

TENDER DOCUMENT

FOR

Repair and Renovation of Civil & Electrical Works for 'Copyright Board & Copyright Office (CRB&CRO)' at August Kranti Bhawan, Bhikaji Kama Place, New Delhi

MAY, 2014

VOLUME- V: SPECIFICATIONS



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Note : This document is serially numbered from page 01 to 42.

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General Specifications

1.1 Works shall be carried out in accordance with Specifications as detailed below:

1.1(a) For Civil Works:

Central Public Works Department's Specifications – 2009 Volume I to II read with correction slips issued upto the date of receipt of tenders and relevant IS Codes.

1.1(b) For Electrical Works:

General Specifications for Electrical Works : Part-I (Internal) 2013 ; Part-II (External) 1994; Part-IV (Sub-stations) 2013; Part-V (Wet Riser & Sprinkler System) 2006; Part-VII (DG sets) 2013; relevant Indian Standard Code of Practice for Fire Safety and Indian Electricity Rules 1956, & as per bye-laws laid down by local Electricity Department and Indian Electricity Act-1910 as amended upto date.

All installations shall comply with the requirements of Indian Electricity Rules, 1956 and Indian Electricity Act – 1910 as amended upto date.

1.2 Wherever reference to any Indian Standard Specifications occurs in the documents relating to this contract, the same shall be inclusive of all amendments issued thereto or revisions thereof, if any, up to the date of receipt of tenders.

ADDITIONAL SPECIFICATIONS

Civil Works

1.0 WATER PROOFING TREATMENT

1.1 General

Two samples of the waterproofing materials /compound proposed to be used shall be submitted to the Project Manager alongwith test result from a testing laboratory of repute confirming its quality and performance.

1.1.1 Total quantity of the waterproofing material/compound required shall be arranged only after obtaining the prior approval of the Project Manager in writing. Materials shall be kept under double lock and key and proper account of the waterproofing material / compound used in the work shall be maintained. It shall be ensured that the consumption of the material/compound is as per specified requirement.

Cement based integral waterproofing compound : shall be of specified quality and also satisfy all the performance requirements indicated in IS Code 2645-1975. The compound shall be used @2% by weight of cement used or as recommended by the manufacture.

1.1.2 Any other waterproofing compound, if specified for use, shall satisfy the manufacturer's specifications.

1.2 Guarantee Bond & Security Deposit

Ten years guarantee bond in prescribed proforma, as given in Volume-V of the Tender Document shall be submitted by the contractor which shall also be signed by the contractor to meet their liability under the guarantee bond.

In addition 10% (Ten percent) of the cost of this item (waterproofing) work shall be retained as security deposit and the amount so withheld would be released after ten years from the date of completion of the entire work under the agreement only, if the performance of the work done is found satisfactory. Any defect, if noticed during the Maintenance Period, shall be rectified by the contractor alongwith any incidental repairs to structure, flooring, finishing, fixtures and any other related damaged work within fifteen days of receipt of intimation of such defects in the work. If the defects pointed out are not attended to within the specified period, the same will be got done from another agency at the risk and cost of the contractor and the cost of attending to such repairs shall be deducted from any dues payable to the Contractor.

However, the security deposit deducted may be released in full against Bank guarantee of an equivalent amount in favour of Director (BP & CR). The security deposit against this item of work shall be in addition to the security deposit deducted @ 10% of the tendered amount.

2.0 ANODISED/POWDER COATED ALUMINIUM WORK

- 2.1 The aluminum work shall be carried out as per detailed specifications and conditions for the work.
- 2.2 All aluminum work shall be free from defect in impairing, strength durability appearance and shall be of the best commercial quality for purposes specified made with structural properties to withstand safely strains / stresses to which they shall be normally subjected. All sections shall be of approved extruded tubular anodized aluminum sections from the approved manufacturers, as per architectural drawings and as per relevant IS Specifications and extrusions from Indal/Jindal/Hindalco only as specified. Any equivalent extrusion will be got approved from the Project Manager.
- 2.3 The contractor shall provide all items, articles, materials, operations, mentioned or scheduled, on the drawings, including all labour, materials fixing devices, equipment and incidentals necessary as required for their completion.
- 2.4 The contractor shall submit shop drawings and samples of each types of doors, windows, railing and other items of aluminum work to the Project Manager for approval. The shop drawings shall show full size sections of doors and windows etc. thickness of aluminium sections, details of construction hardware as well as connections of doors, windows and other aluminium work to adjacent work. Shop drawings shall be based on actual dimensions available on site. The variation in openings and shop drawings shall not be more than ± 1.5 mm.
- 2.5 Aluminium doors and shutters shall be manufactured by an approved manufacturer and shall be of sections, sizes, combination and details shown on the architectural drawings. The frame member shall be of one piece and glazing bars shall be threaded or interlocked as approved by the Project Manager.
- 2.6 Glazing for doors and windows shall be of specified thickness and approved quality and shall conform to specification of glazing. Fixing of glazing shall be done with aluminum 'Snap-On' beading as per detailed drawings and instructions. Necessary rubber gaskets of approved make shall be provided.
- 2.7 Upon delivery of doors and windows to site, they shall be handled with care, stored on edge on level bearers and supported evenly.
- 2.8 The manufacturer, immediately prior to the commencement of glazing, shall adjust and set all doors and accept responsibility for the satisfactory working of the opening frames. All doors shall open or slide as indicated in drawings and schedules.
- 2.9 The contractor shall be responsible for the doors & window shutters being set straight, plumb and level and for their satisfactory operation after the fixing its complete.
- 2.10 Fittings shall retain the casements rigidly in both open & closed positions. All fittings shall be got approved from the Project Manager. The fittings and aluminium work shall be complete and shall be wrapped and protected until the complete aluminium

work is washed with mild solution of non-alkali soap and water and left in complete finished conditions.

- 2.11 Fabrication: All fabrications shall be got done with workmen who are skilled in the trade and fully equipped to carry out phases of fabrication in accordance with the best accepted practice and as shown on the drawing. All work shall be shop fabricated and finished and then brought on site for installations. The details of the equipment possessed by the contractor shall be provided, which should conclusively prove that all facilities required to execute the work as per specifications, are available.
- 2.12 All aluminium works shall be deemed to include in various items, complete work including fittings, fixtures, stays, locks, handles, special hinges, floor springs, neoprene/rubber linings, gaskets, bushes, rollers, sealant etc. as directed and approved by the Project Manager.
- 2.13 The rates quoted for aluminium works shall be inclusive of all fixtures/fittings also anodized as per main member like handles, stays, sliding gears, tower bolts, cleats, hinges etc., and their weight shall not be considered in the finished product. The payment shall be given only for the members used measured centre to centre of the sections.
- 2.14 Standard weights shall be considered for payments and not actual weights. However if the actual weights of the members is less than the standard weight, then the actual weight shall only be considered provided the same is within the permissible limit of variation. The permissible limit of variation for aluminum works shall be $\pm 5\%$ over the standard weight.
- 2.15 All windows, glazing etc shall be made completely water proof to the satisfaction of the Project Manager and necessary Silicon / Polysuphide sealants etc. shall be provided. No payment shall be made for providing necessary Silicon / Polysuphide sealant etc. to items under this sub-head.
- 2.16 In the items of aluminum glazing in doors and windows etc. work shall include the provision of mullions, coupling bars as required to join various units of glazing in windows and doors etc. to form larger glazing in doors or door-cum-windows as required and as per architects drawings.
- 2.17 Taking into consideration varying profiles of aluminum sections being extruded by approved manufacturers and their availability in time as required the contractor shall prepare detailed shop drawings using suitable sections based on architectural design/drawings and adequate to meet the performance and other specifications parameters laid down for the work. The section profile weight and suitability to meet the requirement/specifications as proposed by the manufacturer and detailed shop drawings shall be subject to approval of Project Manager who should be satisfied that it fully meets the design. In case it is proposed to provide substitute for any aluminium sections, which is specified for any aluminium glazing, this would be subjected to approval of the Project Manager who is to be satisfied regarding the suitability of the alternative section and it having no financial variation.

- 2.18 Aluminium sections used for doors and openable windows including sliding windows, fixed glazing, curtain walls, glazing frame work, extruded wall paneling of certain hand rails etc. shall be suitable for use to meet architectural designs of relevant works and shall be subject to approval of Project Manager who would be required to be satisfied about their being appropriate on technical, functional and aesthetic considerations.
- 2.19 All joints shall be accurately fabricated and be hairline in appearance. The finished surface shall be free from visible defects.
- 2.20 All aluminium shall be anodized/powder coated as specified. Anodizing powder coating shall be of approved colour and conform to IS 1868-1968 and shall be of AC 15 grade with minimum thickness of 15 microns, when measured as per IS: 6012-1970, and density shall be at least 32 mg/sq cm. All sections are to be matt anodized/powder coated in colour as per sample approved by the Architects.
- 2.21 The anodized coating shall be properly sealed by steam or boiling in de-ionised water as per IS 1868-1968 and of IS 6057. Sealing quality shall be tested in accordance with DIN 50949 or similar standards.
- 2.22 Colour anodizing would be done only by electro colour process.
- 2.23 Colour fasteners shall be as per 1868-1968 grading-B
- 2.24 No visual variation in shade shall be permitted. The fabricator shall clearly indicate the shade variation tolerance as measured by standard equipment.
- 2.25 No payment shall be released till the thickness of the anodic coating is found to be minimum 15 microns and sealing quality appropriate every where. The testing shall be done by Eddy Current method as per IS :6012-1970, for thickness and relevant DIN for sealing. Like wise colour variation measurements shall also be carried out. If any material is found sub-standard this shall be totally rejected. Requisite tests shall be done at the site. 100% checking, as instructed by the Project Manager may be resorted to.
- 2.26 Each glazing shall be tailor made as per opening at site. No cutting and making good of concrete surface shall be permitted.
- 2.27 Doors, windows or fixed glazing frames shall be fixed to concrete or brick work with approved metal fasteners. Method of fixing shall be approved by the Project Manager before mass fabrication.
- 2.28 Samples of typical glazing shall be made and got approved from the Project Manager before fabrication.
- 2.29 All hardware used shall conform to the relevant IS specifications. Design, quality, type number and fixing of the hardware shall be got approved from the Project Manager .

