INDEX

NAME OF WORK : **COMPOSITE WORK FOR CONSTRUCTION OF NCR BIOTECH SCIENCE CLUSTER PHASE-II WORKS AT FARIDABAD, HARYANA**

NAME OF PROJECT : **CONSTRUCTION OF NCR BIOTECH SCIENCE CLUSTER PHASE-II WORKS AT FARIDABAD, HARYANA**

(TECHNICAL SECTION)

COMPOSITE WORK FOR CONSTRUCTION OF NCR BIOTECH SCIENCE CLUSTER PHASE-II WORKS AT FARIDABAD, HARYANA

SCOPE OF WORK

1. **BRIEF SCOPE OF WORK SHALL COMPRISE OF BUT NOT LIMITED TO THE FOLLOWING:-**

Section-I: Execution Phase

i) Civil, Structural and Architectural works.
ii) Internal and external Electrical works.
iii) Internal plumbing, sanitary & water supply works.
iv) External water supply, sewerage and drainage works.
v) Air conditioning works of Office of Connectivity building.
vi) Installation of standby AHU's in existing SAF building.
vii) Elevators.
viii) Fire fighting/ suppression and fire detection works.
ix) Solar panels.
x) BMS works in existing buildings viz. RCB 4th wing and ATPC building including integration with existing BMS system and up-gradation of existing BMS system.
xi) Covered parking lots.
xii) Steel foot over bridge.
xiii) External development works such as development of water body, landscaping & horticulture works, construction of roads and foot paths, boundary wall, fencing, bituminous carpeting of existing/new roads etc.

Section-II: Maintenance Phase

i) 3 years comprehensive maintenance starting after completion of one year of Defect Liability Period for Elevators, BMS works and HVAC works
ii) 5 years comprehensive maintenance starting after completion of one year of Defect Liability Period is to be provided for Solar PV works

Any other works not specifically mentioned above; but, required for achieving overall completion of work.

2. **GENERAL FEATURES OF THE PROPOSED BUIDLINGS ARE ENUMERATED BELOW:-**

Sl No	Building Name	No. of Floors	Built up area. (Sq. M)
1.	Office of Connectivity	G+2	2700
2.	BSL-3	G+1	1250
Total Built - up area			**3950**

Areas mentioned above may vary based on the actual requirements during execution.

TECHNICAL SPECIFICATIONS

GENERAL

1. GENERAL:

The work in general shall be executed as per the description of the item, specifications attached and CPWD Specifications (Latest version). Wherever any reference to any Indian Standard Specifications is made in the document relating to this contract, the same shall be inclusive of all amendments issued there to or revision thereof, if any, up to the date of receipt of tender. The rates quoted by the contractor shall be inclusive of all items, included in these specifications and special conditions and nothing extra shall be payable whatsoever unless otherwise specified.

In case of an irreconcilable conflict between the provisions of Specifications and Schedule of Rates (SOR), the provisions of Specifications shall be superseded by the provisions of SOR.

However, wherever required by Engineer-in-Charge, the contractor shall submit a detailed methodology for execution of the specific work and shall get the same approved before the start of that specific work.

In case scope of supply, mode of measurement etc. mentioned in the Technical Specifications are in variance with Schedule of Rates (SOR), the provisions of Schedule of Rates (SOR) shall prevail over Technical Specifications.

For the specialized works, contractor shall engage specialized agencies with prior approval of Engineer-In-Charge. Performance guarantee for the items mentioned in SOR/ technical specifications shall be provided in the standard format enclosed with the tender.

Wherever it is mentioned “at all levels” in Schedule of Rates/ Technical Specifications for any item, the same shall be considered for “at all heights” irrespective of height of the structural element viz. Columns, Walls, Retaining walls etc. Contractor to quote his rates accordingly and nothing extra shall be paid on this account.

Retaining wall, Basement structure shall be considered under works upto plinth level only irrespective of the height of the basement above the Ground Level.

2. BASIC COST OF MATERIALS:

Wherever “minimum basic cost” is mentioned in the Schedule of Rates (SOR) or elsewhere in the bidding document, it shall mean “cost of material excluding taxes, freight charges, loading/unloading charges etc.”

The contractor shall submit, for Engineer-in-Charge’s approval, samples of materials meeting the minimum basic cost of materials wherever mentioned in the Schedule of Rates (SOR). Engineer in- charge shall constitute a committee consisting of EIL/ Contractor’s/owner’s representative who shall verify the basic cost of materials.

In case the basic cost, as verified by the committee is less than or exceeds the “minimum basic cost” as defined above, payment shall be made for that material considering the applicable rebate/ extra cost after suitably applying the taxes, contractor’s overhead & profits and other charges e.g. wastage, water charges etc. as applicable.

3. APPROVAL OF SAMPLES:

Wherever “approved equivalent” is mentioned in the Schedule of Rates (SOR) or elsewhere in the Bidding document, it shall mean “material meeting all the technical properties/ parameters and rate of the make mentioned in the SOR or LIST OF MAKES OF MATERIAL”.

CIVIL, STRUCTURAL AND ARCHITECTURAL WORKS

1. CARRIAGE OF MATERIALS

The carriage and stacking of materials shall be done as per Sub-head No-1 of CPWD Specifications Volume-1. However, where CPWD specifications are not available, the work shall be carried out with prior approval of Engineer-in-Charge.

2. EARTH WORK

2.1 General

The work shall be carried out as per CPWD specifications, Volume-1, Sub-head No-2. However, where CPWD specifications are not available, the work shall be carried out with prior approval of Engineer-in-Charge. The following shall not be measured separately for payments and allowance for the same shall be made by the contractor in the quoted rates:

I. Setting out of work.
II. Excavation for insertion of planking and strutting.
III. Removal of slips or falls in excavation due to any reason whatsoever.
IV. Forming steps/slopes in the sides of excavation and their removal.
V. Forming ramps for vehicular movement during excavation and their removal.
VI. Bailing out or pumping of rain water from excavations.
VII. Disposal of earth within the site plot boundaries.
VIII. Additional lift in backfilling work.
IX. Use of Chemicals for splitting of rocks.
X. Keeping the excavated area clean from any deposition of water due to rain, sandstorm, flood, landslip etc.

2.2 Measurements

2.2.1 Measurements shall be done as per the relevant CPWD specification/ IS codes. However, for hard rock and soft rock/ disintegrated rock, following mode shall be followed for measurement;

2.2.2 Excavated materials from `hard rock' and soft rock/ disintegrated rock shall be stacked separately, measurement reduced by 50% to allow for voids to arrive at the quantity payable under 'hard rock' and 'soft rock' respectively.

2.2.3 The difference between the entire excavation (worked out from the levels) and such of the quantities payable under 'hard rock' and 'soft rock/ disintegrated rock' shall be paid for as excavation in all kinds of soil.

2.3 Excavation in all types of Soils

Excavation and/ or removal of any other material on the site shall be carried out accurately to the lines, levels and dimensions shown in the drawings or as ordered by the Engineer-in-charge, so as to allow proper and efficient concrete work and other work in clean and dry condition. The method of excavation shall be at the discretion of the Engineer-in-charge.

2.4 Material for Earthwork in Filling

2.4.1 Only soil considered suitable by the Engineer-in-charge shall be used for backfilling/filling unsuitable soil shall be disposed off, as directed by Engineer-in charge.

2.4.2 The soil used for filling shall be free from boulders, lumps, tree roots, rubbish or any organic deleterious matter.

2.4.3 Soil having laboratory maximum dry density of less than 1.5 gms/cc shall not be used.

2.4.4 Care shall be taken to see that unsuitable waste material is disposed off in such a manner that there is no likelihood of it getting mixed with the material, proposed to be used, for filling.

2.4.5 Hard rock obtained from excavation shall be measured as per CPWD specifications Vol.1 and the hard rock so obtained shall be the Owner's property. However, if the Owner desires the contractor to take the possession of the excavated hard rock, recovery shall be made at unit prices mentioned in Schedule of Rates. The utilization/ disposal of hard rock once possessed and removed from site by the contractor, shall be as per contractor's discretion. The contractor shall indemnify Owner from all liabilities thereof towards any statutory, legal implications.

3. MORTARS

3.1 General

The work shall be carried out as per CPWD specifications, Volume-1, Sub-head No-3. However, where CPWD specifications are not available, the work shall be carried out with prior approval of Engineer-in-charge.

3.2 Materials

3.2.1 The cement used shall be Portland Pozzolana cement (fly ash based) conforming to IS 1489 (Part 1).

3.2.2 The responsibility of storing and stacking of all construction materials lies with the contractor.

3.2.3 Natural river sand obtained from river beds and pits, shall only be used as fine aggregate. Sand conforming to Zone-II/ III as per IS 383 shall be used for cement mortar works.

4. CONCRETE WORK & REINFORCED CEMENT CONCRETE WORK

4.1 General

All concrete included in the work shall comply with the General requirements of this section of the specification except where those requirements are modified by the provisions of later Clauses relating to specialized uses for concrete in which case the requirements of those Clauses shall take precedence. Apart from this specification, construction of Plain and Reinforced Cement Concrete works shall be in accordance with Vol. 1, Sub-head No - 4 & Sub-head No - 5 of CPWD Specifications, the Indian Standard Code of Practice for Plain and Reinforced Cement Concrete - IS: 456 and other relevant codes mentioned therein.

4.2 Materials

4.2.1 Portland Pozzolana Cement (PPC) confirming to IS 1489 Part 1, shall be used for all concrete works.

4.2.2 The responsibility of storing and stacking of all construction materials lies with the contractor.

4.2.3 Natural river sand obtained from river beds and pits, shall only be used as fine aggregate for concreting works. Crushed stone aggregates shall only be used as coarse aggregates for concreting works. Aggregates should not be elongated or flaky.

4.2.4 Quarry/ Source of materials shall be inspected/ approved by Engineer-in-Charge. Change of source, if proposed by the contractor, shall immediately be informed to and got approved by Engineer-in-Charge.

4.2.5 Water for construction purpose shall confirm to IS:456. Contractor shall get the water tested from any approved laboratory before commencement of works at his own cost. Water shall be tested at every three months to ascertain the quality. In case, there is change in the source of water, the same shall be tested again to meet the requirements at any stage of construction as directed by the Engineer-in-charge.

4.3 Laying of Concrete

4.3.1 To ensure proper cover, preferably factory made cover blocks/PVC cover blocks will be used to avoid displacement of bars in any direction.

4.3.2 The construction joints if unavoidable shall be provided in predetermined locations only as directed by Engineer-in-charge. Nothing extra shall be paid for providing shuttering as required or for applying a coat of neat cement slurry on the joints before re-commencing concreting work.

4.3.3 The contractor shall necessarily use the surface vibrator for compaction of concrete in floor slab etc. For placement of concrete at various levels tower crane of appropriate size, capacity and boom length or concrete pump shall necessarily be deployed by the contractor. However, mechanical hoist can be used by the contractor for lifting other construction materials.

4.4 Design Mix

4.4.1 Design mix concrete shall be used for all RCC works. Fully automatic computerized batching plant of required capacity shall be installed by the contractor at a suitable location outside the boundary limit of the site, but as near as possible to the site or alternatively RMC as per approved design mix from approved RMC plant shall be used.

4.4.2 The concrete mix design with and without admixture will be carried out by the contractor through approved laboratory/ test house/ institute and reviewed and approved by Engineer-in-Charge. Ready Mix concrete shall confirm to accepted/ approved mix.

4.4.3 The Contractor shall submit the mix design report for approval of Engineer-in-Charge within 30 days from the date of issue of letter of commencement of the work. No concreting shall be done until the mix design is approved by Engineer-in-Charge.

4.4.4 The cost of packaging, sealing, transportation, loading, unloading, cost of samples and the testing charges for mix design in all cases shall be borne by the contractor.

4.4.5 The various ingredients of mix design for laboratory test shall be sent to the laboratory/ test house through the Engineer-in-Charge after joint sampling of ingredients.

4.4.6 The contractor shall make cubes of size 15cm x 15cm x 15cm of trial mixes as per approved mix design at site laboratory for all grades of concrete in presence of the Engineer-in-Charge using same ingredients as adopted for design mix, prior to commencement of concreting and get them tested for strength in presence of Engineer-in-Charge for 7 days and 28 days. For each design mix, a set of six cubes shall be prepared from each of the three consecutive batches three cubes from each

set shall be tested at the age of 7 days and three cubes at the age of 28 days. The cubes shall be made, cured, transported and tested strictly in line with CPWD specifications. The average strength of cubes at the age of 28 days shall exceed the specified target strength for which design mix has been approved.

4.4.7 For each change of source of quality/ characteristic properties of the ingredients from that approved & used in the concrete mix during the work, a fresh mix design shall be got done by the contractor at no extra cost. Revised trial mix test shall be conducted at laboratory established at site and shall be submitted by the contractor as per the direction of the Engineer-in-Charge.

4.4.8 The item of design mix cement concrete shall be inclusive of all the ingredients including the required dosage of admixtures as required, labour, machinery and shuttering, T&P etc. (except reinforcement which will be measured & paid for separately) required for design mix concrete of required strength and workability and for transporting, placing, compacting and curing etc. The rate quoted by the contractor shall be net & nothing extra shall be payable on account of change in quantities of concrete ingredients like aggregates and admixtures etc. as per the approved mix design.

4.5 Use of admixture

4.5.1 Approved admixture conforming to IS: 9103 shall be permitted to be used for obtaining required workability and for retarding/ accelerating setting time of concrete. The Chloride content in the admixture shall satisfy the requirement of BS 5075. The total amount of chloride content in the admixture mixed concrete shall satisfy the requirement of IS: 456-2000.

4.5.2 The quantity of admixture to be used (per cu.m.) in concreting works shall be as recommended by the Laboratory carrying out the Concrete Mix Design within the range as specified by the relevant manufacturers/ I.S. Codes. No extra payment whatsoever shall be paid to the contractor towards any dosage(s) of Admixtures used within the permissible range as per Manufacturer's recommendation/specification.

4.6 Batching Plant

4.6.1 The contractor shall arrange and install fully automatic computerized batching plant of adequate capacity (with printer to generate pre- printed details of each load) at a suitable separate location beyond the boundary limit of the site, but as near as possible from the site. The batching plant should have all the facilities as per IS 4925 including water measuring device for controlled concrete mix. Volumetric mix shall not be allowed for controlled concrete. All other operations in concreting work like mixing, transportation, laying/placing of concrete, compaction, curing etc. are not mentioned in this particular specification for design mix of concrete shall be as per IS 456-2000 and CPWD specification.

4.6.2 Transportation of Concrete from batching plant: Concrete shall be transported from batching plant to work site through transit mixers or any other suitable arrangement approved by Engineer-in-Charge.

4.6.3 No extra payment shall be made for establishing of establishment of batching plant at a separate location beyond the boundary limit of the site. And transportation of concrete from the batching plant to the site.

4.7 RMC (Ready Mix Concrete) Plant

4.7.1 Alternatively, the contractor may be allowed by Engineer-in-Charge to arrange Ready Mix Concrete (RMC) from producing plants. The RMC plant proposed to be engaged by the contractor shall fulfil the following requirements:

a) It shall be fully automatic and computerized with facility for providing printed advice showing ingredients of concrete carried by each mixer.

b) It should have supplied RMC for projects of similar magnitude.

4.7.2 For procurement of ready mix concrete from RMC plants, the contractor shall, within 15 days of award of the work, submit list of at least three RMC plant companies of repute along with details of such plants including details of transit mixer and pumps etc. to be deployed indicating name of owner/ company, its location, capacity, technical establishment, past experience and text of MOU/ Agreement proposed to be entered between purchaser (the contractor) and supplier (RMC Plant) to the Engineer-in-Charge. The Engineer-in-Charge shall give approval in writing (subject to drawl of MOU). The contractor shall draw the MOU with approved RMC plant owner/ a company and submit to Engineer-in-Charge within a week of such approval. The contractor will not be allowed to purchase ready mixed-concrete without completion of above stated formalities for use in this project. Availability of concrete round the clock throughout the project duration shall also be included in MOU.

4.7.3 Notwithstanding the approval granted by Engineer-in-Charge in aforesaid manner, the contractor shall be fully responsible for quality of concrete including input control, transportation and placement etc.

4.7.4 The Engineer-in-Charge will reserve the right to inspect at any such stage and reject the concrete if he is not satisfied about quality of product. The contractor should therefore draw MOU/ agreement with RMC owner/ company very carefully keeping all terms and conditions/ specifications forming a part of this tender document.

4.7.5 It shall be the responsibility of the contractor to ensure that all-necessary equipment manpower & facilities are made available to Engineer-in-Charge and/ or his authorized representative at RMC plant.

4.7.6 Ingredients, admixtures & water declared unfit for use in production of mix shall not be used. A batch mix found unfit for use shall not be loaded into the transit mixer for transportation.

4.7.7 The RMC produced concrete shall be accepted by Engineer-in-Charge at site after receipt of the same after fulfilling all the requirements of mix mentioned in the tender documents.

4.8 Quality Control of Ready-Mix Concrete

It shall be the responsibility of the contractor to ensure that the RMC producer provides all necessary testing equipments and take all necessary measures to ensure Quality control of ready – mixed concrete. In general, the required measures shall be:

4.8.1 Control of Purchased Material Quality: RMC producer shall ensure that all the materials purchased and used in the production of concrete conform to the stipulation of the relevant agreed standards with the materials supplier and the requirements of the products mix design and quality control procedures. The materials shall be accomplished by visual checks, sampling and testing, certification and information/

data from material supplier. Necessary equipment for the testing of all material shall be provided and maintained in calibrated condition at the plant by the RMC producer.

4.8.2 Control of Material Storage: Adequate and effective storage arrangement shall be provided by RMC producer at RMC plant for prevention of contamination, reliable transfer and feed systems, drainage of aggregates, prevention of freezing or excessive solar heating of aggregate etc. Each truckload/ transit mixer dispatched to site shall carry computer printout of the ingredients of the concrete it is carrying. The printout shall be handed over to Engineer in-Charge or his representative at site before RMC is used in work.

4.8.3 Transfer and Weighing Equipment: RMC producer shall ensure that a documented calibration is in place. Proper calibration records shall be made available indicating date of next calibration due, corrective action taken etc. RMC producer shall ensure additional calibration checks whenever required by Engineer-in-Charge in writing to contractor. RMC producer shall also maintain a daily production record including details of cubes. Record shall also be maintained of the materials used for that day's production including water and admixtures. The accuracy of measuring equipment shall be as per manufacturer's recommendation/ relevant IS specifications.

4.8.4 Production of Concrete: The following precautions shall be taken during the production of RMC at the plant:

a) Weighing (correct reading of batch data and accurate weighing) - For each load written, printed or graphical records shall be made of the weights of the materials batched, the estimated slump, the total amount of water added to the load, the delivery ticket number for that load and the time of loading the concrete into the truck.

b) Visual observation of concrete during production and delivery during sampling and testing of fresh concrete assessment of uniformity, cohesion, workability, adjustment to water content: The workability of concrete shall be controlled on a continuous basis during production. The batch mix found unfit shall not be loaded into the truck for transportation. Necessary corrective action shall be taken in the production of mix as required for further batches.

c) Use of adequate equipment at the plant to measure surface moisture content of aggregates, particularly fine aggregate or the workability of the concrete, cube tests etc. shall also be ensured.

d) Making corresponding adjustment at the plant automatically or manually to batched quantities to allow for observed, measured or reported changes in materials or concrete qualities.

e) Sampling of concrete, testing, monitoring of results, diagnosis and correction of faults identified from observations/ complaints. The RMC plant produced concrete shall be accepted by Engineer-in-Charge at site after receipt of the same after fulfilling all the requirements of mix mentioned in the tender documents.

f) Ready mix concrete shall be arranged in quantity as required at site of work. The ready mix concrete shall be supplied as per the pre-agreed schedule approved by Engineer-in-Charge.

g) If so required by the Engineer-in-Charge, the RMC producer shall provide separate storage space/ godown for storage of materials approved by Engineer-in-Charge for the design mix concrete.

h) Use of Fly ash/ mineral based admixtures in RMC shall not be permitted without prior approval of Engineer-in-Charge.

i) No addition of water or other ingredients shall be permitted in the RMC at site or during transit.

j) Concrete shall be placed by pump of suitable capacity or tower crane or boom placer and the contractor shall arrange sufficient length of pipe at site to place the concrete in the minimum required time. Nothing extra shall be paid for placing of concrete through concrete pump/ tower crane/boom placer.

k) Printed delivery tickets shall be produced with each truck load of RMC.

l) The representative of RMC supplier shall attend the site meeting as and when decided by the Engineer-in-Charge.

m) The contractor shall assess the quantity of RMC requirement at site well in advance and order accordingly to the RMC supplier. In case excess RMC is received at site, the Engineer-In-Charge shall not be under any obligation to get the extra quantity utilized and no payment for such RMC shall be made.

n) The contractor shall have to employ labour in shifts to ensure continuous casting of raft and other RCC members as directed by Engineer-In-Charge. No extra payment on this account shall be made.

