setting out and making profiles and *burgeis* & pillars for the work at his own cost. The profiles and *burgeis* shall be maintained during the execution of the work.

Marks/pillars shall invariably be diagonal unless other wise directed, and should be such that their average height is representative of average depths. Payments will be made on the basis of volume measurement after with-holding the amount corresponding to 5% of the volume of earth work on account of non-removal of marks/pillars. The Contractor shall have to remove the marks/pillars and utilise the earth spoils as per the directions of the Engineer-in-Charge. The withheld amount as stated in the above paragraph may be paid after certification of the Engineer-in-Charge; regarding his full satisfaction and to the effect that the mark/pillars, etc. have been removed and soils/earth thereof has been utilised as directed by him.

If the contractor fails to remove, partly or fully the marks/pillars in the manner and within the period as aforesaid double the amount spent by the owner for removal of marks/pillars will be recovered from dues payable to the contractor.

3.1.3.2 Excavation and Filling -General

All excavations shall be carried out in conformity with the directions laid Here in under and in a manner approved by the Engineer-in-Charge. The work shall be so done that the suitable materials available from excavation are satisfactorily utilised as decided upon before disposal.

While planning or executing excavation, the Contractor shall take all adequate precautions against soil erosion, water pollution, air pollution etc.

The excavations shall conform to the lines, grades, side slopes and levels shown on the drawings or directed by the Engineer-in-Charge. The Contractor shall not excavate outside the slopes or below the established grade or loosen any material outside the limits of excavation. Subject to the permitted tolerances, any excess depth excavated below the specified levels shall be made good at the cost of the Contractor with suitable material of similar characteristics and compacted to the required density and to the satisfaction of the Engineer-in-Charge.

All debris and loose material on the slopes of cuttings shall be removed.

Cutting shall be done from top to bottom. Under no circumstances undermining or undercutting shall be allowed. Final surface shall be neatly dressed. The earth from cutting shall be directly used for filling and no extra claim for double handling of earth shall be admissible to the contractor.

All cutting shall be done to the required slopes/shapes, levels and profiles as indicated in the construction drawing with a negative tolerance of 100 mm. If cutting be taken deeper, it shall be brought to the required level as per the instructions of the Engineer-in-Charge, by filling in with the earth and duly Consolidating at the Contractor's cost.

Filling shall be done in regular horizontal layers not exceeding 20 cm. in depth. The earth shall be free from all roots, grass, rubbish and humps and clods exceeding 80mm in any direction shall be broken. Each layer shall be consolidated by breaking clods and Compacting each layer with wooden /steel rammer or movement of dozers, trucks or 8/10 tonne power road rollers, sheep foot roller and vibratory compactors etc. so that compaction of 95% of the maximum dry density is

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achieved. Adequate watering shall be done. The surface finished shall be neatly dressed to the required formation levels and slopes.

Tests for Compaction are to be performed as per the procedures laid down in the relevant I.S. Codes of practice and Standard Field Quality Plan of POWERGRID. In cases of compaction below the stipulated percentage, the contractor shall adopt proper techniques as directed by the Engineer in-Charge and to his satisfaction to ensure the specified degree of compaction. The cost of tests to be performed shall be borne by the Contractor. Tests shall be carried out as per FQP; compaction shall be tested as decided by the Engineer-in-Charge from time to time. During the execution of work, natural drainage of the area shall be maintained by the contractor.

3.1.3.3 Hard Rock Excavation.

Hard Rock, when encountered during excavation, shall be removed up to the finished ground level or as indicated on the drawings. In all cases, the excavation operations shall be so carried out that at no point on cut formation the rock protrudes above the specified levels, provided, however, that a negative tolerance of 150 mm shall be permissible.

Slopes in rock cutting shall be finished to uniform lines corresponding to slope lines shown on the drawings or as directed by the Engineer-in-Charge. Notwithstanding the foregoing, all loose pieces of rock on excavated slope surface which move when prised by a crowbar shall be removed.