- 2.30 A thick layer of the clear transparent lacquer based on Methacrylates or cellulose Butyrate shall be applied on the anodized glazing before they are brought on the site. The lacquer shall be removed on completion of erection.
- 2.31 All screws shall be stainless steel screws threads of machine screws used shall conform to IS: 4218 or other wise approved by the Project Manager . Gaskets for retaining glass shall be of heavy extruded neoprene.
- 2.32 The corners of the frame being fabricated to a true right angle. Both the fixed and opening frames shall be fabricated out of sections which have been cut to length mitered and mechanically jointed. All members shall be accurately machine milled and fitted to form headline joints. The joining accessories such as cleats, brackets, etc shall be such material as not to cause any bimetallic corrosive action.
- 2.33 All the frame members shall be in plumb and level and jointed in such a way that maximum expansion and contraction will not cause distortion or leakage. The contractor shall be responsible for their satisfactory performance/operation after fixing is complete.
- 2.34 All aluminium work shall be washed with a suitable thinner and left in a finished condition in approved uniform appearance and free from all marks and blemishes. The glass panes shall be thoroughly washed and cleaned before the work is handed over.
- 2.35 The requirements provisions for all anodized aluminium work shall conform to requirements specifications and parameters given in this tender, drawings, instructions and shall at least provide for or conform to IS codes relating to materials workmanship, fabrication, finishing, erection, installation etc. In this connection relevant IS codes including Nos. 1868-1973, 6012-1970,1285-1975,7400-1974 as deemed applicable by the Project Manager shall be considered.
- 2.36 Suitable sections with lighter/heavier weights as may be required and approved by architect shall be provided by the contractor. No variation in quoted rates shall be made for change in section or weights given as a guide.
- 2.37 Clear Glass
- The glass shall be float glass of Modi Float or equivalent. Glass used in glazing, openable and fixed doors, windows etc shall provide clear, completely undistorted vision and reflection. It shall be free from any bubbles, waves or blemishes. Glass used shall be of required size as per drawings. No extra payment shall be made for use of glasses of any size having an area up to 32 sq.ft(in one piece) for 5mm thick glass.
- 2.38 Tinted Glass
- Tinted glass shall have same quality and specifications as indicated above for clear glass. It shall however be transparent glass to Bronze/Blue/Green/Smoke gray shade as required and would be expected to absorb to absorb a greater proportion of sun's radiant heat and reduce transmission than clear glass.

3.0 PLASTERING

The 'U', 'V' grooves of required dimensions shall be provided in the plaster at the junction of meeting places of two dissimilar materials particularly of RCC and Brick work wherever required for which nothing extra shall be paid other than what is stipulated in the items.

4.0 GRANITE STONE WORK

GRANITE stone work shall comprise of following system as per approved drawings (applicable for polished granite stone work).

MATERIAL

4.1 Granite Stone Slabs

- i) The slabs shall be of selected quality, hard, sound, dense and homogeneous in texture free from cracks, decay, weathering and flaws. They shall be machine cut to the requisite thickness. They shall be of the colour indicated in the drawings or as instructed by the Project Manager .
- ii) The slabs shall have the top (exposed) face polished before being brought to site, unless otherwise specified. The general size of stone shall be 1.0 meter to 1.6 meter in length and 0.8 meter to 1.0 meter in width or any other size approved by the Project Manager .
- iii) Nothing extra shall be paid of using bigger size granite stone as specified above.

4.2 Dressing

- i) Every slab shall be cut to the required size and shape and machine cut and table rubbed on the sides to the full depth so that a straight edge laid along the side of the stone shall be in full contact with it. The sides (edges) shall be table rubbed with machine edges of the slabs shall be true, square and free from chippings and the surface shall be true and plane.
- ii) The thickness of the slab after it is rubbed shall be 18-20 mm.
- iii) Nothing extra shall be paid of using bigger size granite stone as specified above.

4.3 Preparation of Surface and Laying

- i) Base concrete of R.C.C. slab on which the slabs are to be laid shall be cleaned, watted and mopped. The bedding for the slabs shall be with cement mortar 1: 4 (1 cement : 4 coarse sand) as given in the description of the item.
- ii) The average thickness of the bedding mortar under the slab shall be 20 mm and the thickness at any place under the slab shall be not less than 20 mm.
- iii) The slabs shall be laid in the following manner :

- iv) Mortar of the specified mix shall be spread under the area of each slab, roughly to the average thickness specified in the item. The slab shall be washed clean before laying. It shall be laid on top, pressed, tapped with wooden mallet and brought to level with the adjoining slabs. It shall be lifted and laid aside. The top surface of the mortar shall then be corrected by adding fresh mortar at hollows.
- v) The slab to be paved shall then be lowered gently back in position and tapped with wooden mallet till it is properly bedded in level with and close to the adjoining slabs with as fine a joint as possible. Subsequent slabs shall be laid in the same manner. After each slab has been laid, surplus cement on the surface of the slabs shall be cleaned off. The flooring shall be cured for a minimum period of seven days. The surface of the flooring as laid shall be true to levels and slopes as instructed by the Project Manager .
- vi) Due care shall be taken to match the grains of slabs which shall be selected judiciously having uniform pattern of Veins/ Streaks or as directed by Project Manager .
- vii) The slabs shall be matched as shown in drawings or as instructed by the Project Manager .
- viii) Slabs, which are fixed in the floor adjoining the wall, shall enter not less than 12 mm under the plaster skirting or dado. The junction between wall plaster and floor shall be finished neatly and without waviness.
- ix) The surface of existing floor shall be hacked, cleaned, washed and kept wet before flooring is commenced.
- x) The granite slabs shall be of selected quality, hard sound, dense and homogeneous in texture, free from cracks, decay weathering and flaws.
- xi) The granite stone slabs shall be machine cut and machine polished of 18-20mm thickness and of approved quality and size, free from flakes and shall be of uniform colour, with straight edges and an even surface.
- xii) All angles and edges of slabs shall be true, square and free from chipping and the surface shall be true and plane.
- xiii) Slight unevenness at the meeting edges of slabs shall be removed by fine chiseling.
- xiv) The surface then shall be ground evenly with machine fitted with fine grade grit block.
- xv) The next day floor shall be wiped with a moist rag and dried with a soft cloth and finished clean.

xvi) The surface shall be thoroughly cleaned, washed and kept wet.

xvii) The laying details shall be as per approved architectural drawings and as per the directions of EIC.

xviii) The floor shall not sound hollow when tapped with a wooden mallet.

4.4 Measurements

Measurements shall be taken in square meter correct to two places of decimal from wall face to wall face. No deduction in measurement shall be made for opening up to 0.20 sqm and nothing extra shall be allowed for forming such openings. For any opening exceeding 0.20 sqm in area, deduction in measurements for the full opening shall be made in such cases.

4.5 Rate

The rate shall include the cost of all materials and labour involved in all the operations described above including the cost of granite stone & wastage if any, cost of cement mortar bed, as given in the respective BOQ item, cost of jointing with white cement including pigment, rubbing and polishing, cartage of material, lifts and all taxes like, Sales Tax/VAT, Excise duty, Octroi etc. as applicable.

5.0 MIRROR FINISHED SUPERIOR GRANITE WORK

5.1 Material

Granite Stone Slabs

- i) The slabs shall be of selected quality, hard, sound, dense and homogeneous in texture free from cracks, decay, weathering and flaws. They shall be machine cut to the requisite thickness. They shall be of the colour indicated in the drawings or as instructed by the Project Manager .
- ii) The slabs shall have the top (exposed) face polished before being brought to site, unless otherwise specified. The slabs shall conform to the size required. Before starting the work the contractor shall get the samples of slabs approved by the Project Manager .

5.2 Dressing

- i) Every slab shall be cut to the required size and shape and machine cut and table rubbed on the sides to the full depth so that a straight edge laid along the side of the stone shall be in full contact with it. The sides (edges) shall be table rubbed with

machine edges of the slabs shall be true, square and free from chippings and the surface shall be true and plane.

- ii) The thickness of the slab after it is rubbed shall be 18-20 mm.