4.9 RMC/ Site Batch Concrete

The Engineer-in-charge reserves the right to exercise control over the:

4.9.1 Ingredients, water and admixtures purchased, stored and to be used in the concrete including conducting of tests for checking quality of materials, recordings of test results and declaring the materials fit or unfit for use in production of mix.

4.9.2 Calibration checks of the site batching plant / RMC plant.

4.9.3 Weight and quality check on the ingredients, water and admixtures added for batch mixing.

4.9.4 Time of mixing of concrete.

4.9.5 Testing of fresh concrete, recordings of results and declaring the mix fit or unfit for use. This will include continuous control on the workability during production and taking corrective action.

4.9.6 All required relevant records of RMC/ batching plant shall be made available to the Engineer-in-Charge or his authorized representative. Engineer-in-Charge shall, as required, specify guidelines & additional procedures for quality control & other parameters in respect of materials and production & transportation of concrete mix, which shall be binding on the contractor & the RMC plant.

4.9.7 PPC (conforming to IS-1489 Part 1) of brand/ make/ source as approved by Engineer-in-Charge shall only be used for production of concrete.

4.9.8 Ready mix/ batching plant concrete shall be arranged in quantity as required at site of work. The ready mix concrete shall be supplied as per the pre-agreed schedule approved by Engineer-in-Charge.

4.10 Formwork and scaffolding / Staging

4.10.1 For the execution of centering and shuttering, the contractor shall use chemical mould release agent of approved make shuttering oil as recommended by the manufacturer and nothing extra shall be paid on this account.

4.10.2 The shuttering system shall have sufficient strength to withstand the pressure resulting from placement and vibration of concrete and shall have sufficient rigidity to maintain specified tolerances.

4.10.3 Scheme of arrangement /Shop drawings/shuttering design for the shuttering system shall be submitted for approval of the Engineer-In-Charge sufficiently prior to commencement of work.

4.10.4 The design and engineering of the shuttering system shall be the responsibility of the contractor and Contractor shall use the latest technology available for staging and shuttering.

4.10.5 The selection of material shall be consistent with safety and quality required in the finished work.

4.10.6 The shuttering system shall be sufficiently tight to prevent loss of cement slurry from the concrete and shall be securely braced against lateral deflection.

4.11 Removal of Formwork (Striking Time)

4.11.1 Unless specified in the drawing, or directed by the Engineer-in-charge, the minimum intervals of time, which should be allowed between the placing of the concrete and the striking of the formwork shall be as per relevant CPWD Specifications and other IS Standards.

4.12 Curing

4.12.1 Curing of concrete shall be done using potable water/curing compound of approved make.

4.12.2 Exposed concrete slabs: Potable water/Curing compound should be spray applied on to the newly placed concrete slab as soon as possible after it is free from visible surface water.

4.13 Reinforcement steel works

4.13.1 Rate quoted for uncoated reinforcement steel shall include cost of supplying, de-coiling, straightening, cleaning, cutting, bending, placing, binding, welding, if required and providing necessary cover blocks of concrete.

4.13.2 No payment for cement wash shall be made separately and is deemed to be included in the quote rate for RCC works.

5. BRICK WORK

The work shall be carried out as per CPWD specifications, Volume-1, Sub-head No-6. However, where CPWD specifications are not available, the work shall be carried out with prior approval of Engineer-in-Charge.

6. STONE WORK

The work shall be carried out as per CPWD specifications, Volume-1, Sub-head No-7 and other relevant IS codes. However, where CPWD specifications are not available, the work shall be carried out with prior approval of Engineer-in-Charge.

7. MARBLE WORK

The work shall be carried out as per CPWD specifications, Volume-1, Sub-head No-8 and other relevant IS codes. However, where CPWD specifications are not available, the work

shall be carried out with prior approval of Engineer-in-Charge.

8. FLOORING

The work shall be carried out as per CPWD specifications, Volume-1, Sub-head No-11 and other relevant IS codes. However, where CPWD specifications are not available, the work shall be carried out with prior approval of Engineer-in-Charge.

8.1.1 Wooden Laminate Flooring

The respective items of flooring as given in SOR shall be inclusive of protecting and keeping the flooring clean till handing over. No extra amount shall be payable to the contractor on this account. Installation of these flooring shall be carried out as described in the respective SOR item and as per manufacturer's specifications. The warrantee of these flooring shall be as per manufacturer's specifications.

9. STEEL WORK

The work shall be carried out as per CPWD specifications, Volume-1, Sub-head-10. However, where CPWD specifications and relevant IS standards are not available; the work shall be carried out with prior approval of Engineer-in-Charge. The rate quoted by the contractor shall be inclusive of the following clauses as well.

9.1 Material

The material shall conform to relevant IS Codes. The Structural Metal Decking sheets/ system shall confirm to AS 1397 & BS EN 10147:2000/ relevant IS codes.

9.2 Fabrication Drawings

9.2.1 The contractor shall prepare all fabrication and erection drawings on the basis of design drawings supplied to him and submit the same in triplicate to the Engineer-in-charge for review. Engineer-in-charge shall review and comment, if any, on the same. Such review, if any, by the Engineer-in-charge, does not relieve the contractor of any of his required guarantees & responsibilities. The contractor shall however be responsible to fabricate the structural members strictly conforming to specifications and reviewed drawings.

9.2.2 Review by Engineer-in-charge shall not absolve the contractor of his responsibility for the correctness of dimensions, adequacy of details and connections. One copy will be returned with or without comments to the contractor for necessary action.

9.2.3 The contractor shall supply three prints each of the final reviewed drawings to the Engineer-in-charge within a week since final review, at no extra cost for reference and records.

9.2.4 Fabrication and erection drawings shall be thoroughly checked and stamped "Approved for Construction" and signed by the responsible engineer of the Contractor and shall be released for construction by the contractor directly to his work site.

9.2.5 If any modification is made in the design drawing during the course of execution of the job, revised design drawings will be issued to the contractor. Further changes arising out of these shall be incorporated by the contractor in the fabrication drawings already prepared at no extra cost and the revised fabrication drawings shall be duly got reviewed as per the above Clauses.

9.3 Fabrication

9.3.1 Fabrication of structures shall be done strictly as per "Approved for Construction" fabrication drawings (prepared by the Contractor based on the Good for Construction drawings issued by Engineer-in-Charge) and in accordance relevant ISA codes and other relevant BIS Codes.

9.3.2 The contractor shall establish a storage and fabrication yard at a suitable separate location beyond the boundary limit of the site. The fabrication yard should be properly levelled and paved by the contractor. All fabrication shall be done by the contractor at the fabrication yard as per relevant IS codes and BIS codes. No extra amount shall be payable to the contractor on this account

9.3.3 Welding including requirements of welders, testing and inspection of welds shall be as per relevant IS codes and BIS codes.

9.4 Transportation

9.4.1 Loading and transportation shall be done in compliance to the transportation and traffic rules and timings. All members shall be brought to site for direct erection. No extra amount shall be payable to the contractor on this account

9.5 Site Erection

9.5.1 All members shall be hoisted and erected in position carefully, without damage to themselves, other structure, equipment and injury to workman.

9.5.2 The Structural Metal Decking sheets/system shall be installed as per the description given in the relevant item of SOR and manufacturer's specifications

9.5.3 The method of hoisting and erection proposed to be adopted, including the deployment of power cranes, special telescopic cranes, derricks, lifting tackles, winches, ropes etc., shall be prepared by the contractor looking in to the traffic and other site constraint and to the satisfaction of Engineer-in-Charge and shall be got approved from the Engineer-in-charge. The contract shall carry out the erection strictly as per the approved erection plan only. No extra amount shall be payable to the contractor on this account.

9.5.4 The contractor shall however be fully responsible, for the work being carried out in a safe and proper manner.

9.6 Grouting:

9.6.1 Prior to positioning of structural steel columns/ girders/ trusses over the concrete pedestals/columns/brackets, all laitance & loose materials shall be removed by wire brushing & chipping. All pockets for anchor bolts shall also be similarly cleaned and any excess water removed. Structural steel members shall be erected thereafter aligned, maintaining the base plates/shoe plates at the levels shown in the drawings with necessary shims/pack plates/wedges.

9.6.2 After final alignment of structure, the forms shall be constructed all around and joints made water tight to prevent leakage. Grouting (under the base plates/shoe plates including grouting of sleeves & pockets) shall be done with Non-shrink grout having compressive strength (28 days) not less than 40 N/mm^2. Non-shrink grout shall be of free flow premix type and of approved quality and make. It shall be mixed with water in proportion as specified by the Manufacturer. The thickness of grout shall be as shown in the drawings but not less than 25 mm nor more than 40 mm in any case.

9.6.3 The grout mixture shall be poured continuously (without any interruption till completion) by grouting pumps from one side of the base plate and spread uniformly with flexible steel strips and rammed with rods, till the space is filled solidly and the grout mixture carried to the other side of the base plate.

9.6.4 Adequate arrangement shall be made for curing the grout as per the recommendation of Manufacturer.

9.7 Painting on structural steel Work

The work shall be carried out as per CPWD specifications, Volume-2, Sub-head No-13. However, where CPWD specifications are not available, the work shall be carried out with prior approval of Engineer-in-Charge.

10. WOOD WORK AND PVC WORK

The work shall be carried out as per CPWD specifications, Volume-1, Sub-head No-9 and other relevant IS codes. However, where CPWD specifications are not available, the work shall be carried out with prior approval of Engineer-in-Charge.

11. ALUMINIUM WORK

The work shall be carried out as per CPWD specifications, Volume-2, Sub-head No-21. However, where CPWD specifications are not available, the work shall be carried out with prior approval of Engineer-in-Charge.

12. FINISHING WORKS

The work shall be carried out as per CPWD specifications, Volume-2, Sub-head No-13. However, where CPWD specifications are not available, the work shall be carried out with prior approval of Engineer.

13. WATER PROOFING

The work shall be carried out as per CPWD specifications, Volume-2, Sub-head No-22. However, where CPWD specifications are not available, the work shall be carried out with prior approval of Engineer-in-Charge.

14. DISMANTLING AND DEMOLISHING

The work shall be carried out as per CPWD specifications, Volume-2, Sub-head No-15. However, where CPWD specifications are not available, the work shall be carried out with prior approval of Engineer-in-Charge.

15. LANDSCAPING

The work shall be carried out as per CPWD specifications for Horticulture and Landscaping works. However, where CPWD specifications are not available, the work shall be carried out with prior approval of Engineer-in-Charge.

IS 6869 and other relevant standards shall be followed for Playground Equipment for Park and other Equipments to be installed in Parks like Concrete Benches, Bollards etc.

PLUMBING AND SANITARY WORKS

1. GENERAL

1.1 SCOPE OF WORKS

The scope of work under the sub head 'Plumbing and Sanitary Works' includes the following:

(a) Sanitary ware including fixing of fixtures and faucets and associated piping works.
(b) Drainage system including construction of manholes and all associated works.
(c) Water supply works.
(d) Sewerage & storm water drainage.
(e) Obtaining necessary approvals and NOC from local bodies.

1.2 STANDARDS AND CODES OF PRACTICE

The work in general shall be carried out as per CPWD Specifications of Works (with up-to-date correction slips) for various disciplines. These specifications shall be read in conjunction with National Building Code 2005, relevant Codes of Practice and Standards as issued by Bureau of Indian Standards (B.I.S. - all with the latest amendments) wherever applicable, Unified Plumbing Code of India 2011 and other International Standards for materials and systems for which national standards have not been formulated so far.

1.2.1 DRAWINGS AND DOCUMENTS

1.2.1.1 General

(a) The Drawings provided with the Specification shall be treated as confidential documents and must not be copied or loaned to any other party without the express permission of the Engineer-in-Charge.
(b) The Drawings are intended as a guide to the firms tendering and give approximate positions of pipes, conduits, cable runs and/or equipment only and in measuring from these drawings, the contractor must make due and proper allowance for all necessary diversions from the straight line, rises or falls as may be required for the proper execution of the works.
Detail drawings in all cases shall be worked to in preference to those of a more general nature and figured dimensions where indicated shall be followed in preference to scale.
Where necessary, the exact positions of plant and/or equipment will be decided by the issue of further drawings, but no claim for extra payment due to insufficient information on this scope will be entertained.
In any case of doubt as to the interpretation of either Drawings and/or Specification, the Contractor must refer the matter to the Engineer-in-Charge prior to the submission of his Tender.
(c) It is to be clearly understood that this Tender is to be absolutely inclusive for the proper completion of the whole of the works specified to the true intent and meaning of the specification and/or Drawings and the description therein contained shall be read conjointly and together and no error, inconsistency, discrepancy in the Drawings and/or Specification will relieve the Contractor of his obligations to include for an hand-over the work in the true meaning and intent of the Specification and/or Drawings, complete in every respect.
Should any portion of the works which would reasonably and obviously be inferred as necessary for the installation as a whole not be expressly specified, the Contractor shall provide and execute such work as part of the Contract and shall not be entitled to any extra payment of that account.
(d) The Contract Drawings and such other drawings as may be furnished to the Contractor during the progress of the Works shall be considered as illustrating between the Drawings and the Specification; the Contractor shall execute the work in accordance with the decision

of the Engineer-in-Charge. If modifications are necessary, the Contractor shall submit modifications to the Engineer-in-Charge for approval before such modifications are executed.

(e) All Drawings and Specification are the property of the Engineer-in-Charge.

(f) The Contractor will be required to give and obtain all necessary site and other particulars and to agree such details with the Engineer-in-Charge. The Contractor must also obtain details of any other Contractor's work affected by his work and shall work in close co-operation with all such firms or persons concerned.

(g) The Contractor shall be responsible for any damage caused to buildings and contents and works by reason of, arising out of, or incidental to, or in connection with the execution of any work in the Contract Documents.
The Contractor shall permit nothing to be done which may injure the stability of the Works, or existing buildings and no cutting through floors or walls will be allowed other than where required by the Drawings, without the sanction of the Engineer-in-Charge.

(h) The Contractor shall submit to the Engineer-in-Charge for approval, before the work is commenced, a copy of all working details and installation drawings and shall also supply sufficient copies for the use of the Owner/Civil Work Contractor etc.
These drawings must be submitted by the Contractor as soon as possible after the order is placed to give ample time for all parties concerned to study and comment thereon.

(i) The work described on any working drawings submitted shall be carefully checked by the Contractor for all clearance, field conditions, maintenance of architectural conditions and proper co-ordination with all trades on the job. To this end, during the construction drawing stage, the contractor shall ensure that he co-ordinates drawings of all other trades that might interferes with the proper installation of his work. No payment shall be made for any variations or alterations on site due to lack of knowledge of other trades. Any unresolved conflict between various trades shall be referred to the Engineer-in-Charge.
The equipment layout is to be detailed on the drawings, showing the exact method of installing and clearly illustrating components to be used in making all connections.

(j) Pipework drawings must be fully detailed, showing all pipework in double line and indicating the precise size of fittings, valves and equipment, position of hanger supports with reference numbers must be indicated and a large-scale detail must be given, showing the type and method of installation of each type of hanger. A schedule is to be included on each drawing, showing details of the type of hanger fixings and references number for each type.
All general layout drawings shall be drawn 1/50 scale, unless agreed otherwise with the Engineer-in-Charge. Toilet piping layouts, details and hangers, cleanouts, methods of fixing of all fittings and fixtures including pipes, detailed cross sections of service ducts, etc., are to be drawn to 1/10 scale.

(k) The Contractor shall provide a detailed programme incorporating working drawing production which can be read in conjunction with the building construction programme.

(l) The Contractor shall prepare schedules and drawings showing precise details of holes in concrete, block works etc., base frames or support required and the like. The schedules shall show in detail the builder's work required to be performed by all other trades for the mechanical and electrical installations. These drawings and schedules, in an approved form, must be submitted to an properly approved by Engineer-in-Charge before any structural work requiring holes or other modifications is constructed.

(m) The Contractor shall submit all drawings as prescribed hereunder. All drawings shall be supplied in the form of a second negative and signed by a principal of the Contractor. After approval, the negative will be signed by the Engineer-in-Charge and returned to the Contractor. The Engineer-in-Charge will take as many prints from this negative as he requires for his own use.
Signed and approved drawings will not be departed from unless a signed variation or omission certificate is issued in writing by the Engineer-in-Charge. Drawings returned to the Contractor for alteration or amendment shall be re-submitted to the Engineer-in-Charge for

approval.
Amended or altered drawings shall show the nature of the amendment or alteration in a revision block on the drawing, together with the revision number or letter and the date of the revision.

(n) Should the Contractor prove unable to produce satisfactory "Working Drawings" or be unable to produce drawings to conform to the progress of the work, the Engineer-in-Charge reserves the right to take whatever steps are necessary to have drawings undertaken by others and debit the Contractor's account.
Any decision taken by the Engineer-in-Charge to have working drawings produced elsewhere will not relieve the Contractor of his contractual obligations and the Contractor must provide to the Engineer-in-Charge all necessary details, physical dimensions, descriptive literature, etc., of all equipment to be incorporated on drawings within 10 days of a request from the Engineer-in-Charge.

1.2.1.2 Manufacturers' Data

(a) Manufacturers' performance data, certified factory drawings of apparatus, giving full information as to capacity, dimensions, materials and all information pertinent to the adequacy of the submitted equipment shall be submitted for approval.
Manufacturer names, sizes, catalogue numbers and/or samples of all materials shall be submitted for approval.
Submittals and working drawings should, as far as possible be complementary so that drawings and submittals can be cross checked.

(b) Order of equipment submitted for approval must be accompanied by relevant drawings, technical data, catalogues and samples, where data, certified drawings or other required information is not available until after orders have been placed, the Engineer-in-Charge will give provisional approval until all requested drawings and information have been supplied to the Engineer-in-Charge and approved by him. It is the Contractor's responsibility to ensure that all necessary information is supplied to the Engineer-in-Charge in accordance with the progress of the work.

1.2.1.3 Operating and Maintenance Manual

The Contractor shall furnish six copies in bound form of an instruction manual containing all information applicable to this section of the Works. This manual is to be similar in design and content to those to be provided under other services.
The manual shall contain a comprehensive written description of the Works, outlining the operation of the systems and maintenance procedures.

1.2.1.4 “As Installed" Drawings

The Contractor shall arrange to keep on Site a full set of drawings showing the progress of the Works, which must be kept upto date.
The Contractor shall keep a record as the work proceeds of any work installed not in accordance with the drawings. On completion of the Works the Contractor shall supply three clear coloured prints of each applicable drawing, showing the exact position of all apparatus, pipe lines, services, control valves, switchgear, etc., together with diagrams, schedules, etc. to the Engineer-in-Charge's requirements and in addition one complete set of plastic negatives.
The word "AS INSTALLED DRAWINGS" shall be clearly indicated on all drawings adjacent to the title block.

1.2.2 WORK AND TIME SCHEDULE

The Contractor shall prepare a work and time schedule in a format as approved by the Engineer-in-Charge. The schedule shall be submitted to the Engineer-in-Charge within ten

days of the award of the Contract. It shall indicate the expected date of commencement and completion of each item of work. The chart shall also indicate the Scheduling of samples, shop drawings and approvals. In addition to this, the Contractor shall also furnish to the Engineer-in-Charge fortnightly progress reports indicating percentage completion of each item of work.

1.2.3 RATES

The rates quoted for any particular item by the Contractor shall be inclusive of the cost of material, erection, connection, testing, labour, supervision, tools, plant, transportation, excise duties and taxes, contingencies, breakage, wastage and all other sundries.

The rate shall also be inclusive of cutting holes, making chases in RCC and making good the same. No claim for extra would be entertained on this account.