Blasting shall be carried out as per clause 3.2.0 and all precautions indicated therein to be observed.

3.1.3.4 Dewatering

If water is met with in the excavation due to stream flows, springs, seepage, rain or other causes, it shall be removed by suitable diversions, pumping or bailing out and other excavation kept dry whenever so required or directed by the Engineer-in-Charge, Care shall be taken to so discharge the drained water as not to cause damage to the works, crops or any other property. No extra payment shall be admissible to the contractor on this account.

3.1.3.5 Disposal of excavated Materials.

All the excavated materials shall be the property of the Corporation. Where the excavated material is directed to be used in the filling area,

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it shall be directly deposited at the required location complying with the total requirements. All disposed material other than hard material shall be spread in layers at the places within specified leads.

All hard materials, such as hard moorum, rubble, etc., not intended for use in the filling, shall be stacked neatly on Corporation land as directed by the Engineer-in-Charge within the lead specified for the item, for future use such as pitching. Unsuitable and surplus materials not intended for use in any part of the works shall be disposed of as directed by the Engineer-in-Charge.

3.1.4 Plying of Construction Traffic.

Construction traffic shall not use the levelled area without prior permission of the Engineer-in-Charge. Any damage arising out of such use shall be made good by the Contractor at his own expense.

3.1.5 Preservation of Property

The Contractor shall undertake all reasonable precautions for the protection and preservation of any or all existing roadside trees, drains, sewers or other subsurface drains, pipes, conduits and any other structures under or above ground, which may be affected by construction operations and which in the opinion of the Engineer-in-Charge shall be continued in use without any change. Safeguards taken by the Contractor in this respect, shall be got approved by him from the Engineer-in-Charge. However, if any of these objects is damaged by reason of the Contractor's negligence, it shall be replaced or restored to the original condition at his expense.

3.1.6 Finishing Operations.

Finishing operations shall include the work of properly shaping and dressing all excavated surfaces. When completed, no point on the slopes shall vary from the designated slopes by more than 150 mm measured at right angles to the slope, except where excavation is in rock where no point shall vary more than 600 mm from the designated slope. In no case shall any portion of the slope encroach on the road way.

3.1.7.0 Earth Fill

3.1.7.1 Suitable Material

The earth used in filling shall be free from all roots, grass, shrubs, rank vegetation, brush wood, tree sapling and rubbish.

3.1.7.1 Unsuitable Material

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Unsuitable material shall mean materials unsuitable for placing as fill in the works and shall comprise:

- (1) Material from swamps, marshes and bogs;
- (2) Peat, logs, stumps and perishable materials;
- (3) Material susceptible to spontaneous combustion;
- (4) Any natural material or industrial and domestic produce which will adversely affect other materials in the work;
- (5) Clay with liquid limit exceeding 80% and/or plasticity index exceeding 55%.

3.1.7.2 Spreading and Compaction of Filling.

For the earth works contractor shall satisfy the Engineer-in-Charge that the entire specified requirement regarding compaction can be achieved.

Due allowance shall be made for shrinkage and settlements and the ultimate formation shall be correct in level and profile after compaction.

In the case of earth work consolidated under optimum moisture conditions each layer of earth shall be carefully moistened to give field moisture content of about + 1% to - 2% of the optimum moisture content (OMC). The OMC shall be determined according to IS: 2720 (Pt.VII & VIII) Methods of Tests for Soils.

Each layer shall then be compacted by rolling with wooden/ steel rammer or movement of dozers, trucks, 8/10 tonnes power road roller , sheep foot roller and vibratory compactors . The required amount of water shall be added during consolidation to keep the moisture content of the soil at the optimum as per test. The density to be achieved for each layer of the material shall not be less than 95% of the density obtained in the laboratory (Proctor Method).

Each compacted layer shall be tested in the field for density and accepted before the operations for next layer are begun.

Control on compaction in the field shall be exercised through frequent moisture content and density determinations. A systematic record of

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these shall be maintained. At all times during construction the top of the embankment shall be maintained at such cross fall as will shed water and prevent pounding.