5.3 Preparation of Surface and Laying

- i) Base concrete of R.C.C. slab on which the slabs are to be laid shall be cleaned, watted and mopped. The bedding for the slabs shall be with cement mortar 1:3 (1 cement : 3 coarse sand) as given in the description of the item.
- ii) The average thickness of the bedding mortar under the slab shall be 12mm and the thickness at any place under the slab shall be not less than 12 mm.
- iii) The slabs shall be laid in the following manner :
- iv) Mortar of the specified mix shall be spread under the area of each slab, roughly to the average thickness specified in the item. The slab shall be washed clean before laying. It shall be laid on top, pressed, tapped with wooden mallet and brought to level with the adjoining slabs. It shall be lifted and laid aside. The top surface of the mortar shall then be corrected by adding fresh mortar at hollows.
- v) The slab to be paved shall then be lowered gently back in position and tapped with wooden mallet till it is properly bedded in level with and close to the adjoining slabs with as fine a joint as possible. Subsequent slabs shall be laid in the same manner. After each slab has been laid, surplus cement on the surface of the slabs shall be cleaned off. The flooring shall be cured for a minimum period of seven days. The surface of the flooring as laid shall be true to levels and slopes as instructed by the Project Manager .
- vi) Due care shall be taken to match the grains of slabs which shall be selected judiciously having uniform pattern of Veins/ Streaks or as directed by Project Manager .
- vii) The slabs shall be matched as shown in drawings or as instructed by the Project Manager .
- viii) Slabs, which are fixed in the floor adjoining the wall, shall enter not less than 12 mm under the plaster skirting or dado. The junction between wall plaster and floor shall be finished neatly and without waviness.
- ix) The surface of existing floor shall be hacked, cleaned, washed and kept wet before flooring is commenced.
- x) The granite slabs shall be of selected quality, hard sound, dense and homogeneous in texture, free from cracks, decay weathering and flaws.
- xi) The granite stone slabs shall be machine cut and machine polished of 18-20mm thickness and of approved quality and size, free from flakes and shall be of uniform colour, with straight edges and an even surface.

- xii) All angles and edges of slabs shall be true, square and free from chipping and the surface shall be true and plane.
- xiii) Slight unevenness at the meeting edges of slabs shall be removed by fine chiseling.
- xiv) The surface then shall be ground evenly with machine fitted with fine grade grit block.
- xv) The next day floor shall be wiped with a moist rag and dried with a soft cloth and finished clean.
- xvi) Where required the wall surface shall be cut uniformly to requisite depth to accommodate stone face shall have uniform projection from the finished face of wall as per drawings or as directed by EIC.
The concrete wall shall be hacked and roughened with wire brushes.
- xvii) Masonry walls shall have joints racked at least 15mm deep.
- xviii) The surface shall be thoroughly cleaned, washed and kept wet.
- xix) The laying details shall be as per approved architectural drawings and as per the directions of EIC.
- xx) The floor shall not sound hollow when tapped with a wooden mallet.

5.4 Measurement

Measurements shall be taken in square meter correct to two places of decimal from wall face to wall face. No deduction in measurement shall be made for opening up to 0.20 sqm and nothing extra shall be allowed for forming such openings. For any opening exceeding 0.20 sqm in area, deduction in measurements for the full opening shall be made in such cases.

5.5 Rate

The rate shall include the cost of all materials and labour involved in all the operations described above including the cost of granite stone & wastage if any, cost of cement mortar bed, as given in the respective BOQ item, cost of jointing with white cement including pigment, rubbing and polishing, cartage of material, lifts and all taxes like, Sales Tax/VAT, Excise duty, Octroi etc. as applicable.

6.0 TUBULAR STRUCTURE

6.1 General

The above item includes supplying, providing, fabricating, assembling, and erecting at site Tubular structure in the bended profile shaped as per the drawing with special plate connectors, pinion joints, using SAW / MMAW / MIG welding process with cleaning the surface and applying a coat of epoxy primer and two or more coat of polyurethane paint.

6.2 Materials

- i) MS Pipes to be used shall be as per IS 1161 YST 310 Gr. / ASTM A106 Gr. B or equivalent standards.
- ii) Bolts to be high tensile bolts of minimum 10.9 grade having black phosphate coating. The Bolts should be as per IS 1363/1364. Bolts shall be provided with a washer of sufficient thickness to avoid any threaded portion falling within the thickness of the parts bolted together if required.
- iii) The bending of the members wherever specified should be in exact profile as per requirement.
- iv) Connector should be of high strength, manufactured out of similar grade of pipe material of required dimensions and holes for the bolts in the required position and direction. The item includes cleaning the surface and painting one coat of epoxy primer and two or more coat of polyurethane paint.
- v) The structure should be properly bended, connected welded and aligned to get the required profile.

6.3 Execution

- i) Tubular framework (as per design and drawings) shall be got executed by specialized agencies having requisite experience in execution of similar works of similar magnitude as approved by Project Manager .
- ii) The structure should be properly bended, connected, welded and aligned to the required profile, i.e. work shall be executed as per designs.
- iii) Tubular structure system with plate connectors, pinion joints, etc. complete in all respects to make structure.
- iv) All components of tubular frame to be cleared off the dusts/ scales etc. completely before applying primer.

6.4 Test & Codes Applicable

- i) Welding shall be in according with the following Indian Standards as applicable.
- ii) IS 816 Code of Practice for use of metal arc welding for general construction in mild steel.
- iii) IS 820 Code of Practice for the use of welding in tubular construction.
- iv) Shearing, chipping or gas cutting may prepare profile of fusion faces. In all cases the faces should be dressed by chipping, filling or grinding and made regular.
- v) The surface to be welded and adjoining metal for distance of at least 20mm must be clean free of rust, scale, paint etc.
- vi) Each bead of metal shall have the slag removed by light hammering and wire brushing before the next bead is deposited. The weld must show a good clean contour and on a cut specimen good fusion with parent metal. Before applying paint the weld shall be carefully chipped and wire brushed.
- vii) The specifications deals with the fabrication and erection of steel structures for main roof of the main building of the Airport. Size of pipes and dimension as shown in the drawings indicate complete plan layout of the proposed structure together with sections and relative locations of various members. The plate, pipes, tubes and members etc. are to be provided as per design & drawing .

6.5 Fabrication Procedure

a) Assembly

All connections shall be either bolted or welded as per drawings. The contractor shall not redesign or alter any connection without prior approval of the Project Manager . The components parts shall be assembled in such a manner that they are neither twisted nor otherwise damaged and shall be prepared such that the specified cambers, if any, are provided. Drifting done during assembly shall not distort the metal or enlarge the holes.

b) Bolting

- i) All steel work, which is bolted together, shall be in close contact over the whole surface. Where two bolted surfaces are to be in permanent contact after assembly, each shall be thoroughly scraped free of loose scales, dirt and burs and a heavy coat of red oxide, zinc chrome or other approved paint applied after cleaning and drying.
- ii) All bolts shall be providing with washers under the nuts and the washers shall be tapered on the inside of the flanges or RS joists and channels. Bolts and studs shall project not less than one full thread through the nut after tightening. Unless

otherwise specified, the ends of the bolts shall be burred after erections of prevent the removal of nuts.

c) *Painting*

All the components of space frame structure shall be painted with polyurethane paint two or more coat of approved shade and manufacture, and primer will be epoxy primer.

6.6 Measurement

Net length of M.S tubes of various diameters / sizes and categories, as fixed in work, shall be measured in running meters correct to a centimeter and their weight calculated in Kilograms on the basis of standard steel tables or actual whichever is less.

6.7 Rate

The rate shall include cost of prefabricated M.S. tubes (TATA Steel or equivalent conforming to IS 1161 Grade 310), primer, paint, welding material etc. including wastage, all tools & plants, scaffolding and labour involved in all the operations like shifting of materials, straightening, cutting, fabrication, welding machining, threading, assembling and fixing in position/erection etc. transportation and all leads & lifts all complete including charges for necessary tests and all taxes like Sales Tax / VAT, Excise duty, Octroi etc. as applicable.

7.0 VITRIFIED TILES

7.1 Material

- i) The tiles shall be of approved make and generally conform to standard as indicated in acceptance criteria. They shall be flat, and true to shape and free from blisters, crazing, welts, crawling or other imperfection detracting from their appearance. The tiles shall be tested as per standard mentioned in Acceptance criteria .
- i) The tiles shall be square or rectangular of nominal size such as 600mmx600mm mm or any nearest available size as directed and approved by the Project Manager . The thickness of tiles shall be 9.6mm to 10mm for size 600mmx600mm as specified. The length of all four sides shall be measured correct to 0.1mm and average length, breadth shall not vary more than $\pm 0.6\%$ from specified dimensions. The variation of individual dimension from average value of length/breadth shall not exceed $\pm 0.6\%$. Tolerance in thickness shall $\pm 0.5\%$
- ii) The tiles shall be vitrified, homogenous through out its body structure and surface shall be mirror finish as specified. The underside of the tiles shall not have any finish in order that the tiles may adhere properly to the base. The edges of the tiles shall be preferably free from shine or polish. However any finish, if unavoidable shall be permissible on only upto to 50 percent of the surface area of the edges.

7.2 Preparation of Surface and Laying

- i) Base concrete or the RCC slab on which the tiles are to be laid shall be cleaned, wetted and mopped. The bedding for the tiles shall be with cement mortar 1:4 (1 cement : 4 coarse sand) or as specified. The average thickness of bedding shall be 20mm. Mortar shall be spread, tamped and corrected to proper levels and allowed to harden sufficiently to offer a fairly rigid cushion for the tiles to be set and to enable the mason to place wooden plank across and squat on it.
- ii) Over this mortar bedding neat grey cement slurry of honey like consistency shall be spread at the rate of 3.3 kg of cement per square meter over such an area as would accommodate about 5-6 tiles. Tiles shall be soaked in water washed clean and shall be fixed in this grout one after another, each tile gently being tapped with a wooden mallet till it is properly bedded and in level with the adjoining tiles. The joints shall be kept as thin as possible and in straight lines or to suit the required pattern.
- iii) The surface of the flooring during laying shall be frequently checked with a straight edge about 2m long, so as to obtain a true surface with the required slope. Where full size tiles can not be fixed these shall be cut (sawn) to the required size, and their edge rubbed smooth to ensure straight and true joints. Tiles, which are fixed in the floor adjoining the wall, shall enter not less than 10mm under the plaster, skirting or dado. After tiles have been laid surplus cement slurry shall be cleaned off.