1.2.4 PLUMBING DRAWINGS

The plumbing drawings issued from time to time to the Contractor are diagrammatic but shall be following as closely as actual construction work will permit. Any deviation from the drawings required to conform to the building construction shall be made by the Contractor at his own expenses. The architectural drawings shall take precedence over the services drawings as far as the Civil and other trades works are concerned.

DISCREPANCY IN DRAWINGS

Should there be any discrepancy due to in-complete description, ambiguity or omission in the drawings and other documents relating to this Contract found by the Contractor either before starting the work or during execution or after completion, the same shall be immediately brought to the attention of the Engineer-in-Charge and his decision would be final and binding on the Contractor.

1.2.5 MATERIALS

All materials to be supplied by the Contractor shall be new. All packed items shall arrive at site in original packing only. Any items found defective or damaged shall be replaced by the Contractor at his own expenses. The Contractor shall get the `seal` of containers opened from Engineer-in-Charge and maintain a record jointly signed by him and Engineer-in-Charge. No empty containers shall be removed from the site till completion of work or without the written approval of Project in Charge.

STORAGE OF MATERIALS

All the materials brought at site shall be stored and stacked in a proper manner. The materials requiring protection from the Sun and rain shall be kept inside the temporary structures to be erected at site by the Contractor. The Contractor shall also follow the Manufacturers' instructions for storing and stacking the materials.
The storage facilities are to be created by the Contractor at his own expenses.

1.2.6 INSTRUMENTS FOR MEASUREMENT AND TESTING

The Contractor shall provide, free of cost, all equipments, instruments, labour and all other allied assistance required by the Engineer-in-Charge or their representatives for measurement and testing of the works.

1.2.7 CO-ORDINATION WITH OTHER TRADES

The Contractor shall be responsible for coordinating this work with works of other trades sufficiently ahead of time to avoid unnecessary hold ups. Hangers, sleeves, recesses etc. shall be left in time as the work proceeds.

1.2.8 UP-KEEP OF THE SITE

It shall be the responsibility of the Contractor to clear away, from time to time, all debris and excess material generated by the activities of his workers.

1.2.9 PROTECTION

All work shall be adequately protected, to the satisfaction of the Engineer-in-Charge, so that the whole work is free from the damage throughout the period of construction upto the time of handing over.

Special care must be taken to prevent damage and scratching of all fittings and fixtures. Tool marks on exposed fixtures shall not be accepted. Protective paper on fixtures shall be removed with hot water only at the final completion of the work.

Before handing over the work, the Contractor shall clean all elements of the complete installation, remove plasters, splashes, stickers, rust stains and all other foreign matter and leave every part in acceptable condition and ready for use to the satisfaction of the Engineer-in-Charge.

2. SANITARY INSTALLATION

The work shall be carried out as per CPWD specifications, Vol. -2, chapter-17. However, where CPWD specifications are not available, the work shall be carried out with prior approval of Engineer-in-Charge.

All Sanitary Fixtures and Fittings shall be low flow fixtures and fittings with necessary accessories/ cartridges for maintaining/ achieving low flow. Nothing extra shall be payable to the contractor on this account.

3. WATER SUPPLY

The work shall be carried out as per CPWD specifications, Vol. -2, chapter-18. However, where CPWD specifications are not available, the work shall be carried out with prior approval of Engineer-in-Charge.

3.1.1 INSULATION OF HOT WATER PIPES

Thermal conductivity of material shall not exceed 0.038 W/m_oK at an average temperature of 40^0C. The material should have a density in the range of 30 +/- 5 kgs/cu. m. The water vapour resistance factor should be higher than 5300. Insulation Material shall not contain harmful CFC"s. Insulation material have very low smoke index and non-existence of poisonous gases. The installation shall be as per manufacturer's specifications and direction of Engineer-in-Charge.

4. DRAINAGE SYSTEM

The work shall be carried out as per CPWD specifications, Vol. -2, chapter-19. However, where CPWD specifications are not available, the work shall be carried out with prior approval of Engineer-in-Charge.

4.1.1 PP/PE INSPECTION CHAMBERS

The physical and chemical properties of the material shall conform to relevant IS standards and manufacturer's specifications

The installation of the chambers and related accessories shall be carried out as per relevant approved drawings, description of the relevant SOR item, manufacturer's specifications and direction of Engineer-in-charge. Contractor shall submit Installation procedure to Engineer-In-Charge for approval before installation.

4.2 STATUTORY REGULATIONS AND APPROVALS

All external development works comprising sewerage & drainage systems shall be carried out only by those Contractors who are licensed by the concerned local authorities to execute this type of work.

It shall be the responsibility of the Contractor to comply with the regulations as laid down by the local authorities. The Contractor shall also be responsible for obtaining all the statutory approvals/ certificates for the work from the concerned Departments and these certificates shall be handed over to the Owner at the completion.

It shall also be the responsibility of the Contractor to get the sewerage & drainage connections from the concerned authorities. However, the Owner will bear all the statutory expenditures.

ELECTRICAL WORKS

1. GENERAL

1.1 SCOPE OF WORKS

The scope of work under the sub head 'Internal Electrical Works' includes the following:

(a) Wiring for light & Fan points.
(b) Wiring for 6A LP socket outlets.
(c) Wiring for 16A & 20A Power socket outlets.
(d) L.T. Cables and Sub main wiring.
(e) Rising Mains and Bus Duct.
(f) M.V. panels and Distribution Boards.
(g) Supply and Installation of Light fittings, fans & fixtures.
(h) Earthing/Lightening Arrestor
(i) Wiring for Telephone points
(j) Wiring for Networking /LAN points.
(k) Automatic Fire Detection and alarm system

The contractor shall include for the supply (unless specified otherwise), delivery, installation, connection, commissioning and testing of all materials and equipment to provide a complete electrical system.

1.2 STANDARDS AND CODES OF PRACTICE

The electrical Installation work shall be carried out in accordance with Indian Standard Code of Practice. It shall also be in conformity with the current Indian Electricity rules and regulations and requirements of the Local Electricity Supply Authority and Fire Insurance regulations so far as these become applicable to the installation. Electrical work in general shall be carried out as per following CPWD Specifications.

(a) General Specifications for Electrical Works (Part-I) Internal Work - 2013
(b) General Specifications for Electrical Works (Part-II) External Work - 1995
(c) General Specifications for Electrical Works (Part-III-LITS & Escalators) - 2003
(d) General Specifications for Electrical Works Part IV Sub Station – 2013
(e) General Specifications for Electrical Works Part VII D.G. Sets - 2013
(f) General Specifications for Electrical Works Part VIII Gas Based Fire Extinguishing System - 2013
(g) General Specifications for Heating, Ventilation & Air-Conditioning (HVAC) – 2004

The work shall be carried out as per the enclosed Specifications of Work and the construction drawings to be issued from time to time. These specifications shall be read in conjunction with relevant Codes of Practice and Standards as issued by BIS (all with the latest amendments) and with 16th edition of wiring regulation of I.E.E.

Wherever these specifications calls for a higher standard of material and or workmanship than those required by any of the above mentions regulations and specification then the specification here under shall take.

1.3 I.E. RULES COMPLIANCE

The installations and equipment supplied shall comply in all respects with the Indian Electricity Act and the Indian Electricity Rules (1956) amended as on date.

1.4 ELECTRICAL DRAWINGS

The electrical drawings issued from time to time to the Contractor are diagrammatic but shall be followed as closely as actual construction and work will permit. Any deviation from the drawings required to conform to the building construction shall be made by the Contractor at his own expenses. The architectural drawings shall take precedence over the services drawings as far as the Civil and other trade works are concerned.

DISCREPANCY IN DRAWINGS

Should there be any discrepancy due to in-complete description, ambiguity or omission in the drawings and other documents relating to this Contract found by the Contractor either before starting the work or during execution or after completion, the same shall be immediately brought to the attention of the Engineer-in-Charge and his decision would be final and binding on the Contractor.

1.5 INSTRUMENTS FOR MEASUREMENT AND TESTING

The Contractor shall provide, free of cost, all equipments, instruments, labour and all other allied assistance required by the Engineer-in-Charge for measurement and testing of the works.

1.6 CO-ORDINATION WITH OTHER TRADES

The Contractor shall be responsible for coordinating this work with works of other trades sufficiently ahead of time to avoid unnecessary hold ups. Hangers, sleeves, recesses etc. shall be left in time as the work proceeds.

1.7 PROTECTION

All work shall be adequately protected, to the satisfaction of the Engineer-in-Charge, so that the whole work is free from the damage throughout the period of construction upto the time of handing over.

Special care must be taken to prevent damage and scratching of all fittings and fixtures. Tool marks on exposed fixtures shall not be accepted. Protective paper on fixtures shall be removed with hot water only at the final completion of the work.

Before handing over the work, the Contractor shall clean all elements of the complete installation, remove plasters, splashes, stickers, rust stains and all other foreign matter and leave every part in acceptable condition and ready for use to the satisfaction of the Engineer-in-Charge.

1.8 SAFETY PRECAUTIONS

The Contractor shall take all reasonable safety precautions during construction and testing of the works. Particular attention shall be paid to the following:

a) Precautions to the Engineer's approval shall be taken to prevent any conductor or apparatus becoming accidentally or inadvertently charged when persons are working thereon.

b) Prior to the electrical installation (or part thereof being contractor shall ensure that all main switches on equipment in his supply are padlocked off, so that un-commissioned or incomplete circuits cannot be used without the Engineer's consent.

During testing and commissioning or at any other time, when live conductors may be temporarily exposed (e.g. control panel doors open) the Contractor shall provide danger boards and warning signs to the approval of the Engineer to prevent any possibility of

accidental electric shock.

1.9 'AS-FITTED' DRAWINGS

The Contractor shall submit, after the completion of the work, one set of originals and two sets of prints of the 'As-Fitted' drawings, giving the following information.

(a) Position of all light, fan and other outlets, MDBs & SDBs.
(b) Conduit layout.
(c) Single line diagram for internal works.
(d) External lighting schemes, cable route etc.

1.10 OPERATION & MAINTENANCE MANUALS

The Contractor shall hand over to the Owner all operation and maintenance manuals of the plant and equipment supplied and installed by him. Only manufactures catalogues wiring diagrams and installation drawings, relevant to particular items of equipment concerned shall be submitted. General catalogues will not be accepted.

2. L. T. PANELS

2.1 All ACB shall be with Ics as 100 % Icu and Icw=1Sec

2.2 All MCCB shall be provided with door interlocked rotary handle with ON/TRIP/OFF position indicator MCCB can be mounted vertically/horizontally.

2.3 All ACB's shall be with microprocessor based release. Protection functions for different type of releases as specification.

2.4 Spare contacts of ACB/Relays/Contactor etc. shall be wired up to terminal block.

2.5 All outgoing terminals (power and control) shall be brought up to cable alley. 10% extra terminals shall be provided for control ckt.

2.6 All CT, PT shall be cast resin type. All CTs should be clamped & name plate should be visible.

2.7 All meters shall be digital type & door mounted type.

2.8 All incomer meters of Main LT Panel, DG Panel shall be multi function meter EM6400 or Equivalent & should have all the electrical parameters like Current, Voltage, kW, kVAR, kWH, PF, Frequency etc with RS 485 port.

2.9 Panel shall be powder coated of approved colour shade with minimum 80 micron thickness.

2.10 Bus bar chamber shall be kept at top of all panels.

2.11 All bus bar shall be insulated with PVC Sleeve.

2.12 Internal wiring of panel shall be with size 2.5sqmm Flexible Copper Conductor for CT circuit and control wiring with 1.5 sq. mm.

2.13 All indicating light shall be LED type.

2.14 Each vertical section of floor mounted panel shall have independent base frame (75mm x 40mm) size made out of from 5mm sheet steel for main LT Panel & DG Panel.

2.15 All ACB shall be provided with ON/OFF/TRIP indicating lamps.

2.16 All the accessories shall be as per approved make list only.

2.17 Separate UPS Power Supply along with maintenance free battery suitable for operation of PLC for interlocking in main LT Panel/ DG Panel shall be supplied by the vendor. The back-up duration of battery shall be suitable for 30 minutes.

2.18 Separate DC Power supply power pack along with battery for the operation of trip ckt in main LT Panel & DG Panel shall be supplied by the vendor. The back - up duration of battery stand by shall be suitable for 30 minutes.

2.19 Control scheme to be submitted by vendor for approval.
2.20 Suitable Aluminium earth bus to be provided throughout the length of Switch boards.
2.21 Vendor should supply the CPRI test report:
a) For Short Circuit strength at 65 kA RMS for 1 Second.
b) For temperature rise test.
2.22 All shrouds shall be poly carbonated & all hardware shall be high tensile.
2.23 Doors & louvers shall be covered with gaskets to obtain totally enclosed, dust & vermin proof enclosure having IP: 52 Protection rating.
2.24 Space heater shall be provided with thermostat with 6A MCB as back up protection in each feeder section of Main LT Panel/DG Panel.
2.25 All panels shall have provision to accommodate all cables from the bottom and top (Both).
2.26 GI hardware with zinc passivation shall be used in Assembly of Switch boards.
2.27 Vendor shall provide 9" diameter Exhaust fan in all incomers, bus-coupler & capacitor bank of DG & Main LT Panel.
2.28 An approval of GA/SLD/BOQ/Schematic drawings shall be taken for each panel before manufacturing.

3. AIR CIRCUIT BREAKERS

3.1 The ACB shall conform to the requirements of IEC 60947-2 / IS 13947-2 and shall be type tested & certified for compliance to standards from–CPRI, ASTA /any accredited international lab. The circuit breaker shall be suitable for 415 V + 10%, 50 Hz supply system. Air Circuit Breakers shall be with moulded housing flush front, draw out type and shall be provided with a trip free manual operating mechanism or as indicated in drawings and bill of quantities with mechanical "ON" "OFF" “TRIP” indications.
3.2 The ACB shall be 3/ 4 pole with modular construction, draw out, manually or electrically operated version as specified. The circuit breakers shall be for continuous rating and service short Circuit Breaking capacity (Ics) shall be as specified on the single line diagram and should be equal to the Ultimate breaking capacity(Icu) and short circuit withstand values (Icw) for 1 sec. Short circuit withstand values (Icw) for 3 sec has to be minimum 50KA.
3.3 Main LT Panel : Icu=Ics=Icw = 65KA for 1Sec.
3.4 Circuit breakers shall be designed to ‘close’ and `trip' without opening the circuit breaker compartment door. The operating handle and the mechanical trip push button shall be at the front of the breakers panel. Inspection of main contacts should be possible without using any tools. The ACB shall be provided with a door interlock. i.e. door should not open when circuit breaker is closed and breaker should not be closed when door is open.
3.5 The ACB shall have double insulation (Class-II) with moving and fixed contacts totally enclosed for enhanced safety and in accessibility to live parts. All electrical closing breaker shall be with electrical motor wound stored energy spring closing mechanism with mechanical indicator to provide ON/OFF status of the ACB.
3.6 The auxiliary contacts blocks shall be so located as to be accessible from the front. The auxiliary contacts in the trip circuits shall close before the main contacts have closed. All other contacts shall close simultaneously with the main contacts. The auxiliary contacts in the trip circuits shall open after the main contacts open. Minimum 3 NO and 3 NC auxiliary contacts shall be provided on each breaker. Rated insulation voltage shall be 1000 volts AC. Desired Watt Loss/Per Pole Data should be as per attached sheet.

ACB Rating (Draw-out type)	Max. Power Consumption (watts)/Per Pole
800/1000A	40
1250A	60
1600A	77
2000A	100
2500A	113
3200A	143
4000A	240

3.7 Cradle

3.7.1 The cradle shall be so designed and constructed as to permit smooth withdrawal and insertion of the breaker into it. The movements shall be free from jerks, easy to operate and shall be on steel balls/ rollers and not on flat surfaces.

3.7.2 There shall be 4 distinct and separate position of the circuit breaker on the cradle. Racking Interlock in Connected/ Test/ Disconnected Position.

3.7.3 Service Position: Main Isolating contacts and control contacts of the breaker are engaged.

3.7.4 Test Position: Main Isolating contacts are isolated but control contacts are still engaged.

3.7.5 Isolated Position: Both main isolating and control contacts are isolated.

3.7.6 There shall be provision for locking the breaker in any or all of the first three positions.

3.7.7 The following safety features shall be incorporated:

3.7.8 Withdrawal or engagement of Circuit breaker shall not be possible unless it is in open condition. Operation of Circuit breaker shall not be possible unless it is fully in service, test or drawn out position. All modules shall be provided with safety shutters operated automatically by movement of the carriage to cover exposed live parts when the module is withdrawn. All Switchgear module front covers shall have provision for locking. Switchgear operating handles shall be provided with arrangement for locking in 'OFF' position.

3.8 Protections

3.8.1 The breaker should be equipped with micro-controller based release to offer accurate and versatile protection with complete flexibility and shall offer complete over current protection to the electrical system in the following four zones:

- Long time protection with intentional time delay
- Short time protection with intentional delay
- Instantaneous protection option for "Off"
- Ground fault protection with time delay

The protection release shall have following features and settings:

True RMS Sensing

The release shall sample the current at the rate of 16 times per cycle to monitor the actual load current waveform flowing in the system and shall monitor the true RMS value of the load current. It shall take into account the effect of harmonics also.

Thermal Memory

When the breaker shall re close after tripping on overload, then the thermal stresses caused by the overload if not dissipated completely, shall get stored in the memory of the release and this thermal memory shall ensure reduced tripping time in case of subsequent

overloads. Realistic Hot/Cold curves shall take into account the integrated heating effects to offer closer protection to the system.

Trip Indication

Individual fault indication for each type of fault should be provided by LEDs for faster fault diagnosis.

The release shall meet the EMI / EMC requirements.

The setting range of release shall be generally as follows:

- SETTING RANGE OF RELEASE
- Type of Protection
- PICK-UP CURRENT TIME DELAY
- Long Time 0.5 to 1.0 times In
- Steps of 0.05
- Operating Limit : 1.05 to 1.20 times Ir
- 12 to 150 sec at 2 Iu
- Short Time 1.5 to 10 times Ir
- Tolerance : ±15%
- 50 ms to 600 ms
- Tolerance : ±20%
- Instantaneous 2 to 15 times In With OFF option
- Pre Alarm Current 0.7-1.0Iu
- (Optional for critical feeders)

The release should provide display of actual % age loading at any instant in absolute value and in bar graph. Release if with Display should be able to capture short circuit current on which ACB has tripped. The last ten trips shall be stored in memory with the date & time stamping along with type of fault.

Protection

- The ACB control unit shall offer the following protection functions as standard:
- Long-time (LT) protection with an adjustable current setting and time delay;
- Short-time (ST) protection with an adjustable pick-up and time delay;
- Instantaneous (INST) protection with an adjustable pick-up and an OFF Position.
- Earth-fault protection with an adjustable pick-up and time delay shall be provided if indicated on the appended single-line diagram.

3.8.2 Safety Features

The safety shutter shall prevent inadvertent contact with isolating contacts when breaker is withdrawn from the Cradle. It shall not be possible to interchange two circuit breakers of two different thermal ratings. There shall be provision of positive earth connection between fixed and moving portion of the ACB either thru connector plug or sliding solid earth mechanism. Earthing bolts shall be provided on the cradle or body of fixed ACB. The incoming panel accommodating ACB shall be provided with indicating lamps for ON-OFF positions, digital voltmeter and ammeter of size not less than 96 mm x 96 mm, selector switches, MCB for protection circuit and measuring instrument circuits. It shall be possible to bolt the draw out frame not only in connected position but also in TEST and DISCONNECTED position to prevent dislocation due to vibration and shocks.

4. MOULDED CASE CIRCUIT BREAKERS

4.1 GENERAL

Moulded case circuit breakers shall be incorporated in the Main Distribution Board and Sub Distribution Board wherever specified. MCCB's breaking shall be suitable either for single phase AC 230 volts or three phase 415 volts AC at 50 Hz. MCCB shall have class-II front face with no live parts accessible to the user.

The MCCB shall be suitable for isolation as per IS/IEC with clear ON/OFF indicator. The Circuit breaker shall comply with IEC60 947-2 and IS 13947 part 2. The MCCB shall be suitable for isolation as defined by IEC60947-2.

The breaking capacity performance certificate shall be available for category A to the above mentioned standards along with disconnection function requirements. The test shall be carried out under the breaking performance during operation (Ics) equal to 100 % of the ultimate breaking capacity (Icu), with following minimum services Breaking capacity
it breakers shall have a rated operational voltage of 690V AC. The rated insulation voltage shall be 690V.