3.1.7.3. Testing shall be carried out as per field quality plan.

3.1.8 Measurement for Payment.

The ground levels shall be taken at every 5 metres distance and at closer distances where pits, undulations, etc. are met with. The ground level shall be recorded in field book, plotted on plans and shall be signed by contractor and the Engineer-in-Charge before the earth work is started.

The levels of the area after excavation shall be recorded in the field book duly signed by the Engineer-in-Charge and contractor. The labour, materials, tools, equipment, safeguards and incidentals required for taking levels shall be supplied by the contractor at his own cost.

3.1.8.1 Earth work in Excavation and filling:

The quantity of excavation in all types of soil and soft/disintegrated rock shall be worked out by using initial and final levels. No void deduction shall be made to calculate net quantity of earth work. The unit of measurement shall be in cubic metre. In case quantity in excavation is less than the quantity of filling, Quantity of filling shall be restricted to the quantity of excavation.

The unit rate shall include all lifts and all leads within levelling boundary. It also includes disposal of surplus earth and stacking of unusable material up the lead of 1000 meters beyond the levelling boundary.

3.1.8.2 Earth work in excavation in all types of Soils and Soft /disintegrated rocks, Hard rocks:

Quantity of excavation in all type of soils and soft/disintegrated rocks shall be worked out based on initial level before start of excavation and final levels after excavation. No void deduction shall be made to calculate net quantity of earth work in excavation. The excavated soil and soft/disintegrated rock shall be used for filling in lower areas of the substation. The unit rate shall include disposal of excavated material for leads up to 1000 meters beyond the levelling boundary.

For hard rock excavation, the volume of hard rock shall be computed

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on the basis of stacks of excavated rubble after making 50 per cent deduction for voids. The unit of measurement shall be in cubic meter. The unit rate shall include stacking, disposal of excavated material for leads up to 1000 meters beyond the levelling boundary.

Where soil, soft/disintegrated rock and hard rock are mixed, The quantity of earth work in excavation in all kinds of soil & soft/disintegrated rock shall be arrived by reducing quantity of hard rock from the gross excavated quantity.

3.1.8.3 Filling using earth borrowed from outside the substation land:

The quantity of earth shall be worked out based on initial and final levels of levelling area. The quantity of earth work shall be reduced by 5% for payment purposed for voids. The unit of measurement shall be in cubic meter. The rate shall include arrangement of borrow area, payment of royalty, transportation, laying compaction, all leads and lifts etc.

3.1.9 Rate:

Rate shall include all operations specified in the clause "3.0.0. SITE LEVELLING WORK"

3.2.0 Blasting Operations.

3.2.1 General.

Blasting shall be carried out only with the written permission of the Engineer-in-Charge. All the statutory laws, regulations, rules, Indian Standards, etc., pertaining to the acquisition, transport, storage, handling and use of explosives shall be strictly followed.

The Contractor may adopt any method or methods of blasting consistent with the safety and job requirements, after approval from the Engineer-in-Charge and shall muffle the blasting adequately to the satisfaction of the Engineer-in-Charge. Blasting should be carried out as far as possible with the help of Ammonium Nitrate mixed with proper proportions of fuel oil which is a safer method. However, in the event of its non-availability the convenient practice of using gelatine with detonators can be resorted to.

The magazine for the storage of explosives shall be built to the designs and specifications of the Explosives Department concerned and located at the approved site. No unauthorised person shall be

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admitted into the magazine which when not in use shall be kept securely locked. No matches or inflammable material shall be allowed in the magazine. The magazine shall have an effective lightning conductor. The following shall be hung in the lobby of the magazine.

- (a) A copy of the relevant rules regarding safe storage both in English and in the language with which the workers concerned are familiar.
- (b) A statement of up to date stock in the magazine.
- (c) A certificate showing the last date of testing of the lightning conductor.
- (d) A notice that smoking is strictly prohibited.