7.3 Pointing and Finishing

The joint shall be cleaned off the grey cement slurry with wire/coir brush or trowel and all dust and loose mortar removed. Joints shall then be grouted with epoxy grout of desired contrast colour (of any approved make). The floor shall then be kept wet for 7 days. After curing the surface shall be washed and finished clean. The finished floor shall not sound hollow when tapped.

7.4 Acceptance Criteria

S.No.	Property	International Standard Laid Down
1.	Deviation in Length	± 0.6%
2.	Deviation in Thickness	± 0.5%
1.	Straightness of side	± 0.5%
4.	Rectangularity	± 0.6%
5.	Surface Flatness	± 0.5%
6.	Water absorption	<0.5%
7.	MOHS Hardness	>6
8.	Flexural Strength (minimum)	>27 N/MM ²
9.	Abrasian Resistance	<204 MM ²
10.	Skid Resistance	>0.4
11.	Breaking Strength	1111 N
12.	Density (G/CC)	>2
11.	Frost Resistance	Frost proof
14.	Chemical Resistance	No Damage

S.No.	Property	International Standard Laid Down
15.	Thermal Shock Resistance	No Damage
16.	Colour Resistance	No Damage
17.	Thermal Expansion	9×10^{-6}

7.5 Measurement

Length and breadth shall be measured correct to a centimeters before laying skirting, dado or wall plaster and the area calculated in square meter correct to two places of decimal. Where covers are used at the junctions, the length and breadth shall be measured between the lower edges of the covers.

No deduction in measurement shall be made for opening up to 0.20 sqm and nothing extra shall be allowed for forming such openings. For any opening exceeding 0.20 sqm in area, deduction in measurements for the full opening shall be made in such cases.

7.6 Rate

The rate for flooring shall include the cost of all materials, and labours involved in all the operations described above including cartage, lifts and all taxes like, Sales Tax/VAT, Excise duty, Octroi etc. as applicable. Nothing extra shall be paid for the use of cut (sawn) tiles in the work.

8.0 LAMINATED FLOORING

8.1 Installation procedure

The decore planks have to be click secured together on a mineral based sub floor such as pcc or any other suitable existing floor without any major undualation, the installation at site has to be done by company trained and approved installers.

The floating laminate floor is to be secured with the help of wall base- skirting boards/beading to match the approved decore of the floor. all other profiles such as adapter profile / expansion profile etc. will have to be secured to the floating floor as per installation procedure of the manufacturer and in accordance to the approval of the specifier.

8.2 Measurement

The length and breadth shall be measured correctly in sqm. correct to two places of decimal.

8.3 Rate

The rate shall include the cost of all type of the materials, machinery and the manpower involved in all the operations described above. Any incidental additional requirements for execution of this item to the satisfaction of Project Manager shall also be treated as included in the item and nothing extra will be paid for such extra work.

9.0 GLAZING CURTAIN WALL SYSTEM

Glazing Curtain Wall System – Providing and fixing aluminium curtain wall system, the glass to be fixed at the outer side of the Aluminium frame with two sides structural silicon sealant (SG18/DC995) and two side mechanical support with pressure plate and cap. The system should be without direct touch between in and out profiles to avoid acoustic transfer, the system to have a thermal analyst to ensure max. U-value of 2.7 w/sqm, every glass panel to be drained separately to avoid water chambers in the system and to assure easy detection of water problems and repair if required.

- (i) Specially designed mullions and transoms of extruded aluminum sections shall be of 6063 alloy. Specially designed mullions and transoms of extruded aluminum sections shall be of 6063 alloy.
- (ii) Coating of Aluminum section will be done with 20 micron anodized or 60 micron pure polyester powder coating of required colour as per direction of Project Manager .
- (iii) Vertical mullions (150 x 50 mm with minimum 3 mm thickness at the back side) to be fixed to RCC beams / columns with designed Aluminum brackets and Stainless steel Anchor fasteners PVC ply / Teflon separator membranes between metal to metal joints.
- (iv) Horizontal transoms (150 x 50 mm with minimum 2 mm thickness at back) to be fixed to vertical mullions with SS screws such that they are not seen in vision panels, forming grid systems of required size as per elevation drawings for vision and spandrel glazed panels.
- (v) Heavy duty, best quality EPDM gaskets at joints and connection between Aluminum members.
- (vi) Glazed curtain wall infill panels including approved fire-stop-cum smoke seal wherever applicable.
- (vii) All components should be sealed for water proofing with silicon of Wacker, DOW corning make or equivalent.
 - a) Vision panel with glazed units of size as per design / drawing and consisting of 6 mm thick hard coated heat strengthened Reflective Toughened glass of approved shade with characteristics as per specification fixed in precise size on the outer face of the infill panel of approved make and glazed in fill panel to be formed by approved means of special structural quality silicone adhesive sealant layer manufactured by Wacker, Dow corning or equivalent as per direction of Project Manager .
 - b) Vision panel with glazed units of size as per design / drawing and consisting of Hermetically sealed insulated glass comprising with 6 mm thick toughened reflective glass + 10 mm air gap + 6 mm thick plain float glass of approved shade with characteristics as per specification fixed in precise size on the outer face of the infill panel of approved make and glazed in fill panel to be formed by

approved means of special structural quality silicone adhesive sealant layer manufactured to standards like Wacker, Dow coning or equivalent as per direction of Project Manager .

9.1 Technical Specification

The Scope of work includes the designing of the system. The system is to be tested in an approved independently laboratory conditions prevalent at Varanasi Airport but for minimum 1500 pascal wind load and 2250 Pascal safety test, the max. Deflection in the system should be not more than 1:200 or 15mm whichever is less. Water test and air penetration according to the Center for Windows and Cladding Technology (CWCT) standard USA at 600 Pascal pressure. The system should be based on rain screen principal and pressure equalized drainage. The section mentioned in the item are indicative only and the actual sections to be provided shall depend on the design as brought out above. The minimum net weight of aluminium sections in frames, sub frames, covers etc. shall not be less than 8.5 kg / sqm. Of area of glazed curtain wall. If weight of aluminium section works out to more than 8.5 kg. / sqm. The entire weight of aluminium shall be paid under item No.14.05(a)

9.2 Measurement

The measurement shall be made correctly to two decimal places in Square meters and shall be taken out to out of the finished exposed surface.

9.3 Rate

The rate shall be measured in Sqm. and is inclusive:

Items includes shop drawings, Supplying, Installation and Fixing of Aluminium frame with structural members, mullions, Transom, subframe, cover plate, fixtures etc. including supply installation of 6mm thick Light Gold Toughened Glass as approved including cost of sealants, brackets, fastners, screws, sleeve, spacer tap, backer rod, bolts, gasket, fixtures, double stage scaffolding, sales tax, excise duty etc. complete in all respects) The above work is to be carried out by A Specialised Agency approved by the Project Manager .

10.0 SANITARY FIXTURES AND FITTINGS

10.1 Workmanship

All sanitary-ware shall be fixed in a neat workmanlike manner, true to level and plumb. Manufacturer's instructions shall be followed closely regarding installation and commissioning complete to the satisfactions of Project Manager .

10.2 Protection of Fixtures

Fixtures shall be protected throughout the progress of the work from damage. Special care shall be taken to prevent damage and scratching of chromium plated fittings. Tool marks on chromium fixtures, etc. shall not be accepted.

All fixtures shall be fixed with chromium plated brass screws with washers whenever necessary.

Protective paper on fixtures shall be removed with hot water only at the final completion of work.

10.3 Sanitary ware

All porcelain sanitary ware shall be of first quality, free from warps, cracks and glazing defects. All sanitary ware, fittings and fixtures shall be as shown in drawings and indicated in Bill of Quantities.

10.4 Testing

When the installation has been completed to the satisfaction of the Engineer it shall be tested in the following manner:

- i) The entire system shall be slowly filled with water, allowing any trapped air to escape.
- ii) When all outlets are closed the system shall be checked for water tightness.
- iii) Each outlet shall then be checked for rate of flow and correct operation.

Electrical Works

1.0 M.V. POWER DISTRIBUTION BOARD

1.1 System Rating

All the Main MV switchgears/Panels/Motor control centre/ capacitor control panel/Distribution boards, Sub-Main Distribution boards, shall be suitable for operation on three phase/ single phase, 415/230 volts, 50 Hz neutral solidly grounded at transformer and short circuit level not less than 25 KA at 415 Volts.

1.2 Lighting and Power MCB Distribution Boards

This section relates to specifications for design supply, assembly, installation, connection, testing and commissioning of lighting and power distribution boards (LDB, PDB, LPDB), using Miniature Circuit Breaker (MCB), Earth Leakage Circuit breaker (ELCB), Contactor, Neutral link, Earthing terminals, control switch terminals, cubicle of CRCA sheet steel housing and complete the item installation.

1.2.1 System

The MCB distribution boards shall be suitable for operation on 433 Volt, 3 phase, 4 wire, 50 Hz A.C supply system or 230 Volt, 1 phase, 2 wire, 50 Hz A.C. supply system.

1.2.2 Construction

- a) The DB's shall be factory made and shall be of those manufacturers whose MCBs, ELCB's, RCCBs are to be used. General arrangement layout of the DB's shall be approved by the Project Manager before manufacture.
- b) The DB shall be metal clad duly fabricated from CRCA sheet or thermo plastic cabinet of equivalent strength.
- c) The DB shall be cubicle, wall/floor mounted and dead front operated.
- d) The DB shall be totally enclosed and made dust, vermin and weather proof.
- e) A detachable cover plate of CRCA sheet or double door arrangement for thermoplastic cabinets to be provided on front of the board such that all live parts of the electrical accessories mounted on the board can be accessible only on removal of the said cover plate.
- f) The DB shall have top/bottom entry arrangement for incoming and outgoing cables/conduits.