Thermal requirements: MCCB shall have minimum breaking capacity of 36KA.
All circuit overload release adjustment can be done from a single point. MCCB cover needs not to be opened for doing such adjustment.
Electrical endurance of MCCBs at full load shall be of as follows.

- 125A – Min. 35000 operations
- For above than 125 A and upto 250A – Min. 12000 operations.
- For above than 250 A and upto 630 A – Min. 4000 Amp.

All MCCB's shall have spreaders and phase barriers on each terminal. The Breaker shall be maintenance free and fully tropicalized.

4.2 CONSTRUCTIONS

The MCCB cover and case shall be made of high strength heat treatment and flame retardant thermo setting insulating material. Operating handle shall be quick make/ quick break, trip-free type. The operating handle shall have suitable "ON" "OFF" and "TRIPPED" indicators. Three phase MCCBS shall have common operating handle for simultaneous operation and tripping of all the three phases. MCCB's shall have frame sizes as under;

- 100-250A – First Frame
- 400-630A – Second Frame

All Accessories shall be snap fitted type and common for entire range i.e upto 630A. Tripping unit shall be of thermal magnetic or Microprocessor type provided in each pole and connected by a common trip bar such that tripping of any one pole operates all three poles to open simultaneously. Thermal magnetic or microprocessor tripping device shall have IDMT characteristics for sustained over loads and short circuits. MCCB shall confirm to RoHS regulated substances and compatible values to recycle at the end of product life. Contacts trips shall be made of suitable are resistant, sintered alloy for long electrical life. Terminals shall be of liberal design with adequate clearance.

4.3 Protections requirements

MCCBs shall comprise a device, designed to trip the circuit-breaker in the event of high-value short-circuit currents. This device shall be independent of the thermal-magnetic or electronic trip unit. The breaking will be carried out in less than 10ms for short-circuit currents above 20In. MCCBs with ratings up to 250A shall be Thermal Magnetic type. 400A and onwards shall be with Microprocessor trip units.

5. FIRE DETECTION & ALARM SYSTEM

5.1 General

Fire detection and alarm system consists of microprocessor based Intelligent addressable fire alarm panel, intelligent addressable detectors, intelligent addressable manual call points, intelligent addressable input and output modules, Intelligent Addressable electronic hooters, response and floor indicator, repeater panels. All the components and panels shall be of one make. The System offered should be complete in all respect including supply of equipments, conduiting, wiring etc. and shall meet the requirement of applicable standards.

The Scope of work covers provision of addressable fire alarm system in RCB 4th wing and ATPC Block which shall be connected to the main Fire alarm Panel of the Fire alarm system already provided for the Institutes building in Phase –I. The contractor should visit the site to see details of the existing system and ensure that the System being offered is compatible to already Installed system.

In the event of a fire alarm, but not in a fault condition, the following action shall be performed automatically.

The system Alarm LED on the main fire alarm control panel shall flash.

- Hooters in the control panel and in plant shall be sounded.
- Air Handling Units on affected floors shall automatically be switched off And simultaneously respective fire dampers shall also be closed.

The panel shall have all necessary provisions for interfacing with BMS, smoke evacuation system, Air handling units, fire fighting equipment, elevators, access control system, and other third party systems.

5.2 Fire Alarm Panel

a) Maximum system availability will be realized by decentralizing the system intelligence whereby the detection and evaluation task is performed by the detector. The FAP will verify and process the detectors output signals in conjunction with the pre-defined used data, e.g. display the event, perform pre-defined control, signal tasks and respond to manual commands entered by the system operator.

b) The FAP will fully comply with the requirements of the standard EN 54/ UL/FM/VdS/BS/LPCB.

c) A modular assembly concept will allow the FAP to be split into number of units. In order to economize on the field wiring installation for the detection and control devices, these sub units will be installed at the most suitable location with a data link connection to a common operation terminal. All operational and technical

requirements are as detailed herein for CPU/ Master control unit's included in the FAP.

d) The FAP will be capable of operating conventional/collective, analog and interactive detector lines. A combination of these circuits in the same FAP, for the initial installation or for any future system expansions, will be possible.
e) The FAP will be capable of communication with remote operating terminals. Each terminal will be pre-programmable to operate on the whole of the detection system or only a certain section of it.
f) In addition to the fire detection devices, it will be possible for the FAP to evaluate and operate signals from the following devices by using appropriate modules:
    a. Sprinkler flow switches.
    b. Stand-alone gas detection systems
    c. Stand-alone automatic extinguishing systems.
    d. Information form technical plant equipment.
g) It will be possible to freely locate and group detectors according to the geographical and architectural requirements of the user premises. This will allow maximum user orientation in the case of an alarm event.
h) To optimize the response characteristics of automatic detectors, it will be possible to monitor these and to download different algorithms sets.
i) An audible and visual application-warning signal will be activated per detector, if the response characteristic of the detector does not correspond with the environmental conditions it is operating in.
j) The panel shall provide a minimum ¼" VGA Graphic display or minimum160 character alpha numeric LC Display.

5.3 Detector Line Communication

a) The FAP will be able to process in-coming signals from Intelligent Analog addressable devices, such as detectors, manual call points, input and output modules etc. via two wire line.
b) The loop capacity will allow the handling of upto 200 Analog addressable devices.
c) A drift indication will permit, automatically or upon request, status information of an automatic smoke detector.
d) An address will be freely assigned to all the devices that have been connected to an Analog detector line.
e) The Analog addressable detector line will at least process the following verified signal condition between the detection devices and FAP.

- Adjusting the detectors sensitivity level.
- Changing the detectors response characteristics.
- Multi-zone evaluation.

f) The system will be able to identify the type of detector installed in each base and consequently, verify this information during normal operation and service.

5.4 Hardware Configuration/ Mechanical Design

a) The FAP will consist entirely of standard modular printed circuit board assemblies to facilitate removal, easy maintenance and modular system expansion.

g) Provide a 32 bit central CPU module for controlling an operating terminal and an internal bus onto which detection lines, various input/output modules, bell and remote alarm circuits can be connected.
h) Provide an ac/de converter module with charging unit.
i) Provide line/Loop modules to operate Analog addressable detectors/devices.
j) Provide a battery capacity of minimum 48 hours emergency supply in standby mode and 30 minutes in an alarm condition.
k) Processing capacity:
l) The FAP will be able to handle the following capacities.
m) 800 data points (detection devices)
n) 4 Analog addressable type detecting circuits or
o) 800 programmable control outputs.
p) 800 programmable monitored inputs.
q) Capacity to operate 16 Repeater Panels.
r) The panel should with inbuilt interface for connecting Repeater panels and PC and no extra module should be required for that.
s) h) The panel should be network ready and no extra module should be required to network more than one Panel.
t) It should be possible to UPLOAD and DOWNLOAD the program to and from the panel.

5.5 Application Warning

The FAP will be capable of monitoring the frequent occurrence of warning signals released by an automatic detector. This will occur if the detection response behavior of the detector does not correspond to the environmental conditions the detector is operation in. An application warning will then be displayed by means of an audible and visual indication at the operating terminal.

Multi-Detector Logic

It will be possible to indicate an alarm signal at the operation terminal if two or more automatic detector, monitoring the same area, activates a warning signal.

Access Levels and Password

Operator access shall be granted via different access levels protected by the passwords.

History File

The FAP will save and display the date of at least 1000 system-operating events.
The historical data will be displayed at the operating terminal as follows:

- All messages listed in a chronological order.
- All test alarms.
- All test alarms from the same date.
- All faults listed in chronological order.
- All isolate off connect and normal conditions in chronological order.
- All information.
- All active control functions.

Repeater panel

The FAP will be designed such, that the Repeater panel serving as a Interface to be installed at a remote location.

Remote repeater panels for repeating all alarm status indication with LCD display shall be provided at the specified location and shall be VdS/EN/UL/NFPA/BS/LPCB approved.

The repeater panel shall have identical zoning and colour display for all alarms and shall fully correspond to those in the Main control panel.

The repeater panel shall be provided with warning buzzer, which shall activate when an alarm occurs in the fire control room and a push switch shall be provided for silencing the warning signal. Lamp test control switch shall also be provided in the panel.

The panel shall contain an integral backlit LCD display of minimum 160 characters. LCD display shall be viewable through the panel door.

The repeater panel enclosure shall be flush mounted and all electronics shall be contained in the enclosure. Access to the repeater panel switches shall be protected by key-switch/ passwords.

5.6 Systems Devices

Multi-Criteria Detectors (Combined Heat & Smoke)

The design of the smoke sensitive system shall guarantee a uniform response behaviour to all combustion products of smoke-forming flaming and smouldering fires.

The detection principle shall employ a multiple light pulse coincidence circuit for smoke sensor and thermistors for Heat sensing element.

The smoke detector shall conform to EN 54-7/9/UL/VdS/NFPA/BS5839.

The detector shall be controlled by a custom designed application specific integrated circuit (custom – ASIC) in order to guarantee a maximum reliability of the electronic circuit.

The detector shall be able to transmit up to two (2) alarm-level information to the control unit for evaluation according to the customer specific programming of the control unit.

The electronic circuits of the detector shall be internally supervised and be able to signal up to two (2) different status information to the control unit.

The detector shall be able signal deviations from the standard sensitivity to the control unit.

The detector shall be equipped with a response indicator and shall have the possibility to drive remote indicators in order to signal alarm conditions.

The LED on the detector shall blink under normal condition to indicate healthy communication.

The detector shall be able to isolate short circuits on the detector-line bus in order not to disrupt the proper function of the rest of the detectors connected on the detection-line bus.

Each detector shall have in-built isolator or a separate isolator base/ module.

Reversed polarity of faulty wiring shall not damage the detector.

The detector shall be individually identifiable from the control unit by geographical location in the system.

The detector shall support soft addressing only and no manual mode of setting the address of the detector shall be allowed.

All electronic circuits shall be in the detector head, thus not requiring any active electronic circuits in the base.

The detector shall connect to the local control unit via a fully supervised two-wire circuit (Class A and Class B wiring). A twin twisted shielded type of cable shall be employed.

The detector shall have a digital communication with the control unit on the basis of error recognizing protocol with multiple transmission of information.
The system shall be able to signal a priority alarm message no less than two (2) seconds after the detector has recognized this situation.
The optical chamber shall be disposable type. Cleaning or replacing the detector's chamber will allow the detector to reset its digital parameters as well.
A built in barrier shall prevent the entry of insects into the sensor.
The detector shall be designed for easy dismantling for cleaning at site and no factory cleaning shall be required.
The detector shall be inserted into a base without the need of tools.
The base of the detector shall be interchangeable with other Multi-Criteria detectors.
The base shall include all necessary terminals to connect installation wiring.
The base shall allow the removal of the detector without disconnecting the installation wiring.
The detector shall be inserted into or remove from the base by a simple push-twist mechanism with appropriate tools up to 7m above floor level.
The heat element shall employ the thermistor principle for heat.
The Multi-criteria detector shall support at least 3 smoke modes and 3 heat modes. It should be possible to select any combination of above three modes.

Manual Call Point, Analog Addressable

The alarm shall be activated by breaking the glass without the need of an additional instrument (e.g. hammer).
The glass plate shall be designed in away to prevent injuries when struck by the operator.
The manual call point shall be controlled by a custom designed application specific integrated circuit (custom – ASIC) in order to guarantee a maximum reliability of the electronic circuit.
The call point shall have a digital communication with the control unit on the basis of error recognizing protocol with multiple transmission of information.
The call point shall have a built in LED, which will be illuminated upon actuation of the manual call point.
It shall be possible to test the manual call point without destroying the covering window.
Unauthorized removal of the call point's cover must release an alarm.
The manual call point shall comply with standard EN 54-11 or BS 5839-2.
The call point shall fit on a surface-mounting box, which contains at least three terminals for the connection of the filed wiring.
It shall be possible to mount the part containing the sensitive electronic circuit separately just before commissioning, thus preventing any possible damage due to inappropriate installation work.

Monitor Input Module, Analog Addressable

The analogue addressable input module shall be designed to be capable of being connected along with other analogue addressable elements on a loop. The devices shall be interfacing a stub line for simple dry contacts (switch) to the analogue addressable loop.
The monitored input may be supplied either as built-in each multi-criteria detector or as a separate monitored module.
The stub line shall be supervised with an end-of-line resistor.

Programmable normally open or normally closed contracts shall be usable.
The analogue addressable input module shall receive all its power requirements through the analogue addressable detection loop.

Control Output Module, Analog Addressable

The analogue addressable output module shall be designed to be placed somewhere along the other analogue addressable devices on a detector loop. The device shall provide an interface as a control of the fire alarm panel to equipment such as fire doors, smoke vents, smoke curtains, AHUs, Pressurization fans, etc.
The module may be supplied either as built-in in the multi-criteria detector or as a separate module on the detection circuit.
The output control device should be controllable by any detector connected to the same fire detection control unit.
No additional power supply shall be required to activate the relay output.
The analogue addressable output module shall be equipped with to activate the device for testing and for assigning its address during commissioning.

Addressable Loop Sounder cum Strobe

The addressable loop sounder cum strobe should be able to draw its power from the same detection loop and no external power supply unit/ wiring shall be required to operate the sounder cum strobe.
No extra control module or any other module shall be used in order to make the sounder addressable.
The sounder shall be suitable for a maximum output of 84 dB(A) at 1 meter. The sounder should be with minimum 7 different tone setting and 3 volumes settings selectable from the Main Fire Alarm Panel or PC. The sounder may be an integral part of multi-criteria detector and Manual Call Points.

6. STREET LIGHTING

6.1 SCOPE

The specifications cover the supply, installation, testing and commissioning of the following items:

i) Street lighting poles complete with all accessories e.g. looping box, clamps MCBs and required hardwares etc.
ii) Street lighting fixtures complete with all accessories e.g. lamps, holders, choke, upto terminal box etc.
iii) Wiring of street light fixtures.
iv) Cable laying, earthing and inter connection. G.I. pipes for cable entry to looping box.
v) Foundation of poles and erection.
vi) All the items should be tested and installed as per the latest Indian standards specifications and all the sundry items such as clamps, bolts, nuts, racks, support miscellaneous wiring etc., required to make the installation complete shall be taken care while quoting the major items.

6.2 GALVANISED CONICAL POLES

Design: The Conical Poles shall be designed to withstand the maximum wind speed of 160 km / hr. The top loading i.e. area and the weight of fixtures are to be considered to calculate maximum deflection of the pole and the same shall meet the requirement of BS: 5649 /

BSEN 40.

Pole Shaft: The pole shaft shall have circular cross section and shall be continuously tapered with single longitudinal welding. There shall not be any circumferential welding. The welding of pole shaft shall be done by Submerged Arc Welding (SAW) process.

All conical pole shafts shall be provided with the rigid flange plate of suitable thickness with provision for fixing foundation bolts. This base plate shall be fillet welded to the pole shaft at two locations i.e. from inside and outside. The welding shall be done as per qualified MMAW process approved by Third Party Inspection agency.

Door opening: The conical poles shall have door of approximate 500 mm length at the elevation of 500 mm from the Base plate. The door shall be vandal resistance and shall be weather proof to ensure safety of inside connections. The door shall be flush with the exterior surface and shall have suitable locking arrangement. There shall also be suitable arrangement for the purpose of earthing.

The pole shall be adequately strengthened at the location of the door to compensate for the loss in section.

Material: Conical Poles shaft HT steel Conforming to grade S355JO, Base Plate Fe 410 conforming to IS 226 / IS 2062, Foundation Bolts EN 8 Gr. As per IS 1367

Welding: The welding shall be carried out confirming to approved procedures duly qualified by third party inspection agency. The welders shall also be qualified for welding the conical shafts.

Pole sections: The conical poles shall be in single section (upto 11 mtr). There shall not be any circumferential weld joint.

Galvanization: The poles shall be hot dip galvanised as per IS 2629 / IS 2633 / IS 4759 standards with minimum coating thickness of 65 micron. The galvanizing shall be done in single dipping.

Manufacturing: The manufacturing unit shall be ISO 9001: 2000 & ISO 14001

Pole Testing Facility: The manufacturing unit shall have in-house pole testing facility for validation of structural design data. The pole testing facility shall conform to BS EN 40-3-2-2000 part 3-2.

Fixing Type: The conical poles shall be bolted on a pre-cast foundation with a set of foundation bolts for greater rigidity.

6.3 ERECTION OF POLE

While loading, transporting, unloading and erecting the poles care shall be taken so that the poles do not get bent. Out of shape and where necessary such defects shall be rectified before the poles are erected in position. The poles shall be erected in plumb line and correct level as indicated in the drawing and to the satisfaction of the Engineer-in-charge. They shall be kept in this position with the help of manila ropes until the foundation are constructed (for a minimum period of 10 days) and the back filling is complete. Foundation shall be made with reinforced cement concrete (1:2:4) and not less than 200 mm thick all round. The pole base plate shall be fixed over 150 mm thick concrete bed. Foundation shall be continued upto 300 mm or more above ground level as per location of the pole to avoid ingress of water logging etc. The foundation shall be tapered suitably into a collar. The excavated portion shall be filled back with earth and consolidated. The cement concrete foundations shall be cured properly by covering the same with water soaked or moist gunny bags at least two weeks before loading the pole.

6.4 ERECTION OF LIGHT FIXTURES

Each light fixture shall be connected to the supply through MCB of a suitable rating mounted in the looping box. The fitting shall be fixed to the pole properly and securely.

6.5 WIRING OF LIGHT FIXTURES

The wiring of lighting fixtures from terminal block by means of 2.5 Sq.mm PVC insulated two core copper conductor through a suitable rated MCB and neutral. Cost of two core connecting cable from junction box to lighting fixture and earth wire complete with connections are included in the quoted rate.

6.6 CABLING WORKS

All cable installation work shall be done as per relevant clauses of section cable work.

6.7 TESTS

The following tests shall be carried out before handing over the installation, tests on all fittings and cables as per IS specification:

- Meggar test
- Continuity test
- Polarity test and phase sequence test

FIRE FIGHTING WORKS

1. GENERAL

1.1 SCOPE OF WORK

The scope of work under the sub head 'Fire Fighting Works' includes the following:

a) Installation of External and Internal Hydrant System and First Aid Hose Reels.
b) Installation of Automatic Sprinkler System
c) Installation of Fire Fighting Pumping system and associated pipe work
d) Obtaining approvals and NOC from local fire bodies.

The specifications for the supply, installation, testing and commissioning of the components and accessories of the Fire Fighting System, shall be in accordance with these Specifications. For items not included in these Specifications and the Special conditions installation shall be done in accordance with the latest IS Standard/ NFPA codes.

For items not covered by any of the above the installation shall be done as directed by the Construction Manager and as per sound engineering practices.

1.2 STATUTORY APPROVALS

Fire Fighting Installation shall be in conformity with the regulations of local Fire Department and TAC.

The Contractor shall be responsible for obtaining the approval of the Local Fire Department for the installation done under the scope of work. The work will not be considered as complete unless the N.O.C/clearance certificate from Chief Fire Officer is provided.

1.3 TECHNICAL SPECIFICATION

The work shall be carried out as per the enclosed Specifications of Work and the construction drawings to be issued from time to time. These specifications shall be read in conjunction with CPWD specifications 2002 (with up-to-date correction slips), National Building Code 2005, relevant Codes of Practice and Standards as issued by Bureau of Indian Standards (B.I.S. - all with the latest amendments) wherever applicable, Fire Protection Manual & Sprinkler Regulations of Tariff Advisory Committee (TAC) & NFPA (USA) Publications.

1.4 DRAWINGS AND DOCUMENTS

1.4.1 General

(a) The Drawings provided with the Specification shall be treated as confidential documents and must not be copied or loaned to any other party without the express permission of the Engineer-in-Charge.

(b) The Drawings are intended as a guide to the firms tendering and give approximate positions of pipes, conduits, cable runs and/or equipment only and in measuring from these drawings, the contractor must make due and proper allowance for all necessary diversions from the straight line, rises or falls as may be required for the proper execution of the works.
Detail drawings in all cases shall be worked to in preference to those of a more general nature and figured dimensions where indicated shall be followed in preference to scale.
Where necessary, the exact positions of plant and/or equipment will be decided by the issue of further drawings, but no claim for extra payment due to insufficient information on this scope will be entertained.
In any case of doubt as to the interpretation of either Drawings and/or Specification, the

Contractor must refer the matter to the Engineer-in-Charge prior to the submission of his Tender.