In addition to these, the Contractor shall also observe the instructions in Following clauses and any further additional instructions which may be given by the Engineer-in-Charge and shall be responsible for damage to property and any accident which may occur to workmen or the public or the materials on account of any operations and blasting. The Engineer-in-Charge shall frequently check the Contractor's compliance with these precautions.

3.2.2 Materials, tools and Equipment.

All the materials, tools and equipment used for blasting operations shall be of approved type and shall be arranged by the contractor from any authorised dealer of such approved material. Necessary assistance in the form of approval for procurement of the material shall be given by the Corporation. The contractor shall be fully responsible for entering into the agreement with any authorised magazine contractor in respect of rates, regularity of supply, etc. the Engineer-in-Charge may specify the type of explosives to be allowed in special cases. The fuse to be used in wet locations shall be sufficiently water-resistant as to be unaffected when immersed in water for 30 minutes. The rate of burning of the fuse shall be uniform and definitely known to permit such a safe length being cut as will permit sufficient time to the firer to reach safety before explosion takes place. Detonators shall be capable of giving effective blasting of the explosives. The blasting powder, explosives, detonators fuses, etc., shall be fresh and not damaged due to damp, moisture or any other cause. They shall be inspected before use and damaged articles shall be discarded totally and removed immediately.

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The blasting operation shall remain in the charge of competent and experienced supervisor and workmen who are thoroughly acquainted with the details of handling explosives and blasting operations.

3.2.4 Blasting Operations.

The blasting shall be carried out during fixed hours of the day preferably during the mid-day lunch hour or at the close of the work as ordered in writing by the Engineer-in-Charge. The hours shall be made known to the people in the vicinity. All the charges shall be prepared by the man in charge only. Proper precautions for safety of persons and property shall be taken.

Red danger flags shall be displayed prominently in all directions during the blasting operations. People, except those who actually light the fuse shall be prohibited from entering this area. The flags shall be planted 200 metres from the blasting site in all directions and all persons including workmen shall be excluded from the flagged area at least 10 minutes before the firing, a warning whistle being sounded for the purpose.

The charge holes shall be drilled to required depths and in suitable places. Blasting should be as light as possible consistent with thorough breakage of the material necessary for economic loading and hauling. Any method of blasting which leads to overshooting shall be discontinued.

When blasting is done with powder, the fuse cut to the required length shall be inserted into the hole and the powder dropped in. The powder shall be gently tamped with copper rods with rounded ends. The explosive powder shall then be covered with tamping material which shall be tamped lightly but firmly.

At a time, not more than 10 such charges will be prepared and fired. The man in charge shall blow a whistle in a recognised manner for cautioning the people. All the people shall then be required to move to safe distances. The charges shall be lighted by the man in charge only. The man in charge shall count the number of explosions. He shall satisfy himself that all the charges have been exploded before allowing the workmen to go back to the work site.

When blasting is to be carried out in the proximity of other existing structures, sand/earth bags, etc. shall be used on the top of the blast holes to prevent the rock fragment from causing damage to the structures.

However, when blasting is prohibited for any reasons the excavation shall be carried out by chiselling, wedging or any other agreed

method.

3.2.5 Misfire

In case of misfire, the following procedure shall be observed:

- (i) Sufficient time shall be allowed to account for the delayed blast. The man in charge shall inspect all the charges and determine the missed charges.
- (ii) If it is the blasting powder charge it shall be completely flooded with water. A new hole shall be drilled at about 45 cm. from the old hole and fired. This should blast the old charge. Should it not blast the old, the procedure shall be repeated till the old charge is blasted.

If a misfire has been found to be due to defective detonator, the whole quantity in the box from which defective article was taken must be sent to the authority directed by the Engineer-in-Charge for inspection to ascertain whether all the remaining materials in the box are also defective.

3.2.6 Account.

A careful and day to day account of the explosives shall be maintained by the Contractor in an approved register and manner which shall be open to inspection by the Engineer-in-Charge at all times.