- g) All internal electrical connections shall be carried out using 650/1100 volt grade, PVC insulated, Copper conductor of ISI approved make, having rated current carrying capacity to carry continuous full current of respective switch.
- h) The earthing strip shall be brought out on two sides of the DB's with bolted type earth terminating arrangement, for connecting to the building earthing grid. The earth terminal shall be of either brass or zinc passivated mild steel.

1.3 Moulded Case Circuit Breakers (MCCB):

MCCBs shall satisfy the requirements of BIS and shall be of current limiting type. MCCB shall conform to the latest IS:13947-1993. MCCBs shall be quick make, quick break, and preferably double break contact system, arc extinguishing device, independent manual type with trip free feature with mechanical ON, OFF, and TRIP indications. All MCCBs shall have $I_{cs}=I_{cu}$ values.

MCCB shall be a compact high strength, heat resistant, flame retardant, insulating moulded case with high withstand capability against thermal and mechanical stresses. All MCCBs shall be capable of defined variable overload adjustment. All MCCBs rated 200 Amps and above shall have adjustable Magnetic short circuit pick up.

1.4 Voltmeter

Voltmeter shall comply with IS-1248 (Latest edition) requirements. The dial of the meter shall be square in shape of 96 mm size. The voltmeter shall be moving iron type, flush pattern, with dust and moisture proof enclosure.

The voltmeter selector switch shall be arranged to provide line to line voltage reading and line to neutral voltage reading.

1.5 Ammeter

Ammeter shall comply with IS-1248 (Latest edition). The dial of the ammeter shall be square in shape of 96 mm size. The Ammeter shall be moving iron type, flush pattern with dust and moisture proof enclosure. The range of the ammeter shall be in accordance with 1 to 1.5 times the feeder full load current. Separate current transformer shall be provided for all ammeters. Three way selector switch shall be provided for measuring current in different phases.

1.6 Current Transformer

Where ammeters are called for C.T's shall be provided for current measuring. Each phase shall be provided with separate current transformer of accuracy class-I and suitable VA burden for operation of associated metering and controls. Current transformer shall be in accordance with IS:2705 as amended up to date.

2.0 CABLES (1100V Grade Power/ Control Cables)

The MV cable shall be PVC/ XLPE insulated Aluminium conductor armoured cable conforming to IS : 1554 (part -I). MV cables shall be supplied, inspected, laid, tested and commissioned in accordance with drawings, specifications, relevant Indian Standards Specifications and cables manufacturer's instructions. The cable shall be delivered at site in original drums with manufacturer's name clearly written on the drum.

3.0 CONVENTIONAL FIRE DETECTION SYSTEM

3.1 General (Description)

This section of the specification includes the furnishing, installation, connection and testing of conventional fire alarm equipment required to form a complete, operative, coordinated system. It shall include, but not be limited to, alarm initiating devices, alarm notification appliances, Fire Alarm Control Panel (FACP), auxiliary control devices, annunciators, and wiring as shown on the drawings and specified herein.

The fire alarm system shall comply with requirements of NFPA Standard 72 for Protected Premises Signaling Systems except as modified and supplemented by this specification. The system shall be electrically supervised and monitor the integrity of all conductors.

The system and its components shall be Underwriters Laboratories, Inc. listed under the appropriate UL testing standard as listed herein for fire alarm applications and the installation shall be in compliance with the UL listing.

3.2 Scope

A new fire detection system shall be installed in accordance to the project specifications and drawings.

3.3 Basic Performance

Alarm, trouble and supervisory signals from all devices shall be encoded on NFPA Style 6 (Class A) Signaling Line Circuits (SLC).

On Style 6 or 7 (Class A) configurations a single ground fault or open circuit on the system Signaling Line Circuit shall not cause system malfunction, loss of operating power or the ability to report an alarm.

Alarm signals arriving at the FACP shall not be lost following a primary power failure (or outage) until the alarm signal is processed and recorded.

NAC speaker circuits shall be arranged such that there is a minimum of one speaker circuit per floor of the building or smoke zone which ever is greater.

Audio amplifiers and tone generating equipment shall be electrically supervised for normal and abnormal conditions.

NAC speaker circuits and control equipment shall be arranged such that loss of any one (1) speaker circuit will not cause the loss of any other speaker circuit in the system.

Two-way telephone communication circuits shall be supervised for open and short circuit conditions.

3.4 DRAWINGS & TECHNICAL SUBMITTALS

General

Two copies of all submittals shall be submitted to the Project Manager for review.

All references to manufacturer's model numbers and other pertinent information herein is intended to establish minimum standards of performance, function and quality. Equivalent compatible UL-listed equipment from other manufacturers may be substituted for the specified equipment as long as the minimum standards are met.

For equipment other than that specified, the contractor shall supply proof that such substitute equipment equals or exceeds the features, functions, performance, and quality of the specified equipment.

3.5 Shop Drawings

Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.

Include manufacturer's name(s), model numbers, ratings, power requirements, equipment layout, device arrangement, complete wiring point-to-point diagrams, and conduit layouts.

Show annunciator layout, configurations, and terminations.

3.6 Warranty

All work performed and all material and equipment furnished under this contract shall be free from defects and shall remain so for a period of at least one (1) year from the date of acceptance. The full cost of maintenance, labor and materials required to correct any defect during this one year period shall be included in the submittal bid.

3.7 APPLICABLE STANDARDS AND SPECIFICATIONS:

The specifications and standards listed below form a part of this specification. The system shall fully comply with the latest issue of these standards, if applicable.

National Fire Protection Association (NFPA) - USA

NFPA 13	Sprinkler Systems
NFPA 16	Foam/Water Deluge and Spray Systems

NFPA 17	Dry Chemical Extinguishing Systems
NFPA 17A	Wet Chemical Extinguishing Systems
NFPA 2001	Clean Agent Extinguishing Systems
NFPA 72	National Fire Alarm Code
NFPA 76	Telecommunication Facilities
NFPA 318	Clean Room Applications
NFPA 101	Life Safety Code
NFPA 90A	Air conditioning & ventilation system

Underwriters Laboratories Inc. (UL) - USA:

UL 268	Smoke Detectors for Fire Protective Signaling Systems
UL 864	Control Units for Fire Protective Signaling Systems 9 th Edition Listed
UL 268	A Smoke Detectors for Duct Applications
UL 521	Heat Detectors for Fire Protective Signaling Systems
UL 464	Audible Signaling Appliances
UL 38	Manually Actuated Signaling Boxes
UL 346	Waterflow Indicators for Fire Protective Signaling Systems
UL 1971	Visual Notification Appliances
UL 228	Door Holders

National Building Code

3.8 Terminal Boxes, Junction Boxes and Cabinets

All boxes and cabinets shall be UL listed for their use and purpose.

The fire alarm control panel shall be connected to a separate dedicated branch circuit, maximum 20 amperes. This circuit shall be labeled at the main power distribution panel as FIRE ALARM.

3.9 MAIN FIRE ALARM CONTROL PANEL:

The main FACP Central Console shall contain a equipment which shall communicate with and control the following types of equipment used to make up the system: smoke and thermal (heat) detectors, panel modules including initiating circuits, control circuits, and local and remote operator terminals, annunciators, and other system controlled devices.

1. In conjunction with Control Modules, the main FACP shall perform the following functions:
 - a) Supervise and monitor all detectors and monitor modules connected to the system for normal, trouble and alarm conditions.
 - b) Supervise all initiating signaling and notification circuits throughout the facility by way of connection to monitor and control modules.
 - c) Detect the activation of any initiating device and the location of the alarm condition. Operate all notification appliances and auxiliary devices Circuits.

- d) Visually and audibly announce any trouble, supervisory, security or alarm condition on operator's terminals, panel display, and annunciators.
2. When a fire alarm condition is detected and reported by one of the system initiating devices or appliances, the following functions shall immediately occur:
 - a) The system alarm LED shall flash.
 - b) A local piezo-electric audible device in the control panel shall sound a distinctive signal.
 - c) All system outputs assigned via preprogrammed equations for a particular point in alarm shall be executed, and the associated system outputs (alarm notification appliances and/or relays) shall be activated.
 3. When a trouble condition is detected and reported by one of the system initiating devices or appliances, the following functions shall immediately occur:
 - a) The system trouble LED shall flash.
 - b) A local piezo-electric audible device in the control panel shall sound a distinctive signal.
 - c) All system outputs assigned via preprogrammed equations for a particular point in trouble shall be executed, and the associated system outputs (trouble notification appliances and/or relays) shall be activated.
 4. When a supervisory condition is detected and reported by one of the system initiating devices or appliances, the following functions shall immediately occur:
 - a) The system trouble LED shall flash.
 - b) A local piezo-electric audible device in the control panel shall sound a distinctive signal.
 - c) All system outputs assigned via preprogrammed equations for a particular point in trouble shall be executed, and the associated system outputs (notification appliances and/or relays) shall be activated.
 5. When a pre-alarm condition is detected and reported by one of the system initiating devices or appliances, the following functions shall immediately occur:
 - a) The system pre-alarm LED shall flash.
 - b) A local piezo-electric audible device in the control panel shall sound a distinctive signal.

- c) All system outputs assigned via preprogrammed equations for a particular point in alarm shall be executed, and the associated system outputs (alarm notification appliances and/or relays) shall be activated.