(c) It is to be clearly understood that this Tender is to be absolutely inclusive for the proper completion of the whole of the works specified to the true intent and meaning of the specification and/or Drawings and the description therein contained shall be read conjointly and together and no error, inconsistency, discrepancy in the Drawings and/or Specification will relieve the Contractor of his obligations to include for an hand-over the work in the true meaning and intent of the Specification and/or Drawings, complete in every respect.
Should any portion of the works which would reasonably and obviously be inferred as necessary for the installation as a whole not be expressly specified, the Contractor shall provide and execute such work as part of the Contract and shall not be entitled to any extra payment of that account.

(d) The Contract Drawings and such other drawings as may be furnished to the Contractor during the progress of the Works shall be considered as illustrating between the Drawings and the Specification; the Contractor shall execute the work in accordance with the decision of the Engineer-in-Charge. If modifications are necessary, the Contractor shall submit modifications to the Engineer-in-Charge for approval before such modifications are executed.

(e) All Drawings and Specification are the property of the Engineer-in-Charge.

(f) The Contractor will be required to give and obtain all necessary site and other particulars and to agree such details with the Engineer-in-Charge. The Contractor must also obtain details of any other Contractor's work affected by his work and shall work in close co-operation with all such firms or persons concerned.

(g) The Contractor shall be responsible for any damage caused to buildings and contents and works by reason of, arising out of, or incidental to, or in connection with the execution of any work in the Contract Documents.
The Contractor shall permit nothing to be done which may injure the stability of the Works, or existing buildings and no cutting through floors or walls will be allowed other than where required by the Drawings, without the sanction of the Engineer-in-Charge.

(h) The Contractor shall submit to the Engineer-in-Charge for approval, before the work is commenced, a copy of all working details and installation drawings and shall also supply sufficient copies for the use of the Owner/Civil Work Contractor etc.
These drawings must be submitted by the Contractor as soon as possible after the order is placed to give ample time for all parties concerned to study and comment thereon.

(i) The work described on any working drawings submitted shall be carefully checked by the Contractor for all clearance, field conditions, maintenance of architectural conditions and proper co-ordination with all trades on the job. To this end, the Contractor, during the construction drawing stage, shall ensure that he co-ordinates drawings of all other trades that might interferes with the proper installation of his work. No payment shall be made for any variations or alterations on site due to lack of knowledge of other trades. Any unresolved conflict between various trades shall be referred to the Engineer-in-Charge.
The equipment layout is to be detailed on the drawings, showing the exact method of installing and clearly illustrating components to be used in making all connections.

(j) Pipework drawings must be fully detailed, showing all pipework in double line and indicating the precise size of fittings, valves and equipment, position of hanger supports with reference numbers must be indicated and a large scale detail must be given, showing the type and method of installation of each type of hanger. A schedule is to be included on each drawing, showing details of the type of hanger fixings and references number for each type.
All general layout drawings shall be drawn 1/50 scale, unless agreed otherwise with the Engineer-in-Charge. Toilet piping layouts, details and hangers, cleanouts, methods of fixing of all fittings and fixtures including pipes, detailed cross sections of service ducts, etc., are to be drawn to 1/10 scale.

(k) The Contractor shall provide a detailed programme incorporating working drawing production

which can be read in conjunction with the building construction programme.

(l) The Contractor shall prepare schedules and drawings showing precise details of holes in concrete, block works etc., base frames or support required and the like. The schedules shall show in detail the builder's work required to be performed by all other trades for the mechanical and electrical installations. These drawings and schedules, in an approved form, must be submitted to Engineer-in-Charge for approval before any structural work requiring holes or other modifications is constructed.

(m) The Contractor shall submit all drawings as prescribed hereunder. All drawings shall be supplied in the form of a second negative and signed by a principal of the Contractor. After approval, the negative will be signed by the Engineer-in-Charge and returned to the Contractor. The Engineer-in-Charge will take as many prints from this negative as he requires for his own use.

Signed and approved drawings will not be departed from unless a signed variation or omission certificate is issued in writing by the Engineer-in-Charge. Drawings returned to the Contractor for alteration or amendment shall be re-submitted to the Engineer-in-Charge for approval.

Amended or altered drawings shall show the nature of the amendment or alteration in a revision block on the drawing, together with the revision number or letter and the date of the revision.

(n) Should the Contractor prove unable to produce satisfactory "Working Drawings" or be unable to produce drawings to conform to the progress of the work, the Engineer-in-Charge reserves the right to take whatever steps are necessary to have drawings undertaken by others and debit the Contractor's account.

Any decision taken by the Engineer-in-Charge to have working drawings produced elsewhere will not relieve the Contractor of his contractual obligations and the Contractor must provide to the Engineer-in-Charge all necessary details, physical dimensions, descriptive literature, etc., of all equipment to be incorporated on drawings within 10 days of a request from the Engineer-in-Charge.

1.4.2 Manufacturers' Data

- Manufacturers' performance data, certified factory drawings of apparatus, giving full information as to capacity, dimensions, materials and all information pertinent to the adequacy of the submitted equipment shall be submitted for approval.

  Manufacturer names, sizes, catalogue numbers and/or samples of all materials shall be submitted for approval.

  Submittals and working drawings should, as far as possible be complementary so that drawings and submittals can be cross checked.
- Order of equipment submitted for approval must be accompanied by relevant drawings, technical data, catalogues and samples, where data, certified drawings or other required information is not available until after orders have been placed, the Engineer-in-Charge will give provisional approval until all requested drawings and information have been supplied to the Engineer-in-Charge and approved by him. It is the Contractor's responsibility to ensure that all necessary information is supplied to the Engineer-in-Charge in accordance with the progress of the work.

1.4.3 Operating and Maintenance Manual

The Contractor shall furnish six copies in bound form of an instruction manual containing all information applicable to this section of the Works. This manual is to be similar in design and content to those to be provided under other services.

The manual shall contain a comprehensive written description of the Works, outlining the operation of the systems and maintenance procedures.

1.4.4 "As Installed " Drawings

The Contractor shall arrange to keep on Site a full set of drawings showing the progress of the Works, which must be kept upto date.

The Contractor shall keep a record as the work proceeds of any work installed not in accordance with the drawings. On completion of the Works the Contractor shall supply three clear coloured prints of each applicable drawing, showing the exact position of all apparatus, pipe lines, services, control valves, switchgear, etc., together with diagrams, schedules, etc. to the Engineer-in-Charge's requirements and in addition one complete set of plastic negatives.

The word "AS INSTALLED DRAWINGS" shall be clearly indicated on all drawings adjacent to the title block.

1.5 WORK AND TIME SCHEDULE

The Contractor shall prepare a work and time schedule in a format as approved by Engineer-in-Charge. The schedule shall be submitted to Engineer-in-Charge within ten days of the award of the Contract. It shall indicate the expected date of commencement and completion of each item of work. The chart shall also indicate the Scheduling of samples, shop drawings and approvals. In addition to this, the Contractor shall also furnish to Engineer-in-Charge fortnightly progress reports indicating percentage completion of each item of work.

1.6 RATES

The rates quoted for any particular item by the contractor shall be inclusive of the cost of material, erection, connection, testing, labour, supervision, tools, plant, transportation, excise duties and taxes, contingencies, breakage, wastage and all other sundries for all levels.

The rate shall also be inclusive of cutting holes, making chases in RCC/brick work, inserting sleeves and making good the same with two hours fire rated materials. No claim for extra would be entertained on this account.

1.7 STANDARD AND CODES OF PRACTICE

The work shall be carried out as per the enclosed Specifications of Work and the construction drawings to be issued from time to time. These specifications shall be read in conjunction with CPWD specifications 2002 (with up-to-date correction slips), National Building Code 2005, relevant Codes of Practice and Standards as issued by Bureau of Indian Standards (B.I.S. - all with the latest amendments) wherever applicable, Fire Protection Manual & Sprinkler Regulations of Tariff Advisory Committee (TAC) & NFPA (USA) Publications.

A) General

SP : 6 (1)	Structural steel sections
IS : 27	Pig lead
IS : 325	Three phase induction motors
IS : 554	Dimensions for pipe threads where pressure tight joints are required on the threads.
IS : 694	PVC insulated cables for working voltages up to and including 1100 V.
IS : 779	Specification for water meters (domestic type)
IS : 782	Specification for caulking lead
IS : 800	Code of Practice for general construction in steel
IS : 1068	Electroplated coatings of nickel plus chromium and copper plus nickel plus chromium

IS : 1172	Code of basic requirements for water supply drainage and sanitation
IS : 1367 (Part- 1)	Technical supply conditions for threaded steel fasteners: Part 1 introduction and general information.
IS : 1367 (Part- 2)	Technical supply conditions for threaded steel fasteners: Part 2 product grades and tolerances.
IS : 1554 (Part- 1)	PVC insulated (heavy duty) electric cables: Part 1 for working voltages up to and including 1100V.
IS : 1554 (Part- 2)	PVC insulated (heavy duty) electric cables: Part 2 for working voltages from 3.3 kV up to and including 11 kV.
IS : 1726	Specification for cast iron manhole covers and frames
IS : 1742	Code of practice for building drainage.
IS : 2064	Selection, installation and maintenance of sanitary appliances – Code of practice.
IS : 2065	Code of practice for water supply in buildings.
IS : 2104	Specification for water meter boxes (domestic type)
IS : 2373	Specification for water meters (bulk type)
IS : 2379	Colour code for identification of pipe lines
IS : 2527	Code of practice for fixing rainwater gutters and down pipes for roof drainage.
IS : 2629	Recommended practice for hot dip galvanizing on iron and steel
IS : 3114	Code of practice for laying of cast iron pipes
IS : 4111 (Part 1)	Code of practice for ancillary structures in sewerage system : Part 1 manholes
IS : 4127	Code of practice for laying glazed stoneware pipes.
IS : 4853	Recommended practice for radiographic inspection of fusion welded butt joints in steel pipes
IS : 5329	Code of practice for sanitary pipe work above ground for buildings.
IS : 5455	Cast iron steps for manholes.
IS : 6159	Recommended practice for design and fabrication of material prior to galvanizing
IS : 7558	Code of practice for domestic hot water installations
IS : 8321	Glossary of terms applicable to plumbing work
IS : 9668	Code of practice for provision and maintenance of water supplies and fire fighting.
IS : 9842	Preformed fibrous pipe insulation
IS : 9912	Coal tar based coating materials and suitable primers for protecting iron and steel pipe lines.
IS : 10221	Code of practice for coating and wrapping of underground mild steel pipelines
IS : 10234	Recommendations for general pipeline welding.
IS : 10446	Glossary of terms relating to water supply and sanitation.
IS : 11149	Rubber Gaskets
IS : 11790	Code of practice for preparation of butt-welding ends for pipes, valves, flanges and fittings.
IS : 12183 (Part 1)	Code of practice for plumbing in multi-storeyed buildings : Part 1 Water supply
IS : 12251	Code of practice for drainage of building basements
IS : 5572	Code of practice for sanitary pipe work
IS : 6700	Specification for design, installation, testing and maintenance of services supplying water for domestic use within buildings and their cartilage.
IS : 8301	Code of practice for building drainage

BSEN : 274	Sanitary tapware, waste fittings for basins, bidets and baths. General technical specifications.

B) PIPES AND FITTINGS

IS : 458	Specification for precast concrete pipes (with and without reinforcement)
IS : 651	Salt glazed stone-ware pipes and fittings
IS : 1239 (Part 1)	Mild steel tubes, tubular and other wrought steel fittings Part 1 Mild Steel tubes
IS : 1239 (Part 2)	Mild steel tubes, tubular and other wrought steel fittings : Part 2 Mild steel tubular and other wrought steel pipe fittings.
IS : 1536	Centrifugally cast (spun) iron pressure pipes for water, gas and sewage
IS : 1537	Vertically cast iron pressure pipes for water, gas and sewage.
IS : 1538	Cast iron fittings for pressure pipes for water, gas and sewage
IS : 1729	Sand cast iron spigot and socket soil, waste and ventilating pipes, fittings and accessories
IS : 1879	Malleable cast iron pipe fittings
IS : 1978	Line pipe
IS : 1979	High test line pipe
IS : 2501	Copper tubes for general engineering purposes
IS : 2643 (Part 1)	Dimensions for pipe threads for fastening purposes: Part 1 Basic profile and dimensions.
IS : 2643 (Part 2)	Dimensions for pipe threads for fastening purposes: Part 2 Tolerances
IS : 2643 (Part 3)	Dimensions for pipe threads for fastening purposes: Part 3 Limits of sizes.
IS : 3468	Pipe nuts
IS : 3589	Seamless or electrically welded steel pipes for water, gas and sewage (168.3 mm to 2032 mm outside diameter)
IS : 3989	Centrifugally cast (spun) iron spigot and socket soil, waste and ventilating pipes, fittings and accessories.
IS : 4346	Specifications for washers for use with fittings for water services.
IS : 4711	Methods for sampling steel pipes, tubes and fittings
IS : 6392	Steel pipe flanges
IS : 6418	Cast iron and malleable cast iron flanges for general engineering purposes.
IS : 7181	Specification for horizontally cast iron double flanged pipe for water, gas and sewage.

C) VALVES

IS : 778	Specification for copper alloy gate, globe and check valves for water works purposes
IS : 14846	Specification for sluice valves for water works purposes (50 mm to 1200 mm size)
IS : 1703	Specification copper alloy float valves (horizontal plunger type) for water supply fittings
IS : 2906	Specification for sluice valves for water works purposes (350 mm to 1200 mm size)
IS : 3950	Specification for surface boxes for sluice valves
IS : 5312 (Part 1)	Specification for swing check type reflux (non-return) valves : Part 1

	Single door pattern
IS : 5312 (Part 2)	Specification for swing check type reflux (non-return) valves : Part 2 Multi door pattern
IS : 12992 (Part 1)	Safety relief valves, spring loaded : Part 1 – Design
IS : 13095	Butterfly valves for general purposes.

D) FIRE FIGHTING EQUIPMENT

TAC	Tariff advisory committee fire protection manual Part I
TAC	Rules of Tariff Advisory Committee for Automatic Sprinkler system
NFPA : 12, 1993	Standards on Carbon Dioxide Extinguishing System
IS : 636	Non- percolating flexible fire fighting delivery hose
IS : 884	Specification for First Aid Hose Reel for fire fighting
IS : 901	Specification for first aid hose reel for fire fighting
IS : 902	Specification for couplings, double male and double female, instantaneous pattern for fire fighting
IS : 903	Suction hose coupling for fir fighting purposes
IS : 904	Specification for fire hose delivery couplings, branch pipe, nozzles and nozzle spanner
IS : 905	Specification for 2-way and 3-way suction collecting heads for fire fighting purposes
IS : 907	Specification for delivery breechings, dividing and collecting instantaneous pattern for fire fighting purposes
IS : 908	Specification for suction strainers, cylindrical type for fire fighting purposes.
IS : 909	Specification for underground fire hydrant, sluice valve type
IS : 910	Specification for combined key for hydrant, hydrant cover and lower valve.
IS : 15683	Specification for portable chemical foam fire extinguisher
IS : 1648	Code of practice for fire safety of building (general) : Fir fighting equipment and its maintenance.
IS : 15683	Specification for portable fire extinguishers dry powder (cartridge type)
IS : 2190	Selection installation and maintenance of first-aid fire extinguishers-Code of practice
IS : 2871	Specification for branch pipe, universal for fire fighting purposes.
IS : 15683	Specification for fire extinguishers, carbon dioxide type (portable and trolley mounted)
IS : 3844	Code of practice for installation and maintenance of internal fire hydrants and hose reel on premises
IS : 5290	Specification for landing valves
IS : 5714	Specification for hydrant, stand pipe for fire fighting
IS : 8090	Specification for coupling, branch pipe, nozzle, used in hose reel tubing for fire fighting
IS : 8423	Specification for controlled percolation type hose for fire fighting
IS : 10658	Specification for higher capacity dry powder fire extinguisher (trolley mounted)
IS : 11460	Code of practice for fire safety of libraries and archived buildings
IS : 13039	External hydrant system – provision and maintenance – Code of practice.
IS : 5514 (Parts 1 to 7)	Reciprocating internal combustion engines: performance.

E) WATER QUALITY TOLERANCE

IS : 3025 (Part 1 to 44)	Method of sampling and test (physical and chemical) for water and waste water
IS : 4764	Tolerance limits for sewage effluents discharged into inland surface waters
IS : 10500	Drinking water

F) PUMPS AND VESSELS

IS : 1520	Specification for horizontal centrifugal pumps for clear cold fresh water
IS : 2002	Steel plates for pressure vessels for intermediate and high temperature service including boilers
IS : 2825	Code for unfired pressure vessels
IS : 4682 (Part 1)	Code of practice for lining of vessels and equipment for chemical processes Part 1 : Rubber lining
IS : 5600	Specification for sewage and drainage pumps
IS : 8034	Specification for submersible pump sets for clear, cold, fresh water
IS : 8418	Specification for horizontal centrifugal self-priming pumps

1.8 FIRE FIGHTING INSTALLATION DRAWINGS

The Fire Fighting Installation drawings issued from time to time to the Contractor are diagrammatic but shall be following as closely as actual construction and work will permit. Any deviation from the drawings required to conform to the building construction shall be made by the Contractor at his own expenses. The architectural drawings shall take precedence over the services drawings as far as the Civil and other trades works are concerned.

DISCREPANCIES IN THE DRAWINGS

Should there be any discrepancy due to in-complete description, ambiguity or omission in the drawings and other documents relating to this Contract found by the Contractor either before starting the work or during execution or after completion, the same shall be immediately brought to the attention of the Engineer-in-Charge and his decision would be final and binding on the Contractor.

1.9 CO-ORDINATION WITH OTHER TRADES

The Contractor shall be responsible for coordinating this work with works of other trades sufficiently ahead of time to avoid unnecessary hold ups. Hangers, sleeves, recesses etc. shall be left in time as the work proceeds.

1.10 INSTRUMENTS FOR MEASUREMENT AND TESTING

The Contractor shall provide, free of cost, all equipments, instruments, labour and all other allied assistance required by the Owner/ Engineer-in-Charge or their representatives for measurement and testing of the works.

1.11 UP-KEEP OF THE SITE

It shall be the responsibility of the Contractor to clear away, from time to time, all debris and excess material generated by the activities of his workers.

1.12 PROTECTION

All work shall be adequately protected, to the satisfaction of the Engineer-in-Charge, so that

the whole work is free from the damage throughout the period of construction upto the time of handing over.
Special care must be taken to prevent damage and scratching of all fittings and fixtures. Tool marks on exposed fixtures shall not be accepted. Protective paper on fixtures shall be removed with hot water only at the final completion of the work.
Before handing over the work, the Contractor shall clean all elements of the complete installation, remove plasters, splashes, stickers, rust stains and all other foreign matter and leave every part in acceptable condition and ready for use to the satisfaction of the Engineer-in-Charge.

2. SYSTEM SPECIFICATION

2.1 INTERNAL HYDRANT

The Internal hydrant provided near the staircases shall cover the entire building internally with landing valves, hose reel, C.P hose pipe, Branch pipe, M.S Boxes/Shutter provided at appropriate location.

2.2 DOWN COMER SYSTEM

The Down Comer system shall comprises of AC motor driven pump set installed at Terrace near the over head tank, associated instruments, cabling, piping, valves, control panel etc and any other component required to complete the system in all respect. The Down Comer system shall cover various areas as marked in the drawings.

2.3 PRESSURISATION SYSTEM:

2.3.1 This system shall comprises of one (1) No. Terrace pump with electric motor.

2.3.2 The down comer system shall be kept pressurised all the times through the Terrace pump. The pump shall start automatically upon getting impulse from the pressure switch on drop of pressure in the pipe lines.

2.3.3 Mode of Operation:

a) The pressure in the down comer pipe network shall be kept constant at 3 Kg/Sqcm near the pump and approximately 4.5 Kg/Sqcm. at Ground Floor. In the event of fire, when one or more valves are opened, the fire pump shall start automatically.

b) The setting of the pressure switches shall be adjustable so that any desirable sequence of starting may be achieved at site.

c) In addition to auto start arrangements, the pump shall also have an overriding manual starting facility by push button arrangement in case of an emergency.

2.4 Internal Hydrant (Accessories):

a) The internal hydrant system shall be provided at every floor/platform level and at landing staircases. The hydrant point shall be directly tapped from riser pipes in accordance with the statutory requirement.

b) One single headed gun metal landing valve with 63 mm dia outlets and 80 mm dia inlets conforming to IS-5290 with cast iron wheels shall be provided. Landing valves shall have flanged inlet and instantaneous female type outlets.

c) First Aid Hose Reel Drum directly tapped from the Wet Riser pipe with 25 mm dia gun metal gate valve and fittings etc. with 3o meters of 20 mm dia high pressure rubber pipe with shut off nozzles 1 set.

d) Internal Hydrant shall have 63 mm dia 2 nos. 15 meter long confirming to IS-8423 complete with ISI marked male and female coupling and one number 63 mm dia ISI marked gunmetal short branch pipe with nozzle.

e) M.S. Hose Cabinet with glass front door and locking arrangements shall be provided at each landing. M.S. hose cabinet shall be constructed out of 16 gauge (1.6 mm) mild steel sheet and duly painted in approved finish. The cabinet shall be sufficient enough to accommodate first-aid hose reel and two canvas hoses of 63 mm dia & 15 meter long.

f) The hydrant riser shall be terminated with air release valve at the highest points to release the trapped air in the piping network.

2.5 Fire Brigade Inlet Connection:

Fire brigade inlet connection shall be of gun metal with three 63 mm dia instantaneous type inlets with leak proof built in type check valves and 150 mm dia flanged outlet connections feeding to the main fire grid. The collecting head shall conform to IS-904.

2.6 Hose Reels:

a) Swinging hose reels conforming to IS-884 shall be with rubber hose of 20 mm (3/4") diameter, 3 Ply rating and suitable for 350 psig bursting pressure. The reel shall be fabricated out of heavy gauge pressed mild steel capable of swinging up to 170 degree rotation. The movement of the reel shall be friction less and shall be provided with suitable bearings. Gun metal packing glands shall be provided with adjustable nuts.

b) The swinging hose reels shall be complete with the following accessories.

i. Shut-off nozzle of gun metal duly chromium plated complete with control valve suitable for throw of 40-45 ft. at 60 psig pressure.

ii. Wall bracket with U shape reel carrier made out of cast iron.

iii. G.M. isolation valve.

2.7 HAND HELD APPLICATIONS:

2.7.1 Installation of fully charged and tested fire extinguishing hand appliances CO2, and water type (capacity and location as shown on drawings) as required.

3. OTHER REQUIREMENTS

3.1 Fire extinguishers shall conform to the relevant Indian Standards.

3.2 The portable fire extinguishers i.e water CO2 type fire extinguishers having cap. 9 ltr and CO2 type fire extinguisher having cap. 4.5 kg shall be provided at strategic locations as indicated on the drawings. The number of fire extinguishers must be installed and maintained in accordance with IS:2190.

3.3 Hand held appliances shall be installed in readily accessible locations with the appliance brackets fixed to wall by suitable anchor fasteners or by means of floor mounted supports. Alternatively, they shall be installed within hose reel cabinets.

3.4 Each appliance shall be provided with an inspection card indicating the date of inspection, testing, changes of charge and other relevant data.

3.5 All appliances shall be fixed in a true workman like manner truly vertical and at correct locations. Identical type of extinguishers shall be of same make and shall have similar method of operation.

4. FIRE PUMPS & ACCESSORIES:

4.1 PUMP CONSTRUCTION:

4.1.1 The electrical pump shall be designed for continuous operation and shall have a continuously rising head characteristics without any zone of instability. The pump shall conform as per IS-1520-1660, IS-9079, IS-325 and shall be of the following construction:

	Pump Description	**Horizontal Split Casing Double Suction**
1.	Casing	Cast Iron/Cast Steel
2.	Impeller	Bronze
3.	Shaft	High Tenstile Steel
4.	Bearings	Heavy duty Ball/ Roller Bearings
5.	Base Plate	Cast Iron/ Fabricated M.S.

6.	Flanges	Conforming to ISS 1536/1960
7.	Packing	Mechanical Seal
8.	Max. Speed	1500 RPM/2900 RPM
9.	Driver	TEFC
10.	Starter	DOL

4.1.2 Pump and driver shall be mounted on a single bed-plate and directly driven through flexible coupling.

4.1.3 The pumps shall be of the type approved by TAC and capable of delivering not less than 150 % of rated capacity at a head of not less than 65% of the rated head. The shut off head of pump shall not exceed 120% of the rated head. The drive motor shall be continuous rating type and its rating shall be at least equivalent to the horse power required to drive the pump at 150% of its rated discharge.

4.2 ACCESSORIES AND FITTINGS:

4.2.1 The following accessories shall be provided with each pump among other standard accessories required:

a) Coupling guard for horizontal split casing pumps.

b) Lubrication fittings and seal piping.

c) Test and/or air vent cocks.

4.2.2 5.2.2 Following fittings shall be provided with each pump among other standard fittings required :

a) Suction and discharge shut off valves (gate type) and discharge check valves as specified under section "Piping".

b) Pressure gauge at discharge of size not less than 100 mm dia and of the appropriate rating with gauge valves etc.

c) 25 mm GI gland drain.

5. WATER PIPING:

5.1 GENERAL

a) All piping laid shall be as follows:

Pipe Size	Material	Joints & Fittings	Sealing Materials
Upto 50 mm	G.I pipe	Screwed fittings	Non-hardening
	Heavy Class	Unions	Lubricant
	IS-1239/1979	Raised face Slip-on flanges	
Above 50 mm to 150 mm	G.I. pipe	Welded fittings	---
	Heavy Class	Raised face Slip-on flanges	
	IS-1239/1979	--	3 mm, 3-ply rubber insertion

Pipe threads shall be to IS-554 and flanges to IS-1536.

b) All piping shall be black steel unless otherwise stated. Pipes shall be given one primary coat of red oxide paint & 2 coats of synthetic enamel paint of approved color before being installed. Pipes shall be sloping towards drain points.

c) Fittings shall be new and from reputed manufacturers, fittings shall be of malleable casting of pressure rating suitable for the piping system. Fittings used on welded piping shall be of the weldable type. Flanges shall be new and from standard manufacturers. Supply of flanges shall include bolts, washers gaskets etc as required.

d) Tee-off connection shall be through reducing tees, wherever possible. Otherwise ferrules welded to the main pipe shall be used. Drilling and tapping of the walls of the main pipe shall not be resorted to.

e) All equipment and valve connections shall be through flanges (Welded or screwed for mild steel).

e) All welded piping is subjected to the approval of the Construction Manager and sufficient number of flanges and unions shall be provided.

g) Gate valves/water type Butterfly valves shall be provided as required or as shown in the applicable shop drawings conforming to the following specification:

h) Gate valves shall conform to IS-780/1969, Flanges to IS-1536 or as required. Valves shall have non-rising spindles unless otherwise specified and shall be suitable for 21 Kg/Sqcm test pressure. Tail pieces shall be used where required.

i) Butterfly valves shall conform to BS-5155, MSS SP 67 & API 609 and designed to fit without gaskets between mating flanges. The valves shall be suitable for flow in either direction and seal in both directions. The valve shall be of integral moulded design.

j) Check valves shall be provided as required or as shown on the drawings and conform to the following specifications:

Size **Connection** **Ends**

12 mm to 50 mm	Gun Metal	Screwed Female
65 mm and above	Gun Metal/C.I.	Flanged

Swing check valves shall normally be used in all water services. Lift type valves may be used in horizontal runs. Air release and clean out plugs shall be provided and valves shall be suitable for 21 Kg/Sqcm test pressure.

k) Strainers shall be preferably of the approved type with C.I. bodies designed to the test pressures specified for the gate valves. Strainers shall have removable bronze screen with 3mm perforations and a permanent magnet. Strainers shall be provided with flanges or threaded sockets as required. They shall be designed so as to enable blowing out accumulated dirt and facilitate removal and replacement of screen without disconnection of the main pipe. All strainers shall be provided with equal size isolating gate valves with rising spindles so that the strainer may be cleaned without draining the system. Strainers shall be provided on the suction side of each pump; and wherever shown in the drawings.

5.2 PIPING INSTALLATION:

5.2.1 The drawings indicate schematically the size and location of pipes. Pipes runs and sizes may, however, be changed to meet the site conditions. The contractor on the award of the work, shall prepare detailed working drawings showing the cross section, longitudinal section, detail of fittings, locations of isolating drain and air valves etc. They must keep in view the specific openings in buildings and other structures through which the pipes are designed to pass. This working drawing will be approved by the Construction Manager before commencement of work.

5.2.2 Piping shall be properly supported on or suspended from stands, clamps, hangers etc, as specified and as required. The tender shall adequately design all the brackets, saddles, clamps, hangers etc and be responsible for their structural integrity.

5.2.3 Pipe supports shall be of steel, adjustable for height and primer coated with rust preventive paint and finish coated black. Where pipe and clamp are of dissimilar material, a gasket shall be provided in between.

5.2.4 Spacing of pipe supports shall not exceed the following:

Pipe Size (mm)	**Spacing (M)**
3 to 12	1.22
19 to 25	1.83
32 to 150	2.44
150 to above	3.05

Pipe hangers shall be fixed on walls and ceilings by means of metallic rawl plugs.

5.2.5 Vertical risers shall be parallel to walls and column lines and shall be straight and plumb. Risers passing from floor to floor shall be supported at each floor by clamps or collars attached to pipe and with a 12mm thick ribbed rubber pad or any other

approved resilient material. Where pipes pass through the terrace floor, suitable curbing shall be provided to prevent water leakage. Risers shall also have a suitable concrete pipes support at the lowest point.

5.2.6 Piping work shall be carried out with minimum disturbance to the other works being done at the sites. A program work shall be chalked out in consultation with the construction manager and approved by him.

5.2.7 Piping layout shall take due care for expansion and contraction in pipes.

5.2.8 All pipes using screwed fitting shall be accurately cut to the required sizes and thread in accordance with IS-554 and burrs removed before laying. Wherever reducers are to be made horizontal runs , eccentric reducers shall be used if the piping is to drain freely, in other location, concentric reducers may used.

5.2.9 Air valves shall be provided at all high points in the piping system for venting. Valves shall be of the double float type, with G.M./C.I. body, vulcanite balls, rubber seating etc. Air valves shall be of the sizes specified and shall be associated with an equal size gate valve with rising spindle.

Mains	**Air valves**
Up to 100 mm dia	25 mm dia

Discharge from the air valves shall be piped through an equal sized G.I pipe to the nearest drain or floor waste or as shown.

5.2.10 All burried pipes shall be cleaned and coated with zinc chromate primer and bituminous paint, than wrapped with two layers of fiberglass felt each layer laid in bitumen.

5.3 PRESSURE GAUGES:

5.3.1 Pressure gauge shall be not less than 100 mm dia dial and of appropriate range and be complete with shut off gauge valve etc duly calibrated before installation.

5.3.2 Pressure gauge shall be provided at the following locations and as indicated on the drawings & schedule of quantities.

Care shall be taken to protect pressure gauges during pressure testing.

5.4 VIBRATION ELIMINATION:

5.4.1 Piping installation shall be carried out with vibration elimination fittings wherever required.

5.5 TESTING:

5.5.1 All piping shall be holiday testing 1.5 times pressure to withstand hydrostatic test pressure of 10.5 Kg/Sq cm for the design pressure for a period of not less than 24 hours. All leaks and defects in joints revealed during the testing shall be rectified to the satisfaction of the Construction Manager.

5.5.2 Piping required subsequent to the above pressure test shall be retested in the same manner.

5.5.3 Systems may be tested in sections and such sections shall be securely capped.

5.5.4 The Project Manger shall be notified well in advance by the contractor of his intention to test a section of piping and all testing shall be witnessed by the Construction Manger.

5.6 PAINTING:

5.6.1 After the piping has been installed, tested and run for at least ten days. The piping shall be given two finish coats, 3 mils each of approved colour.

5.6.2 The direction of flow of fluid in the pipes shall be visibly marked in white arrows or as directed by the Construction Manager.

ELEVATOR WORKS

1. GENERAL

1.1 SCOPE OF WORKS

The scope of work shall cover design, supply delivery, installation, testing and commissioning of elevators as described in the Schedule of Rates (SOR) and the SOR item shall also include the following:

a) Necessary scaffolding temporary barricade in the hoist way required during the erection of the elevators.
b) Minor building work comprising of cutting holes and making good, the car and counterweight rail brackets, hall buttons and indicators including laying of sills in position.
c) Steel items such as machine beams, bearing plates buffer support channels, sill angles and fascia plates etc.
d) Suitable trap doors with steel chequered plate covers.
e) Providing and installation of a suitable vertical iron ladder for access to the pit.
f) Any other item required for successful completion and commissioning of lifts (including the hoisting beam).

1.2 STANDARDS

The work shall be done in accordance with regulations of any local code and following ISI codes which govern the requirements of installations.

- IS: 1860-1980 Code of practice for installation, operation and maintenance of Electric Passenger and Goods Lifts.
- IS: 3534-1976 Outline dimensions of Electric Lifts.
- IS: 4666-1980 Specifications for Electric passenger and Goods Elevators.
- IS: 2365-1977 Specification for steel wire suspension ropes for lifts and hoists.
- IS: 4289-1984 Specification for lift cables.
- IS: 7759-1975 Specification for lift door locking device and contacts.
- IS: 3043-1987 Code of practice for earthing.
- IS: 1646-1997 Electrical installation for safety of building
- IS: 2309-1989 Protections of building & structures against lighting.
- Indian Electricity Act 1910.
- Indian Electricity Rules, 1956.
- Delhi Lifts Rules, 1942.

1.3 SHOP DRAWINGS AND APPROVAL OF ELECTRICAL INSTALLATIONS

The selected contractor shall prepare a furnish shop drawings for approval by The Engineer in charge, such shop drawings shall be based on the Architectural drawings and requirements laid down in specifications, local laws and regulations etc.

The detailed drawings shall be submitted within one month of placement of order. The successful contractor shall obtain the approval of electrical Inspector and other local authorities as per requirements before submitting the drawings to Client/ Engineer. The contractor shall not proceed with installation work till the drawings are approved by the Engineer-in-Charge. Expenses incurred such as license fee etc. towards obtaining the approval of Electrical Inspector, local authority shall be reimbursed to the contractor as per actual on production of documentary proof. Approval of contractor's drawings shall not absolve the contractor of any of his obligations to meet the requirements of specification under this contract. Five sets of completion drawings, operation manual, maintenance manual, spare parts details shall be submitted to the Client/ Engineer in charge after

completion of work.

1.4 GUARANTEE

The contractor shall guarantee the equipment against all defects of materials and workmanship for a period of one year from the date of commissioning of the equipment as certified by the owner. Any defects arising during the guarantee period shall be rectified and replaced by the contractor, at his own expense, to the satisfaction of the owner.

The warranty shall cover the following:

- Quality, strength and performance of the materials and equipment used.
- Safe electrical and mechanical stresses on all parts of the equipment under all specified conditions of operation.
- Satisfactory, performance during guarantee period including free replacement to be done in accordance with the maintenance instructions and schedules.
- Performance figures and other values as specified in schedule of guaranteed technical particulars.
- Prompt services during maintenance period for repairs and breakdowns.
- Attending to consequential damages to consignment of lift items supplied and installed due to defective workmanship, material designs etc., in any part from manufacturers work.
- There should not be more than 8 hours delay in attending to break downs/defects reported in station where the contractor has his service organization. At other places the contractor shall specify this service period along with his tender and this shall be strictly adhered to.

1.5 PERMITS, INSPECTION & LICENSE FEE

The contractor shall arrange all necessary local, provincial or national government permit and shall make arrangements for inspection and tests required thereby. All Expenses in this regard are to be borne by contractor except the Statutory license fee which shall be reimbursed by the Owner on production of documentary evidence (in Original) for payment of the same.

1.6 ELECTRIC SUPPLY

3 phase, 415 Volts, 50 cycles A.C Electric supply shall be made available by the owner in machine room. The entire lift equipment should be suitable for operation and +10% to -20% of the rated supply voltage.

1.7 ELECTRICAL WIRING

The necessary A.C. supply of 3 Phase, 415 Volts 50 HZ shall be made available in the main control switch unit to be provided by the electrical contractor of owner in the machine room. All the electrical works beyond the main supply switch shall be carried out by the lift contractor i.e. supply and installations of panels for drive motors, switches and control complete with wiring as per system requirement and approval of the Engineer. The wiring shall be carried out strictly in accordance with Indian Electricity Rules and Indian code of Practice for Electrical Wiring Installation IS-732-1963 System Voltage not exceeding 650 V). For works not covered under any of the above wiring rules, the 13th edition of Electrical Engineers (Condense) shall apply. The cable and conduits to be used shall be of suitable size and grade conforming to relevant IS specification. Wiring for LT switch board to the motor terminal shall be with heavy duty 1.1 KV grade PVC insulated PVC sheathed, FRLS aluminium cable. All the trailing cables used for control and safety device shall conform to IS: 4289-1967, Specifications for lifts cables. The trailing cable circuits for controls, safety devices, lighting and signaling shall be separate and distinct. Power wiring between

controller and main board to various landings shall be drawn in suitable size heavy gauge conduit stove enameled/painted conforming to I.S specifications. The Voltage and frequency of the supply shall be subjected to variations permissible under Indian Electricity Acts and Rules.

2. DRIVE MACHINERY

2.1 Lift Machine

The Lift machine will be gearless and shall be placed in the lift shaft. No machine room shall be provided. The gearless lift machine shall consist of a motor, traction sheave and brake drum/disc completely aligned on a single shaft. The gearless machine shall be A.C. gearless with the VVVF drive.

2.2 Sheaves

Sheaves and pulley shall be of hard alloy, cast iron, SG iron or steel and free from cracks, sand holes and other defects. They shall have machined rope grooves. The traction sheaves shall be grooved to produce proper traction and shall be of sufficient dimension to provide for wear in the groove. The deflector sheave shall be grooved so as to provide a smooth bed for the rope. The deflector or secondary sheave assemblies where used shall be mounted in proper alignment with the traction sheaves. such deflectors sheaves shall have grooves larger than rope diameter as specified in clause 8 of IS 14665 (Part -4 sec3) :2000 .The size of all the sheaves shall be in accordance with clause 8 .4 of IS 14665 (Part4-sec 3):2000.Wherever necessary suitable protective guards may be provided.

2.3 Shaft Keys

Shafts which support sheave, gears, coupling and other members which transmit torque shall be provided with tight fitting keys of sufficient strength and quality.

2.4 Brake

The lift drive machinery shall be provided with an electro-magnetic brake or motor operated brake normally applied by means of springs in compression when the operating device is in off position. The brake shall be suitably curved over the brake drum or brake disc and provided with fire proof friction lining. The operation of brake shall be smooth, gradual and with minimum noise .The brake shall be designed to be of sufficient size and strength to stop and hold the car at rest with rated load. The brake should be capable of operation automatically by the various safety devices, current failure and by the normal stopping of the car. The brake shall be released electrically. It shall also be possible to release the brake manually, such releases requiring the permanent application of manual forces so as to move the lift car in short stops. For this purpose suitable brake release equipment wherever necessary shall be supplied with each lift installation and the same shall be kept in safe custody to prevent misuse.

2.5 Hand winding wheel or handle

A suitable hand winding wheel or handle mounted on the end of motor shaft for manual operation to move the lift car up or down to bring it to nearest landing manually. The up or down direction of the movement of car should be clearly marked on the motor/ at suitable location. A warning plate written in bold signal red letters advising the maintenance staff to switch off the mains supply before releasing the brake and operating the wheel is to be prominently displayed.

2.6 Type of controls

Microprocessor based A.C Variable Voltage Variable Frequency Control shall be used. The design of the controller should be such that it can be mounted on a wall and is dust protected, providing sufficient protection against lizards, rodents, etc. Max. Permissible leveling inaccuracy shall be ±5 mm only. The VVVF controller shall have the following features:

a) Total control at all stages of the motion cycle
b) A consistent fully adjustable smooth ride
c) Better leveling accuracy under all condition
d) A higher power factor
e) Lower starting current
f) Energy saving through the reduced power consumption

The system should monitor critical aspects of system health, self help diagnostic capability as built in, control system to speed up trouble shooting. It shall have constant voltage transformer for trouble free operation.