Operator Control

Acknowledge Switch

- a) Activation of the control panel acknowledge switch in response to new alarms and/or troubles shall silence the local panel piezo electric signal and change the alarm and trouble LEDs from flashing mode to steady-ON mode. If multiple alarm or trouble conditions exist, depression of this switch shall advance the LCD display to the next alarm or trouble condition. In addition, the FACP shall support Block Acknowledge to allow multiple trouble conditions to be acknowledged with a single depression of this switch.
- b) Depression of the Acknowledge switch shall also silence all remote annunciator piezo sounders.

Signal Silence Switch:

Depression of the Signal Silence switch shall cause all programmed alarm notification appliances and relays to return to the normal condition. The selection of notification circuits and relays that are silence able by this switch shall be fully field programmable within the confines of all applicable standards. The FACP software shall include silence inhibit and auto-silence timers.

1. Drill Switch

Depression of the Drill switch shall activate all programmed notification appliance circuits. The drill function shall latch until the panel is silenced or reset.

2. System Reset Switch

Depression of the System Reset switch shall cause all electronically latched initiating devices to return to their normal condition. Initiating devices shall re-report if active. Active notification appliance circuits shall not silence upon Reset. Systems that deactivate and subsequently re-activate notification appliance circuits shall not be considered equal. All programmed Control-By-Event equations shall be re-evaluated after the reset sequence is complete if the initiating condition has cleared. Non-latching trouble conditions shall not clear and re-report upon reset.

3. Lamp Test

The Lamp Test switch shall activate all local system LEDs, light each segment of the liquid crystal display and display the panel software revision for service personal.

4. Scroll Display Keys

There shall be Scroll Display keys for FIRE ALARM, SECURITY, SUPERVISORY, TROUBLE, and OTHER EVENTS. Depression of the Scroll Display key shall display the next event in the selected queue allowing the operator to view events by type.

Enclosures

1. The control panel shall be housed in a UL-listed cabinet suitable for surface or semi-flush mounting. The cabinet and front shall be corrosion protected, given a rust-resistant prime coat, and manufacturer's standard finish.
2. The back box and door shall be constructed of 0.060 steel with provisions for electrical conduit connections into the sides and top.
3. The door shall provide a key lock and shall include a glass or other transparent opening for viewing of all indicators. For convenience, the door may be site configured for either right or left hand hinging.
4. The control unit shall be modular in structure for ease of installation, maintenance, and future expansion.

Power Supply

1. The Main Power Supply shall operate on 120/240 VAC, 50/60 Hz, and shall provide all necessary power for the FACP.
2. The Main Power Supply shall provide sufficient power, using a switching 24 VDC regulator and shall incorporate a battery charger for 24 hours of standby power using dual-rate charging techniques for fast battery recharge.
3. The Main Power Supply shall provide a battery charger for 24 hours of standby using dual-rate charging techniques for fast battery recharge. The supply shall be capable of charging batteries ranging in capacity from 25-200 amp-hours within a 48-hour period.
4. The Main Power Supply shall provide a very low frequency sweep earth detect circuit, capable of detecting earth faults.
5. The Main Power Supply shall be power-limited per 1995 UL864 requirements.

BATTERIES

The battery shall have sufficient capacity to power the fire alarm system for not less than twenty-four hours plus 5 minutes of alarm upon a normal AC power failure.

The batteries are to be completely maintenance free. No liquids are required. Fluid level checks for refilling, spills, and leakage shall not be required.

If necessary to meet standby requirements, external battery and charger systems may be used.

INSTALLATION

Installation shall be in accordance with the NEC, NFPA 72, local and state codes, as shown on the drawings, and as recommended by the major equipment manufacturer.

All conduit, junction boxes, conduit supports and hangers shall be concealed in finished areas and may be exposed in unfinished areas. Smoke detectors shall not be installed prior to the system programming and test period. If construction is ongoing during this period, measures shall be taken to protect smoke detectors from contamination and physical damage.

All fire detection and alarm system devices, control panels and remote annunciators shall be flush mounted when located in finished areas and may be surface mounted when located in unfinished areas.

Manual fire alarm boxes shall be suitable for surface mounting or semi-flush mounting as shown on the plans, and shall be installed not less than 42 inches (1067 mm), nor more than 48 inches (122 mm) above the finished floor.

TEST

The service of a competent, factory-trained engineer or technician authorized by the manufacturer of the fire alarm equipment shall be provided to technically supervise and participate during all of the adjustments and tests for the system.

Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.

Open initiating device circuits and verify that the trouble signal actuates.

Open and short signaling line circuits and verify that the trouble signal actuates.

Open and short notification appliance circuits and verify that trouble signal actuates.

Ground all circuits and verify response of trouble signals.

Check presence and audibility of tone at all alarm notification devices.

Check installation, supervision, and operation of all intelligent smoke detectors using the walk test.

Each of the alarm conditions that the system is required to detect should be introduced on the system. Verify the proper receipt and the proper processing of the signal at the FACP and the correct activation of the control points.

FINAL INSPECTION

At the final inspection, a factory-trained representative of the manufacturer of the major equipment shall demonstrate that the system functions properly in every respect.

INSTRUCTION

Instruction shall be provided as required for operating the system. Hands-on demonstrations of the operation of all system components and the entire system including program changes and functions shall be provided.

The contractor and/or the systems manufacturer's representatives shall provide a typewritten "Sequence of Operation."

4.0 DG SETS

4.1 GENERAL SPECIFICATIONS

1. Actual Capacity : 125 KVA, 415 volts, 3 phase, 4-wire 50 Hz, Pure sine wave, 1500 RPM, prime duty base load application after de-rating for site conditions
2. Duty Cycle : Continuous 24 hours, 7 days a week with 10% overloading for one hour in every 8 hours
3. Starting : The set shall be suitable for Auto start-up with provision of manual start and stop
4. Standards : The system will have to be in accordance with relevant BSS/ISS/DIN or any other internationally accepted standard and shall comply with Indian Electricity Act & Rules 1956 amended from time to time
5. Fuel : The diesel generating set shall be capable of working on HSD oil
6. Scope of work : Diesel Engine: The set should be complete with a diesel engine of suitable BHP rating to give the desired alternator output of 125 KVA (taking into account de-rating factors for the ambient conditions specified) with radiator cooled type. Radiator fan to be mounted on the Engine.

DG set is required to be supplied with acoustic enclosure as per CPCB norms. DG set with acoustic enclosure shall preferably be installed outside the building & location should be finalized in consultation with NTPC. However, DG set should be as near to Essential LT panel as possible. Associated AMF panel/ Electrical panel of the DG set can be located inside the acoustic enclosure or outside the acoustic enclosure as per manufacturer standard. In case, AMF/Electrical panel has to be installed outside the acoustic enclosure, location of room to house AMF/Electrical panel should be decided in

consultation with the NTPC so that it shall be as near to the acoustic enclosure as possible.

Alternator: Alternator is to generate 125 KVA of output power at 415 Volts, 50 Hz, pure sine-wave form (with brushless excitation system and built in AVR) mounted on a common base-plate with suitable coupling to the diesel engine and foundation bolts with suitable termination box for connection to a control panel. Alternator capacity shall be suitable for the ambient conditions considering necessary de-rating factors.

Starting System: Starting by Electrical Motor, suitable voltage and capacity (12V or 24 V DC) and the supply should be from a set of batteries. The charging circuit for the battery should be built in the Panel with current controlling type with provision for trickle & boost charge.

7. Documentation : Two sets of complete detailed documentation is to be provided for installation, commissioning and maintenance of the engine, alternator, control panel and other sub-systems, comprising of general and dimensional layout drawings, foundation details, wiring and schematic drawing, inter-piping and inter-cabling drawings, installation instructions, operation, maintenance and service manuals, part-list, spare-parts catalogue, third party supplied catalogue, are to be supplied along with the main equipment.

Test Certificates: All test certificates at works with regard to diesel engine, turbo-charger fuel pump, governor, fuel injection system, silencer, alternator, AVR, excitation system and control panel shall be supplied.

4.2 Detailed specifications

4.2.1 General

Engine shall be of standard design of the original manufactures. It should be 4 stroke cycles, Water Cooled, naturally aspirated/turbo charged (as per manufacturers standard), diesel engine developing suitable BHP for giving a power rating as per ISO 8528 Part I in KVA at the load terminals of alternator at 1500pm at ambient conditions.

4.2.2 Diesel engine

Turbo-charged, Vertical/V cylinders either in line or in V formation, counter-clockwise rotation, Water-cooled with Radiator type of cooling with turbo charger,

Direct injection-Four stroke, compression ignition-D.C. motor starting-Designed for operation with fuel oil and lube oil as per enclosed specifications-Continuous rated output of 125 KVA at 1500 RPM-Stationery type conforming to IS 10000/BS 5514 & BS649 or any other equivalent internationally accepted standards, amended upto date.

Output: 125 KVA, at site at ambient temperature and relative humidity (This is the rating required at site after taking into consideration all de-rating factors, capable of taking 10% overloading for one hour in every 12 hours).

Standard accessories for the engine:

- a. i) Exhaust gas with insulated piping.
- ii) Turbocharger
- b. Day Tank: Outdoor mounting type with capacity to hold fuel oil required for running the diesel engine on full load for 8 hours, flow pipe, drain pipe, fuel oil level indicator, main hole for inspection, etc. (all pipes connected through flanged joints)
- c. Lubrication system: Sump tank incorporated in the common Base frame for Diesel engine and generator, with one level switch for minimum, level alarm- with shell type oil to air heat exchanger (with flanged pipe connection) coarse and fine filters with by-pass arrangements in the lubricating circuit when the engine is on and with automatic by-ass valve for the filter in case of filter getting clogged. Thermostatic by-pass valve for lube-oil heat exchanger when the lube oil is cold, lube oil pressure gauge, lube oil temperature indicating devices, both at the intel and outlet of the lube-oil heat exchanger.
- d. Speed load regulation:

The engine should have a speed governing system to regulate the speed of the engine within + 0.2% of the rated 1500 RPM from No load to full load. (To give a 50 Hz, +0.1% frequency stability at the alternator output).