2.7 VVVF Inverter Drive

Fully digital VF inverter incorporating Flux Vector Control, technique of Pulse Width Modulation (PWM) for directly controlling the current of the elevator motor and providing constant speed control over the entire frequency range under all conditions to achieve considerable power saving thereby reducing the overall power consumption reduction in generator capacity and improvement in power factor and high speed switching device – the IGBT (Insulated Gate Bipolar Transistor) embedded in the inverter for smooth and quite operation.

3. Installation Aspects

3.1 Installation of Lift Machine

Lift machine room will not be provided and the drive machinery, controller etc. of the Lift shall be installed in the lift shaft.
Equipment layout in lift shaft should allow proper access to the maintenance staff.
Vibration Isolation arrangement shall be provided as required to prevent transmission of vibrations to the building and structure.
Provision of Lift shaft shall be as per requirement of lift vendor.

3.2 Guide Rails

The guide rails for lift car and counter weights shall be in accordance with clause 3 of IS 14665 (Part-4, section-2) 2000 .The Guide rails supported by brackets secured to hoist way at each floor shall be continuous throughout the entire travel and shall withstand without any deformation the action of safety care with a fully loaded car .

3.3 Guide Rails Shoes

To prevent car shaking automatic adjustable guide shoes should be used. The firm should use Teflon guide gibes on lubricated guide rails.

4. Lift Car

4.1 Car frame

The car frame shall be in accordance clause 4 of IS 14665 (Part-4, section-2) 2000 fabricated from formed or structural steel members shall be provided with adequate bracing

to support the platform and car enclosures. The car safety shall be integral with car mounted on the bottom members of the car frame and shall be with flexible guide clamp type designed to stop and hold a fully loaded car and withstand without permanent deformation the operation of safety gears.

4.2 Car Platform

The car platform shall be of framed construction and designed on the basis of rated load evenly distributed confirming to IS 14665 (Part-1) 2000.
A load plate along with overload alarm, giving the rated load and permissible maximum number of passenger should be fitted in each lift car in a conspicuous position.

4.3 Car Body

The car shall be with glass panel at the rear side and enclosed on three sides by a metallic enclosure .The enclosure including the door shall withstand without deformation a thrust of 35 Kg applied normally at any point and as per IS 14665 (Part-4, section-3) 2001 and Ventilation openings as required.
Lift car door shall have a fire resistant rating of 1 hour.
The car roof shall be solid type capable of supporting a weight of at least 140 Kg and as per IS 14665 (Part-4, section-3) 2001

4.4 Operating Panels inside the car

The car operating panel shall be of metal, flush mounted and duly finished to match the car interior décor and shall contain all the devices as may be specified depending upon the type of operation required. In addition separate illuminated panel for indication the floor and direction may be provided on the top or the door way .All switches shall be fade proof and the devices shall be of suitable quality.
Each device and its operating position shall be legible fade proof and marked.

5. Lift Cables and Ropes

5.1 Buffers

The suitable heavy-duty spring buffers shall be placed below the car and counter weight arranged to sustain and shock, should the elevator over travel past the terminal limits. Buffer shall be designed for design speed + 15%. Clearance from under side of car resting on a fully compressed buffer shall not be less than 1.20M.

5.2 Ropes

These will be self lubricated and manufactured from high grade steel and material special flexible and the combine breaking strength will be calculated with a minimum factor of safety of 10 times the combined weight of car with full load.

5.3 Travelling Cables

All wiring and electrical interconnections shall comply with governing codes. Insulated wiring shall have flame retardant and moisture proof outer covering and shall run in metal conduit tubing or approved electrical raceways. Traveling cables shall be flexible and suspended to relieve strain on individual conductors. A minimum of 10% spare conductors shall be provided in traveling cable.

5.4 Threshold

The threshold to be provided should be aluminum grooved, with self-supporting sill angle.

5.5 Hall buttons

For passenger and freight elevators, these shall be provided at each terminal landing. A single micro movement push button shall be provided at top most and landing floors, two micro movement buttons on a single plate shall be provided at each intermediate floor. When a hall call is registered by momentary pressure on a landing button, that button shall become illuminated until the call is answered.

Passenger and freight elevators call buttons shall be as per manufacturers' standard selection. The catalogues of the buttons offered shall be submitted along with the tender.

5.6 Motor

The make and type of hoisting motors and capacity should be mentioned. The motor should be suitable for elevator service (S4 duty) with high starting torque and starting current should be mentioned.
The motor shall be class F insulation and one (1) hour rated squirrel cage induction type having high starting torque.

5.7 Alarm Bell/ Intercom

A battery operated emergency alarm bell, including wiring to be provided and connected to a properly marked push button in the car-operating panel. The alarm bell shall be located at the ground floor, at the floor landing outside and adjacent to hoist way.

A two line EAPBX and intercom Telephones shall be provided in car, security room and one more location for emergency use.

5.8 Hoist way Gate Interlocks

Each host way gate shall be provided with interlock and which shall prevent the movement of the car away from the landing unless all are closed and locked. The interlock shall also prevent opening of gate except at the landing where the car is stopping or has stopped.

5.9 Counter Weight

The counter weight shall consist of cast iron weight containing structural steel frame and shall be equal to the weight of the complete elevator car and approximately 50% of the contract load. Counterweight is to be provided with over speed safety in case of passenger elevators.

5.10 Hitches Plates

Self aligning (with isolation cushion) hitches plates of better roping shall be provided.

5.11 Speed Governor

The car safety shall be operated by a mechanical centrifugal speed governor located at the top of the hoist way. The governor shall actuate a switch when excessive descending speed occurs disconnecting power to the hoist motor and applying the break prior to deployment of the safeties.

5.12 Reverse Phase Relay

Reverse phase relays should be provided on the controller, which should be designed to protect the elevator equipment against phase reversal and single phasing and phase failure.

5.13 Digital Hall Position Indicator

A digital position indicator shall be provided on all landings indicating the position of the car in the hoist way at all times. Illuminating direction arrows shall indicate the direction of the travel.

5.14 Digital car position indicator

A digital car position shall be provided in each elevator car which shall indicate the landing at which the car has stopped or is passing. Illuminating direction arrows shall indicate the direction of travel.

5.15 Car door operator:

a) An electrical A.C/D.C. door operator shall be provided on the car to automatically operate and close the car door in the following manner.
b) When the car stopped at a landing the car door shall be opened by the electric operator. After the hoist way door has been closed, the pressing of either a car button or landing operating button at other landing shall cause the car door to close. An electric contact shall be provided to prevent the operation of the elevator unless the door is in the position.

5.16 Full Collective Automatic Operation

a) The operation shall be full collective automatic type with one button in the car for each landing level served and up and down buttons at the intermediate landings and a single button at each terminal landing. All stops registered by the momentary pressure of the car button shall be made in the order in which the landings are reached after the buttons have been pressed but irrespective of the sequence in which the calls were registered.
b) All up landing calls shall be answered when the car is traveling in the up direction and all down landing calls shall be answered when the car is traveling in the down direction, except in the case of the uppermost or lowermost calls which shall be answered as soon as it is reached.

5.17 Infra Red Door Safety

Car doors should have full infrared safety device. When any beam is interrupted, an electronic circuit shall be actuated and door operating mechanism shall return the doors to the open position and when the entrance is again clear, the elevator door closes automatically.

5.18 Fire Man Drive

Fireman drive shall be provided for each elevator. The operation of the fireman drive shall be in two phases.

In the first phase it shall cancel all the calls and bring the passengers to the parking floor. All the floor buttons shall remain ineffective till the button is reset.

In the second phase the fireman shall use it. In second phase operation the elevator door should open by continuous pressure on the door open buttons and the door shall close if the button is released before the door full open. And hall buttons giving car calls indication shall cause the door to close, and the elevator should run on slow speed. Doors should be fire rated for one hour and shall be provided with jam panels.

5.19 Automatic Rescue Device

Automatic (Emergency) battery device should come into operation in case of power failure it

should sense the direction of motor and stop the elevator at the nearest floor landing and door should open. The automatic rescue device (drive) should be base on maintenance free batteries of suitable capacity –each elevator to have its own Automatic Rescue Device.

6. Test of Lift Installation

6.1 Tests at site:

a) Leveling Test:

Accuracy of the floor leveling shall be tested with the lift empty, fully loaded. The lift shall be run to each floor while traveling both in upward and downward directions and the actual distance of car floor above/ below landing floor shall be measured. In each case there shall not be any appreciable difference in these measurements for leveling at the floors when the car is empty and when it is fully loaded. The tolerances for leveling shall be specified and guaranteed by the tendered.

b) Safety Gear Tests:

With the contract load still in the car, the safety gear may now be tested, if the lift operates from a D.C. supply the excess speed necessary to operate the gear may be obtained by field weakening, but if A.C. motor is installed the gear may be set to operate at the contract speed or alternatively tripped by hand at the contract speed.

Instantaneous safety gear controlled by a governor should be tested with contract load and a contract speed, the governor being operated by hand. Two tests should be made, however, with wedge clamp or flexible clamp safeties, one with contract load in the car and other stopping distance obtained should be compared with the specified figures and the guides, car platform, and safety gear should be carefully examined afterwards for signs of permanent distortion. Note -: if there is sufficient cable left on the safety drum after the gear has operated.

Counterweight safety gear should be tripped by the counter weight governor and the stopping distance noted. In this case, however the governor tripping speed should exceed that of the car safety governor but by more than 10%.

During the safety gear tests an inspector with a tachometer should determine the car speed (from the governor or the main sheave) at the instant or tripping speed with that stated in I.S. The governor jaws and rope should be examined for any undue wear.

c) Contract Speed:

This should be measured with contract load in the car, with half load and with no load, and should not vary from the contract speed by more than 10%. The convenient method is by counting the number of revolutions, made by the sheave of drum in a known time, chalk mark on the sheave or drum and a stop switch will facilitate timing but care must be exercised to ensure that no acceleration or retardation periods are included, if the roping is 2 to 1 the sheave speed is twice the car speed. Alternatively, the speed can be measured by a tachometer applied directly to shaft immediately below the sheave.

d) Lift Balance:

After the above test, some of the weight shall be removed until the remaining weights represent the figures specified by the contractor. With this condition car at half way travel the effort required to move the lift car in either direction with the help of winding wheel shall be as nearly, be the same as can be judged.

e) Car and Landing Doors Interlocks:

The lift shall not move with any door open. The car door relay contact and the retiring release contact must be tested. The workings of the door operation and the safety edges and light equipment if any provided shall also be examined.

f) Controllers:

The operation of the contactors and interlocks shall be examined and it shall be ascertained whether all the requirements laid down in the specifications have been met.

g) Normal Terminal Stopping Switches:

These shall be tested by letting the car run to each terminal landing in turn, first with no load and then with contract load and by taking measurements, top and bottom over travels can be ascertained.

h) Final Terminal Stopping Switches:

The normal terminal stopping switches shall be disconnected for this test. It shall be ensured that these switches operate before the buffers are engaged.

i) Insulation Resistance:

This shall be measured between power and control lines and earth and shall not be less than 5 mega – ohms when measured with D.C voltage of 500 volts. The test shall be carried out with contactors so connected together as to ensure that all parts of every circuit are simultaneously tested.

j) Earthing:

All conduits, switches, casing and similar metal work shall have earthing continuity.

k) Ropes:

The size, number construction and fastenings of the ropes should be carefully examined and recorded.

l) Buffers:

The car should be run on to its butters at contract speed and with contract load in the car to test whether there is any permanent distortion of the car or buffers. The counter weight buffers should be tested similarly.

6.2 Tests at Manufacturer's Works:

a) High Voltage Test:

The dielectric or electrical apparatus (excluding motors, generators and instruments which are tested in accordance with the appropriate Indian Standards wherever they exist) shall be capable of withstanding a test voltage of ten times the working voltage with a maximum of 2000 volts when applied

i). between the live parts and case or frame with all circuits completed
ii). between main terminals or equivalent parts with all circuits open and
iii). between any live parts of independent circuits

Note : Owing to the impracticability of applying tests (ii) & (iii) mentioned above on controllers and similar apparatus after controller wiring has been completed, these tests may be made at convenient stages or manufacture.

b) Method of Applying High Voltage:

The test shall be made with alternating voltage of any convenient frequency, preferably between 49 and 60 cycles per second. The test voltage shall be of approximately sine-wave form and during the application of voltage with peak value, as would be determine by spark gap by orcillograph or by any other approved method shall of the applied voltage shall be measured by means of a transformer or by means of a voltmeter used in connection with a special calibrated voltmeter winding or testing transformer by any other suitable voltmeter connected to the output side of the testing transformer.

Duration of High Voltage Test:

The test shall be commenced at a voltage of about one third of the test voltage which shall be increased to the full test voltage as rapidly as is consistent with the value being indicated by the measuring instrument. The full test voltage shall be maintained for one minute. At the end of this period, the test voltage shall be rapidly diminished to one third of its full value before switching off.

The oil buffers are examined after the above tests have been made to determine if there have been any oil leakages or distortion and to ensure that the buffers return to their normal position.

c) Service Temperature Test:

A continuous run of one hour should be made with number of starts and stops to reproduced as nearly as practical the anticipate duty in service (The standard duty cycle is for 90 to 180 start per hour). It is very difficult in practice to carry out this test with alternate starts at full load and no load and it is very necessary therefore to simulate these cycles. A suitable test for all motor except squirrel cage motors is to run the cat up from the bottom landing with contract load and stop at each floor. From the top floor a non stop run is made to the lowest floor and the upward journey with stop is then repeated. The time intervals between stops and starts at the floors should be uniform and such as to give about 120 starts in one hour. At the end of this run the temperatures of the armatures and fields of the motors and generator are record. The temperature rise should, not exceed 55oC or 75oC for classes. A or E insulation respectively.

d) Buffer test:

Copy of the test report shall be intimated after testing at works.

7. Detailed Requirement of Passenger Elevator

Lift Type	Passenger Lift (13P, 884kg) (Machine Room Less)
No. of lifts	2
Speed	1.5 m / s
Travel & Rise	7.8 mtrs. Approx.
Floors served	Ground Floor, 1st Floor & 2nd Floor
Stops & Openings	3 Stops & 3 Openings (All opening on same side)
Power supply	415 V, 3 phase, 50 Hz AC
Control	AC Variable voltage variable frequency

Operation	DUPLEX with/ without attendant
Machine	Gearless placed in Lift Shaft
Car Size	2000 mm wide x 1100 mm deep inside dimension
Hoist way available	As per drawing (approx. 2500 mm x 1900 mm)
Car enclosure	SS Sheet steel Scratchproof/ Moon Rock finish with Glass Panel on Rear side
Car entrance	Central opening sliding stainless steel Scratchproof / Moon Rock finish doors Clear opening 900 mm wide & 2100 mm high
Hoist way Entrances	Central opening sliding stainless steel Scratchproof finish doors Clear opening 900 mm wide x 2100 mm high.
Door operator	Automatic with AC-Door operator having VF – Controls
Hand rails	Stainless steel
False ceiling	Acrylic / Perspex Ceiling
Flooring	PVC Flooring / Vinyl tiles 3.0 mm thick
Signals	Combined luminous hall buttons and digital hall position indicator with directional arrow. Integral full height car operating panel with luminous buttons Digital car position indicator combined with directional arrow. Battery operated alarm bell and emergency light with batteries as required. Overload warning and service cabinet. Auto fan ON/OFF feature. LED Lights in the car. Fireman's switch at ground floor Intercom system in car (in built) (for 3 position in built feature) All plates should be of stainless steel
Door Safety	Mechanical & Full height infrared door protection system Face plate in hair line finish of stainless steel and of rectangular shape
ARD	Automatic Rescue Device

7.1 Instructions to be displayed in Hindi/ English inside the lift car

S. No.	Description
1	Lift Number
2	Capacity
3	Persons
4	No smoking
5	Operate push buttons/ switches correctly
6	Do not lean against the lift door
7	Do not panic in the event of breakdown press alarm buttons and follow instructions of authorized staff.
8	Use Telephone/ intercom kept inside the car for help

Annexure – 1

Guaranteed Performance

S.No	Particulars of Details	Guaranteed data
A	General :	
1	Name of Manufacturer	
2	Country of manufacturer	
3	Capacities (persons/ weight)	
4	Service	
5	Speed of Travel	
6	Height of Travel	
7	No. of Floors served	
8	No. of openings	
9	Position of counterweight	
10	Type of Leveling method	
B	Machine	
1	Position of Machine	
C	Motor	
	a). Type	
	b). Make	
	c). Horse Power	
	d). Standards conforming to	
	e). Electric supply particulars for which it is suitable for operation	
D	Drive	
	a). Number & diameter of ropes	
	b). Make and Type No. of Reduction gear unit	
	c). Reduction ratio of gear unit	

E. Brake

1 Type

2 Make

3 Construction and Electrical particulars (Operating voltage, current etc)

F. Car :

1 Outside dimensions of car

2 Inside clear dimensions

3 Construction of car

4 Design/ Type of enclosure of car

5 Details of flooring

6 Attachments and fitting inside the car

7 Car Doors :

a). Size

b). Operation

c). Construction, design & finish

d). Details of runners & suspension

8 Landing Doors :

a). Size

b). Operation

c). Construction, design & finish

d). Details of runners and suspension

9 Leveling Method :

G Guides & Guide Shoes:

1 For Car :

a). Size

b). Weight per meter run

H Safety Services:

1 Car safety type

2 Counter weight safety type

3 Door interlocks in Cary-type

4 Door locks in landing type

5 Details of door ledge

6 Limit switches :

a). Type

b). Location

c). Function

d). Number at each location

e). Make

f). Rating (Amps)

I Buffers:

1 For car :

a). Type

b). Construction

c). material

2 For counterweight :

a). Type

b). Construction

J Electrical Particulars of Alarm Bell :

Other safety devices included in the offer :

K Controller :

1 Type

2 Location

3 Manufacturer name, type and electrical particulars
Operating coils of relays

4 Particulars of type, make etc of relays and contractors

5 Any other particulars of construction

L Signaling System :

a). In car :

i). Door button

ii). Call indicator

iii). Direction and position indicator

iv). Emergency button
v). Door button

vi). Alarm bell button

vii). Changeover switches

viii). Light and fan switches

b). At landing :

i). Call button

ii). Direction and car position indicators
Note : Full and comprehensive details are to be given by the contractor

M Inter Communication System :

1 Make & Model

2 Technical Data of Manufacturers

(Please enclosed literature)

N Emergency Power Pack :

1 Type of Battery and Capacity

2 Detail of Float / Boast Change (Make / Model)

O Automatic Rescue Device

a). Make

b). Capacity
c). Battery make and capacity in ampere hour and quantity

P Any other data

Annexure – 2

Completion Certificate

1. Lift installation at
2. No. of lifts
3. Capacity
4. Speed
5. Type
6. Method of operation
7. Give details on list of manuals data and information supplied in accordance with
8. Whether brake release equipment and winding wheel has been provided.
9. Whether the layout of equipment in the machine room ensure free movement within
10. Type of variation, isolation foundation provided
11. Whether guide rails have been installed properly
12. Whether the car frame is made of rigid construction and the car so mounted as to minimize vibration and noise being transmitted inside.
13. Whether the platform and all other dimensions conform to IS:3554-1976 amended upto date
14. Whether the car body is rigid to withstand application of fires
15. Whether car aprons, landing threshold, sills have been provided.
16. Details of intercommunication system provided whether it is working satisfactory
17. Whether rating and instructions plate has been prominently displayed inside the car.
18. Whether doors have been properly fixed
19. Type of levelling device if any provided and the accuracy of levelling achieved
20. Whether counter weight conforms to IS : 4666-1980 and whether counter weight guards have been provided.
21. Type of guide shoes provided
22. No. and size of hoisting ropes and governor ropes along with their origin, type, ultimate strength and factory of safety.
23. Type and method of operation of car and landing doors.

24. Method of proper fastenings

25. Type of safety gear with name of manufacturer

26. Type of buffers indicating also the name, stroke, certified maximum load and certified maximum striking speed and whether buffer has been tested

27. Door locks whether these have been tested for satisfactory submitted by the firm.

28. Whether alarm bell and emergency door lock release operating key and associated safety and other safety included.

29. Whether all wiring in the machine room and the host way etc, properly identified by plastic metallic identification tags.