- e. Fuel Oil: Engine shall be equipped with fuel oil filters. The fuel consumption of the engine shall be expressed by the Contractor in the bid in litres per gross/nett kWh output from the alternator (after supplying the requirements of auxiliaries) at full, three quarters and half of its rated power output and at 0.8 and unitary power factor. A fuel service tank of suitable capacity with each D.G. Set shall be provided on a suitably fabricated steel platform. The tank shall be complete with level indicator marked in litres, filling inlet with removable screen, an outlet, a drain plug, an air vent and necessary piping. The fuel tank shall be painted with oil resistant paint. All pipe joints should be brazed/ welded.

- f. Engine Cooling System: The diesel engine shall be provided with radiator fans for radiator type of DG set.
- g. Charge AIR system: Charge air for the engine shall be through a turbo charger with flexible expansion joint, transition pipe with an intermediate air cooler — oil bath air filter, dry type air cleaner and absorption silencers at the air inlet point.
- h. Exhaust system: Exhaust from the engine manifold shall be connected to the turbo charger (if provided) through a flexible expansion joint or SS flexible connection. Outlet from the turbo charger should be connected to the exhaust silencers (heavy duty) through another set of expansion joint—preferably of Bellows type. The exhaust piping inside the Acoustic Enclosure shall be fully insulated by means of flagging and cladding with asbestos rope along with Aluminium Sheet cladding to avoid heat input inside the enclosure.
- i. Electronic type digital temperature indicating device for air intake and exhaust gas both at the inlet and outlet of the turbo charger with provision for audible alarm in the event of temperature exceeding design parameters (Indicating type Mechanical devices are not accepted).
- j. Pressure gauges for:
 - Lube oil pressure of the main engine
 - Lube oil pressure of the turbo charger
 - Provision for Manometer fitting on to the exhaust piping between the expansion joint at the outlet of the turbo charger and the silencer.
- k. Speed indicator: Digital Tachometer,
- l. Cumulative Hour counter.
- m. Fuel oil level indicator for the day tank.
- n. The set shall be provided with vibration isolation pads the main frame and the accessories as well as flexible vibration insulation joints for all piping.
- o. Accessories for operation and control of the engine:

The following accessories and controls shall necessarily be provided:

- A suitable mechanical arrangement mounted on the engine over-riding

all electronic controls to stop the engine manually in case of failure of any of the controls.

4.2.3 ALTERNATOR:

Self-regulating, three-phase synchronous alternator, Brushless SPDP with copper windings, antifriction bearing, flanged shaft fully tropicalised insulation (class F/H), over-riding controls for manual operation of excitation system, all the six terminals brought out, suitable for delivering the full load at 50°C and 1500 metres. altitude above MSL, conforming to relevant ISS/ BSS/ DIN any other internationally accepted standard or equivalent (IS 4722 & IEC 34 as amended upto date)

Output: 125 KVA 0.8 PF lagging

Voltage: 415 Volts, 4- wire, 3 phase, solidly earthed neutral power system. The steady state voltage stability shall be with voltage variation +/-5% and voltage regulation +/-1% with frequency variation (+/-1%).

Wave Form	:	Pure sine wave, free of all harmonic
Frequency	:	50 Hz
Speed	:	1500 rpm
Protected against	:	Over-load, short circuits, earth faults, winding protection, differential type winding over-temperature. Transient surges and lightning protection. Earth leakage protection as specified by Elec. Inspectorate
Earthing facility	:	Earth lugs on the alternator should be provided for two separate earth connections.
Over Load	:	10 % for one hour in every twelve hours.
Excitation	:	Self - Excitation

4.2.4 Starter Battery:

- The battery shall conform to the requirement of IS:1651. Starting battery each of 12V/24 V, heavy duty high performance approved make/quality shall be provided to enable crank & start the engine even in cold/winter morning conditions as per manufacturer standard. Type/voltage/AH capacity of same on 20 hour rated discharge period shall be indicated in the offer. The battery set shall be capable of performing at least (5) five normal starts without recharging.
- The battery shall be provided with good quality iron battery stand

painted with acid proof black paint with min 3mm thick rubber mat below the battery.

- The battery shall be provided with 2 Nos. cables, minimum 1.5m long heavy duty rubber/PVC insulated cabling with brazed tinned lug at one end and with brazed tinned brass terminal lug at battery end - for connecting batteries to cranking system - with 0.25 m long inter battery connecting cable.
- The lugs shall be clearly stamped (+) or (-) and positive cable also red sleeved for easy identification.
- The batteries set shall be supplied fully filled and first charged ready to use.

4.2.5 Acoustic Enclosure

- i. As per CPCB norms, restriction has been imposed for new DG sets upto 1000 KVA for noise level. Therefore, in terms of these norms, acoustic enclosure should be type tested at the climatic conditions specified above through one of the authorized laboratory.

- ii. Installation

Acoustic enclosures are supplied with built in Anti Vibration Mountings (AVMs). As such Gen set can be installed directly on the leveled surface. Exhaust piping outlet should not be turned towards window/ventilator of building. Provision of rain cap should be ensured.^{2,6,5.}

The acoustic enclosure placement should be such that there is no restriction in front of air inlet and outlet from canopy.

- iii. Service Accessibility

Gen set/Engine control panel should be visible from outside the enclosure. Routine/periodical check on engine/alternator (filter replacement and tappet setting etc.) should be possible without dismantling acoustic enclosure.

For major repairs/overhaul, it may be required to dismantle the acoustic enclosure.

- iv. General Design Guidelines

To avoid re-circulation of hot air, durable sealing between radiator and canopy is must.

Exhaust piping inside the enclosure must be lagged (except bellow).

Temperature rise inside the enclosure should not be more than 5°C for maximum ambient above 40°C and it should be below 10°C for ambient below 40°C.

There should be provision for oil, coolant drain and fill. Fuel tank should have provision for cleaning.

v. Specifications for Acoustic Enclosure

The acoustic enclosure shall be designed and manufactured confirming to relevant standards suitable for out door installation exposed to weather conditions, and to limit overall noise level to 75 dB (A) at a distance of 1 mtr. from the enclosure as per CPCB norms under free field conditions.

The construction should be such that it prevents entry of rain water splashing into the enclosure and allows free & quick flow of rain water to the ground in the event of heavy rain. The detailed construction shall confirm to the details as under:

The enclosure shall be fabricated out of the CRCA sheet of thickness not less than 1.6 mm on the outside cover with inside cover having not less than 0.6 mm thick perforated powder coated CRCA sheet.

The hinged doors shall be made from not less than 16 SWG (1.6 mm) thick CRCA sheet and will be made air tight with neoprene rubber gasket and heavy duty locks.

All sheet metal parts should be processed through 7-tank process.

The enclosure should be powder coated.

The enclosure should accommodate the daily service fuel tank of the D.G. Set to make the system compact. There should be provision of fuel gauge, which should show the level of the fuel even when the DG Set is not running. The gauge should be calibrated. The fuel tank should be filled from the outside as in automobiles and should be with a lockable cap.

The batteries should be accommodated in the enclosure in battery rack.

The canopy should be provided with high enclosure temperature safety device.

The acoustic lining should be made up of high quality insulation material i.e. glass/ mineral wool of minimum 50mm thickness and 75 Kg/cubic metre to 100 Kg/ cubic meter for sound absorption as per standard design of manufacturer's to reduce the sound level as per CPCB norms . The insulation material shall be covered with fine glass fiber cloth and would be supported by perforated M.S. Sheet duly powder coated.

The enclosure shall be provided with suitable size and No. of hinged type doors along the length of the enclosure on each side for easy access inside the acoustic enclosure for inspection, operation and maintenance purpose. Sufficient space will be provided inside the enclosure on all sides of the D.G. set for inspection, easy maintenance and repairs.

The canopy should be as compact as possible with good aesthetic look.

The complete enclosure shall be of modular construction.

The forced ventilation shall be as per manufacturer design using either engine radiator fan or additional blower fan(s). If the acoustic enclosure is to be provided with forced ventilation then suitable size of axial flow fan (with motor and auto-start arrangement) and suitable size axial flow exhaust fan to take the hot air from the enclosure complete with necessary motors and auto start arrangement should be provided. The forced ventilation arrangement should be provided with auto stop arrangement to stop after 5 minutes of the stopping of D.G sets.

The acoustic enclosure should be suitable for cable connection. Such arrangements on acoustic enclosure should be water proof and dust-proof conforming to IP-65 protection.

4.2.6 AMF Control Panel

General Features: The control panel shall be fabricated out of 1,6 mm sheet steel, (totally enclosed, dust, damp and vermin proof free standing floor mounted type & front operated. It shall be made into sections such that as far as feasible, there is no mixing of control, power, DC & AC functions in the same section and they are sufficiently segregated except where their bunching is necessary. Hinged doors shall be provided preferably double leaf for access for routine inspection from the rear. There is no objection to have single leaf hinged door in the front, all indication lamps, instruments meter etc. shall be flushed in the front. The degree of protection required will be IP-42 conforming to IS:2147.

Terminal blocks and wiring: Terminal blocks of robust type and generally not less than 15 Amps capacity, 250/500 volts grade for DC up to 100 volts and 660/1100 volts grade for AC and rest of the junction shall be employed in such a manner so that they are freely accessible for maintenance. All control and small wiring from unit to unit inside the panel shall also be done with not less than 2.5 sq. mm copper conductor PVC insulated and 660/1100 volts grade. Suitable colour coding can be adopted. Wiring system shall be neatly formed and run preferably, function wise and as far as feasible segregated voltage-wise. All ends shall be identified with ferrules at the ends.

Labeling: All internal components shall be provided with suitable identification labels suitably engraved. Labels shall be fixed on buttons, indication lamps etc.

Painting: The entire panel shall be given primer coat after proper treatment and

powder coating with 7 tanks process before assembly of various items.

Equipment requirements: The control cubical shall incorporate into assembly general • equipment and systems as under:

- (a) Control system equipments and components such as relays, contactors, timers, etc. both for automatic operation on main failure and as well as for manual operation.
- (b) Equipment and components necessary for testing generating set's healthiness with test mode and with load on mains.
- (c) Necessary instruments and accessories such as voltmeter, power factor meter, KW meter, KWH meter, Ammeter, Frequency meter etc. in one energy analyzer unit with selector switch to obtain the reading of desired parameters.
- (d) Necessary indication lamps, fuses, terminal blocks, push buttons, control switches etc., as required.
- (e) Necessary engine/generating set shut down devices due to faults/ abnormalities.
- (f) Necessary visual audio alarm indication and annunciation facility, as specified.
- (g) Necessary battery charger.
- (h) Necessary excitation control and voltage regulating equipment.

4.2.7 Power Cabling

Power cabling between alternator and control panel and control panel and change over switch to mains should be done with recommended cable size.

4.2.8 Foundation

A PCC foundations (1:2:4 , M-20 grade) of approximate depth of 300 mm is required so as to provide leveled surface for placement of the acoustic enclosure. About 150 mm foundation height should be above ground level. The length and breadth of foundation should be at least 250 mm more than the size of the enclosure. Gen set should be mounted on AVM's inside the enclosure.

4.2.9 Inspection & Testing

For DG sets of capacity equal to or less than 200 KVA, testing shall necessarily be carried out at site. However, initial inspection can be done at factory/manufacturer works before dispatch at site of work at the discretion of Project Manager. All major items/equipments i.e. engine & alternator in assembled condition, electrical control panel etc. shall be offered for initial inspection at factory/manufacturers works. The cost of the Engineer's visit to the factory will be borne by the Department. After initial inspection, DG Set and associated electrical panel equipments shall be cleared for dispatch at site.

Testing

DG set will be tested on load of unity power factor for the rated KW rating. During testing DG set shall be operated for a period of 12 hours on the rated KW including one hour on 10% overload after continuous run of 12 hours. During testing, all controls/operators safeties shall be checked. Any defect/abnormality noticed during testing shall be rectified.

Copies of all documents of routine and type test certificates of the equipment, carried out at the manufacturers premises shall be furnished to the Project Manager and consignee.

After completion of the installation work in all respects, the contractor shall offer the DG Sets for testing as stated above.

The requirement of testing of DG Set at manufacturer's premises, in presence of representative of the Department, can be dispensed with/waived off, keeping in view the exigency of works, at the discretion of Department. However, test certificates of the particular DG Set on full load, as mentioned above, shall be submitted at the time of delivery of DG Set at site.

Trial Run/Running-in-Period

After successful testing of the DG Set, a trial run at available load will be carried out for 120 Hours or 15 Days whichever is earlier. The DG Set will be operated and a log of all relevant parameters will be maintained during this period. The arrangement of staff for trial run/running in period will be made by the successful tenderer. However, diesel shall be provided by Department. The contractor will be free to carry out necessary adjustments. The DG Set will be said to have successfully completed the trial run, if no break down or abnormal/unsatisfactory operation of any component of the entire installation included in the scope of work of the contract, occurs during this period. After this the DG Set will be made available for beneficial use. After the DG set has operated without any major break down/trouble, it shall be taken over by the department subject to guarantee clause of this contract. This date of taking over of the DG set, after trouble free operation during the trial run/running-in period, shall be the date of acceptance/taking over.

Safety measures

All equipments shall incorporate suitable safety provisions to ensure safety of the operating personnel as per manufacturers' standard practice.

4.2.10 Statutory Clearances

Approval/clearance of the complete installation shall be obtained by the contractor from CPCB/State Pollution Control Boards/Local Bodies/Central Electricity Authority (CEA)/other licensing authorities, wherever required. However, application shall be made by Department and any statutory fee, as applicable, shall be paid by Department directly to the govt. authorities concerned.

4.2.11 Guarantee

All equipments shall be guaranteed, against unsatisfactory performance and/or break down due to defective design, workmanship or material, for a period of 12 months from the date of taking over the installation by the department. The equipments or components, or any part thereof, so found defective during guarantee period shall be forthwith repaired or replaced free of cost, to the satisfaction of the Project Manager. In case it is felt by the department that undue delay is being caused by the contractor in attending the defect/fault removed, the same will be got done by the department at the risk and cost of the contractor. The decision of the Project Manager in this regard shall be final.

LIST OF APPROVED MAKES

S. No.	Description	Approved Make
CIVIL WORKS		
1.	Cement	Ultra tech,ACC,L&T,Unitech
2.	Reinforcement Steel (TMT Bars)	SAIL, Rathi, TATA Steel, RINL
3.	Structural Steel, Structural Hollow Section/Tubular Section	TATA,Asian,Jindal,SAIL,RINL
4.	White Cement	Birla ,J.K.
5.	Plywood	Kitply,Anchor,Green,Mayur
6.	Decorative Ply (Veneer)	Green,Duran,Century,Archid
7.	Laminates	Century ,Legent, Green, Merino
8.	Calcium Silicate Board/Gypsum Board	Saint Gobain,Hilux,Lafartz
9.	Locks/Latch	Godrej, Harrison,Plaza,Golden,Yale,Dorma
10.	Particle Board	Novapan,Kitlam,Archidply
11.	Adhesive	Pidilite,Dunlop,Vamorganic
12.	Flush Door	KIT,Anchor,Green,Uniply,National,Swastic, Corbett
13.	Glass/Float Glass	Saint Gobain,Modi Guard,HNG,Asahi
14.	Hydraulic Door Closer/Floor Spring	Godrej,Hardwyn,Dorma,Yale,Hafle
15.	Anodised Aluminium Hardware	Hardima,Everite,Sigma
16.	Aluminium Section	Jindal,Hindalco,Indalco,Bhoruka
17.	Nuts, Bolts and Screws	Kundal,Priya,Atul

S. No.	Description	Approved Make
18.	Aluminium Window Locks,Handle,Friction Stays	Alualpa,Securestyle,Giessee,Roto,Geze,Savio,Frik stay
19.	EPDM Gasket	Hanu,Anand
20.	Ceramic Tiles	Jhonson,Somany,Kajaria,Nitco,Orient, Asian
21.	Enamel Paint	Berger,Nerolac,Asian
22.	Emulsion Paint	Berger,Nerolac,Asian
23.	Stainless Steel Sink	Nilkanth,AMC,Corba,Nirali
24.	Sanitary Ware	Cera,Parryware,Hindware
25.	C P Fixture and Accessories	Jaquar,Nova,Parko,Marc
26.	UPVC pipe and fittings	Supreme,Finolex,Prince
27.	Toilet Seat	Cera,Parryware,Hindware
28.	Bevelled edge mirror	Atul, Jolly or equivalent , Modi Guard, Tata Firm

S. No.	Description	Approved Make
ELECTRICAL		
1.	CABLE	CCI (Cable Corporation of India), ICC, GLOSTER, NATIONAL & HAVELLS
2	PVC CONDUIT	AKG, BEC , POLY PACK
3.	AUTOMATIC CHANGE OVER SWITCHES	ELECON, CLIPSON, L&T, HAVELLS.
4.	MCCB'S	G.E. POWER CONTROL, CROMPTON, L&T, HAVELLS
5.	MCB'S/MCB DB'S	MDS LEGRAND, HAGER, CLIPSAL, HAVELL'S
6.	PVC INSULATED COPPER CONDUCTOR WIRES & TELEPHONE WIRES	POLYCAB, NATIONAL, FINOLEX, HAVELLS
7.	MODULAR TYPE SWITCHES / SOCKETS/REGULATORS	MK,CPL,CLIPSEL,HAVELLS, ANCHOR
8.	DG SET	
	a) ENGINE	CUMMINS, KIRLOSKAR OIL, CATERPILLAR, PERKINS
	b) ALTERNATOR	KIRLOSKAR ELETRIC CO., STAMFORD, AVK-SEG, LEROY SOMER
	c) ANTI-VIBRATION MOUNTING	DUNLOP, RESISTOFLEX
	d) EXHAUST PIPING	SAIL, TATA, PRAKASH SURYA, JINDAL HISSAR

NOTE:

- A) *The materials of first / standard quality of the above approved makes are to be used.*
- B) *Material shall be brought to site in original packings, manufacturers test certificates and /or invoices for all materials shall be handed over to the Project Manager on demand.*
- C) *Owner reserves the rights to have any or all random samples of materials checked/tested by an approved test house. Contractor will bear all such test fees and other liaison works.*
- D) *Wherever switchgears, DB etc of specified ratings are not manufactured by the manufacturer, next available higher size appropriately shall be used within the rates quoted.*
- E) *All Electrical material to be used on work i.e conduit pipe wires etc. shall be ISI marked. Items which are not ISI approved shall confirm to I.S. specifications.*