30. What auxiliary switches have been provided?

31. Whether earthing has been done properly also the extra wires provided as per requirement mentioned.

32. Whether the controllers casing is insect proof with hinged doors and gaskets and foundation facilities

33. Whether the lift supplier has recommended common spare required for maintenance and trouble free operation.

Certified the lift installation and components confirm to IS: 4666-1980, 1860-1980, 2365-1977, 4289-1984, 7759-1975, 732-1983 and another relevant standard local lift Act and Rules, Indian Electricity Act and Rules and CPWD General Specifications of Electrical Works (2000) amended up to date.

CCTV, HVAC & BMS WORKS

1. CCTV WORKS

1.1 GENERAL

The IP based Closed Camera surveillance system shall use state of the art technology and shall be UL listed.

The scope shall include supply, installation, testing, commissioning and maintenance of the IP based CCTV system proposed.

Scope shall include supply, installation, testing and commissioning of cameras, managed network switches/ network video recorders/ severs, software workstations, monitors, racks, consoles cables, UPS etc. The specifications for these components shall be as per SOR and as per relevant IS codes and standards.

1.2 IP NETWORK DOME CAMERA

Sr.no	Description	Specification
i.	Video standards	Dual streaming H.264/MJPEG selectable
ii.	Sensor	1/3 or 1/4 inch progressive-scan CMOS sensor
iii.	Sensor matrix	PAL : 800 x 600 or better
iv.	Resolution	800 X 600 @25fps or better
v.	Signal	ONVIF IP
vi.	Connectors	RJ-45, 10BaseT/ 100BaseTX
vii.	Minimum Illumination @f/1.2	0.5 Lux (Color) or better 0.03 Lux (B/W) or better
viii.	Dynamic Range	70dB
ix.	White balance	2,500° to 8,000°K
x.	Shutter Speed	1/5 ~ 1/10,000 sec or equivalent/better
xi.	Noise Reduction	Yes
xii.	Lens	2.8 to 10 mm remote zoom with DC iris
xiii.	Iris control	Automatic
xiv.	Unit configuration	Via web browser
xv.	Window Blanking	Configurable, upto 4
xvi.	Audio	Bi-directional
xvii.	Alarm Input	1
xviii.	Alarm Output	1
xix.	Firmware	Remote update
xx.	Protocols	TCP/IP, UDP, ICMP, IPv4, SNMP v2c/v3, HTTP, HTTPS, SSL, SSH, SMTP, FTP, RTSP, UPnP, DNS, NTP, RTP, RTCP
xxi.	Local Storage	Micro SD Card
xxii.	Built-In Analytics	Camera Sabotage & Motion Detection
xxiii.	Ethernet	(10BaseT / 100BaseTX), PoE, RJ45
xxiv.	PoE	IEEE 802.3af compliant
xxv.	Compliance	ONVIF compliant
xxvi.	Input voltage	24V AC or PoE, IEEE 802.3 af
xxvii.	Operating Temp.	0°C to 50°C or better
xxviii.	Operating Humidity	15% to 85% (non-condensing) or better

xxix.	Certification	UL & FCC

1.3 IP NETWORK IP66 BULLET CAMERA

Sr.no	Description	Specification
i.	Video standards	Dual streaming H.264/MJPEG selectable
ii.	Sensor	1/3 or 1/4 inch progressive-scan CMOS sensor
iii.	Sensor matrix	PAL : 800 x 600 or better
iv.	Resolution	800 X 600 @25fps or better
v.	Signal	ONVIF IP
vi.	Connectors	RJ-45, 10BaseT/ 100BaseTX
vii.	Minimum Illumination @f/1.2	0.5 Lux (Color) or better 0.03 Lux (B/W) or better
viii.	IR Distance	25 meter
ix.	Dynamic Range	70dB
x.	White balance	2,500° to 8,000°K
xi.	Shutter Speed	1/5 ~ 1/10,000 sec or equivalent/better
xii.	Noise Reduction	Yes
xiii.	Lens	2.8 to 10 mm remote zoom with DC iris
xiv.	Iris control	Automatic
xv.	Unit configuration	Via web browser
xvi.	Window Blanking	Configurable, upto 4
xvii.	Audio	Bi-directional
xviii.	Alarm Input	1
xix.	Alarm Output	1
xx.	Firmware	Remote update
xxi.	Protocols	TCP/IP, UDP, ICMP, IPv4, SNMP v2c/v3, HTTP, HTTPS, SSL, SSH, SMTP, FTP, RTSP, UPnP, DNS, NTP, RTP, RTCP
xxii.	Local Storage	Micro SD Card
xxiii.	Built-In Analytics	Camera Sabotage & Motion Detection
xxiv.	Ethernet	(10BaseT / 100BaseTX), PoE, RJ45
xxv.	PoE	IEEE 802.3af compliant
xxvi.	Compliance	ONVIF compliant
xxvii.	Built-In Analytics	Camera Sabotage & Motion Detection
xxviii.	Input voltage	24V AC or PoE, IEEE 802.3 af
xxix.	Operating Temp.	-40°C to 50°C or better
xxix.	Operating Humidity	15% to 85% (non-condensing) or better
xxx.	Environmental Housing	IP66 type
xxxi.	Certification	UL & FCC

1.4 DATABASE SERVER / SYSTEM MANAGER

1.4.1 The system shall be an integrated hardware and software platform that serves as the system management component and provides gateway functionality when accessing the security platform from external networks.

1.4.2 The system shall utilize reliable SSD drives for the operating system drive to protect against hard disk drive failures from interrupting system functionality

1.4.3 The system shall support database redundancy by utilizing two servers and maintaining constant synchronization between the two servers. In the event of a system manager failure, the hot standby shall assume management responsibilities until the failed unit is restored. No loss of functionality, recording, or monitoring capability shall occur during the failover process.

1.4.4 The system shall be capable of serving as an NTP Server for the entire system. The IP video security system shall be synchronized to an NTP server so that all system components function on the same time basis. The NTP server shall reside within the system, and it shall be capable of being synchronized to a more accurate external time source if required. All time-zone corrections shall automatically be provided in the system.

1.4.5 The system shall be capable of performing as a DHCP server for the entire system and components. The system manager shall assign IP addresses and manage leases for automatic provisioning.

1.4.6 The system manager shall act as a web server for web browser based access to video cameras and recorders on the network.

1.4.7 The system shall manage system security, functioning as a key server for user and device authentication. The system manager shall store and administer secure keys and shall have multi-level and user permission management.

1.4.8 The system shall incorporate built-in transcoding of video to send video across low bandwidth network connections to remote browsers accessing cameras and recorders. The transcoder shall be capable of delivering MPEG4 and H.264 video streams into lower resolution, lower frame rate streams to fit the bandwidth limit established by the IT administrator or available on the network connection. The system manager shall be capable of supporting up to 16 transcoded streams.

1.4.9 The system shall offer local storage of 4TB for exported video. Hard disk drives used shall be enterprise-class drivers specifically designed for operation in RAID environments. Where more than three data drives are used, the drives shall be configured in a RAID5 array.

1.4.10 The system shall manage rights and permissions for all devices, persons, and any system video or other data.

1.4.11 The system shall maintain a system log of all user activity on the system including time and date of user log-in, log-off, configuration changes made, video exported.

1.4.12 The system shall store the database of device errors, alarms, and other system events, and the comprehensive database shall be accessed and searched through the system log window in an interface.

1.4.13 The system shall allow for connection to an intelligent uninterruptible power supply (UPS), and it shall allow for the initiation of a graceful shutdown should the UPS deplete its stored charge.

1.4.14 The system shall meet or exceed the following design and performance specifications.

1. System Specifications	
a. Processor	2nd Generation Intel® Core™ i7
b. Internal Memory	8 GB or better
c. Operating System	Windows/ Linux
d. System Storage	4 TB in RAID5
2. Network Specifications	
a. Interface	Gigabit Ethernet RJ-45 port (1000BaseT)
b. Security	Two modes: secure mode and unsecure mode
3. Auxiliary Specifications	
a. USB 2.0	Three USB 2.0 ports or more
4. Front Panel Specifications	
a. DVD/CD-RW Drive	
5. Power Specifications	
a. Power Input	100-240 VAC, 50/60 Hz, autoranging
b. Power Supply	Internal

6. Environmental Specifications

a. Operating Temperature	50□ to 95□F (10□ to 35□C)
b. Operating Humidity	20% to 80% non condensing
c. Maximum Humidity	10% per hour
d. Operating Altitude	–50 ft to 10,000 ft (–16 m to 3,048 m)

7. Physical Specifications

a. Construction	Steel cabinet Rack mountable

8. Certifications and Regulations

a. CE, Class A
b. UL/cUL Listed
c. FCC, Class A
d. C-Tick

1.5 NETWORK ATTACHED STORAGE/ NETWORK STORAGE MANAGER

1.5.1 The network storage shall record video and audio streams from IP cameras and video encoders on the network.

1.5.2 The network storage shall incorporate the server functions and storage elements into a purpose-built chassis.

1.5.3 The network storage shall use RAID 6 parity across the storage drives to protect recorded data against a hard disk drive failure.

1.5.4 The network storage manager shall only use enterprise-level hard disk drives specifically rated for operation in RAID systems.

1.5.5 The network storage manager chassis shall be designed for video surveillance recording applications and encompass redundancy at all vital points:

1. Redundant, hot swappable power supply modules
2. Redundant, hot swappable system fans
3. Hot swappable O/S drive
4. Hot swappable CPU fans

1.5.6 The network storage manager chassis shall be designed for online service and maintenance and cannot be removed from the rack when hard disk drives, fans, power supplies, or operating system drives must be replaced.

1.5.7 The network storage manager shall be built upon a reliable and robust Windows/ Linux operating system.

1.5.8 The network storage manager shall support a guaranteed recording throughput of 250 Mbps per storage device with a minimum of 64 Mbps of read throughput. This throughput shall be guaranteed under normal and error (RAID rebuild) conditions.

1.5.9 The network storage manager shall support any number of cameras so long as the maximum throughput required is less than 150 Mbps.

1.5.10 The network storage manager shall support the recording of MPEG-4 and H.264 baseline, and high profile streams from standard resolution and megapixel cameras.

1.5.11 The network storage manager shall support continuous, scheduled, alarm/event (including analytics alarms), motion, and manual recording. Pre- and post-alarm periods shall be configurable up to the total capacity of the system.

1.5.12 The network storage manager shall support bookmarking and locking/unlocking of video content on the drives.

1.5.13 The network storage manager should have Active-Active Failover Within a Storage Pool to Ensure Continued Recording if Catastrophic Failure Occurs

1.5.14 The network storage manager should support redundant recording to ensures duplication of vital data for mission-critical applications

1.5.15 The network storage manager shall support privacy tools that allow administrators to establish maximum retention times for normal, alarm, and locked video.

1.5.16 The system should have video pruning to increase storage efficiency by grooming recorded streams based on age and priority

1.5.17 The network storage manager shall support an intelligent video grooming protocol that can reduce the frame rate of recorded video as the video ages. Administrators shall have the flexibility to determine whether to groom alarm video or leave it at its real-time level.

1.5.18 The network storage manager shall have the ability to report all diagnostic events, including software status diagnostics to a centralized user interface. In addition, Simple Network Management Protocol (SNMP) traps shall be available for monitoring through a third-party SNMP management console.

1.5.19 The network storage manager shall be fully managed from a remote workstation, including the ability to configure settings and update firmware and software.

1.5.20 The network storage manager shall meet or exceed the following design and performance specifications.

1. Power Specifications	
a. Power Input	100 to 240 VAC, 50/60 Hz, autoranging
b. Power Supply	Internal, dual-redundant, hot-swappable
2. Environmental Specifications	
a. Operating Temperature	50□ to 95□F (10□ to 35□C) at unit intake
b. Operating Humidity	20% to 80%, non condensing
c. Maximum Humidity	10% per hour
d. Operating Altitude	–50 to 10,000 ft (–16 to 3,048 m)
e. Operating Vibration	0.25 G at 3 to 200 Hz at a sweep rate of 0.5 octave/minute
3. Physical Specifications	
a. Construction	Steel cabinet
Mounting	Rack Mountable (Rack rails and hardware provided)
4. System Specifications	
a. RAID Level	RAID 6 for storage drives
b. Effective Capacity	Up to 27.2 TB or better
c. Drive Interface	SAS/SATA II
d. Network Interface	2, 1 Gigabit Ethernet RJ-45 ports (1000Base-T)
e. Security	2 modes: secure mode (device authentication) and unsecured mode
f. Auxiliary Interfaces	
USB 2.0	3 USB 2.0 Ports or more
5. Certifications	
a. CE, Class A	
b. FCC, Class A	
c. UL/cUL Listed	
d. C-Tick	

1.6 CLIENT SOFTWARE ON WORKSTATION

1.6.1 The workstation shall be a high end personal computer with two DVI-I monitor outputs, USB keyboard, and mouse.

1.6.2 The workstation shall use a graphical user interface and keyboard/mouse that runs on 64-bit Microsoft Windows 7 Ultimate for monitoring live and recorded video, and virtual matrix functionality that shall allow operators to see and respond to any alarm from any device on the network as well as direct any camera to any monitor on the network.

1.6.3 The client software shall allow administrators to configure devices, set up users, adjust network settings, and create recording schedules. Permission to access these functions and all other system services shall be configured to a fine level of detail including the ability to restrict cameras from viewers, restrict PTZ operation, allow or restrict digital zoom, Zone of Interest operations, or the ability to configure maps. In addition, user permissions shall allow for designated users to receive and respond to alarm and system diagnostic messages. Administrators shall have the ability to prioritize user access to PTZ cameras.

1.6.4 The client software shall have advanced search capabilities, event logging, and alarm interface displays. The workstation shall export video and still images in multiple formats, including AVI, BMP, and JPG. The unit shall provide a front panel USB port and DVD/CD-RW drive to make it capable of exporting video clips and still images to external media.

1.6.5 The client software shall allow users with authority to monitor content from standard resolution and megapixel resolution cameras and encoders throughout the network. The workstation shall display content encoded in MPEG-4 and H.264 baseline, main, and high profiles. The workstation shall support cameras from multiple manufacturers.

1.6.6 The client software shall be capable of decoding up to 16 simultaneous 4CIF resolution, 30 images per second (ips) video streams encoded in MPEG-4; or 12 simultaneous 4CIF resolution, 30ips video streams encoded in H.264 baseline profile; or 2 simultaneous 1080p video streams encoded in H.264 baseline profile.

1.6.7 The client software shall be capable of minimizing the CPU processing load and network bandwidth , a scheme that shall automatically seek out and subscribe to a secondary stream from the cameras or encoders at a lower resolution when the display is changed to a multichannel display.

1.6.8 The client software shall provide users with single,2 x 2, 3 x 3, 4 x 4, 1 + 5, 1 + 12, 2 + 8 displays for 4:3 aspect ratio monitors, and provide 3 x 2 and 4 x 3 displays for 16:9 aspect ratio monitors or better

1.6.9 The client software shall retain the camera's aspect ratio and allow mixing standard resolution and megapixel resolution cameras on the same display.

1.6.10 The client software shall allow any combination of live or playback video on the same monitor at the same time. The workstation shall provide time-synchronized playback of up to 16 cameras simultaneously.

1.6.11 The client software shall provide digital zoom capability for any camera in live or playback mode.

1.6.12 The client software shall provide a Zone of Interest feature that can generate up to six independently controlled and zoomed images from a single image and allow operators to maintain a panoramic view of the scene while closely monitoring selected areas. This shall be accomplished without requiring additional network throughput.

1.6.13 The system shall be capable of customizing the display area to suit user preferences. All aspects of the graphical user interface shall be capable of being resized, torn-off and moved to other monitors, or simply hidden. The system shall allow up to 6 customizable workspaces to be created and loaded with camera groups to facilitate easy and efficient monitoring. The system shall allow for up to two detachable video display windows to accommodate up to a 32-camera display.

1.6.14 The client software shall notify designated operators of all alarms on the system in an alarm tab. Video thumbnails shall be available for visual verification within the alarm monitoring workspace. The system shall allow alarms to be acknowledged or snoozed by the operator. The workstation application shall support the functionality to view procedures and instructions for given alarms triggered to appear during alarm events, while generating detailed written or verbal instructions to the operator as to the actions to be taken. An operator shall have the capability of entering his or her own feedback to the given alarm. All user alarms and user actions shall be kept in the system log for audit purposes.

1.6.15 The client software application shall provide the ability to control and program any camera equipped with PTZ. The workstation shall be capable of the following operations

1. Manually control the PTZ
2. Set the pan/tilt home positions for manual or alarm activation
3. Automatically control the cameras through an alarm trigger
4. Ability to set multiple preset positions
5. Ability to set multiple tours
6. Remotely set and clear the movement limits of the pan/tilt mechanism from the control room, through a telemetry unit at an outdoor camera site
7. Adjust the zoom lens
8. Ability to control the camera menu and set up the camera through the IP video security system

1.7 JOYSTICK CONTROLLER/ KEYBOARD

1.7.1 The keyboard controls are located on three modules in the keyboard. Modules shall be capable of rotating to suit user preferences. The keyboard modules shall include a variable speed, vector-solving joystick for precise PTZ control, jog/shuttle for playback control and pattern control, a keypad for camera and monitor control, and a built-in speaker. The keyboard shall have LED buttons that work in conjunction with the feature being used.

1.7.2 The keyboard shall be part of an integrated system and shall be configured so any number of keyboards can be added to the system. When combined with user interfaces (UIs), network storage managers (NSM's), encoders, IP camera, and video consoles, the keyboard forms an integral part of a complete network-based video control system.

1.7.3 The keyboard shall meet or exceed the following design and performance specifications.

1. Power Supply Specifications

a. Input Voltage	100-240 VAC, 50/60 Hz
b. Output Voltage	12 VDC
c. Power Output	20 W
d. Input Connector Type	Universal, interchangeable
e. Output Connector Type	2.5 mm screw-on barrel

2. Keyboard Base Specifications

a. Keyboard Interface	USB 2.0
b. Cable	USB, captive, 16.4 ft (5.0 m)
c. Input Voltage	12 VDC
d. Upstream Port	USB 2.0 (USB type B connector)
e. Downstream Port	2x USB 2.0 hi/full/low speed (USB type A connector)
f. Audio Output	Embedded speaker or plug-in headset, 0.5 W into 8-ohm load per channel
g. Audio Input	Plug-in microphone, mono (30 to 350mVp-p); or line input, stereo (0.35 to 2.0 Vp-p)

3. Keyboard Module Specifications

a. Keyboard Keypad	0-9, camera, monitor, and multiple view keys
b. Joystick	Fully proportional PTZ, variable speed; with zoom, iris, and focus controls
c. Jog/ Shuttle	Proportional, fast forward, reverse, and video transport; menu navigation
d. Module Connectors	Three (one for each module), USB 1.1 mini-USB

4. Environmental Specifications

a. Operating Temperature	32□ to 104□F (0□ to 40□C) at air intake of unit
b. Storage Temperature	–40□ to 149□F (–40□ to 65□C)
c. Operating Humidity	Up to 96%

5. Certifications
a. CE, Class B
b. UL/cUL Listed
c. FCC, Class B
d. C-Tick

2. HVAC WORKS

The work shall be carried out as per CPWD specifications. However, where CPWD specifications are not available, the work shall be carried out with prior approval of Engineer-in-Charge unless mentioned in the specifications of this tender. The contractor shall ensure commissioning of the complete system and shall quote accordingly.

3. BUILDING MANAGEMENT SYSTEM

3.1 GENERAL

Furnish all labour, materials, equipment, and service necessary for a complete and operating Building Management System (BMS), utilizing Direct Digital Controls as shown on the drawings, as in attached Input / Output Summary and as described herein. Drawings are diagrammatic only.
All labour, material, equipment and software not specifically referred to herein or on the plans, that is required to meet the functional intent of this specification, shall be provided without additional cost to the Client.
Client shall be the named license holder of all software associated with any and all incremental work on the project(s).

3.2 SYSTEM DESCRIPTION

The entire Building Management System (BMS) shall be comprised of a network of interoperable, stand-alone digital controllers communicating via LonMark/LonTalk communication protocols to a Network Area Controller (NAC) / Router. Building Management System products shall be manufactured as per LonWorks products must be approved in writing by the consulting Engineer and be submitted for approval ten (10) days prior to the date of the bid submittal.

The entire Integrated Control and Monitor Management System (IBMS) shall be comprise of a network of interoperable, stand-alone digital controllers communicating on an open protocol communication network to a host computer within the facility (when specified) and communicating via the Internet to a host computer in a remote location. The IBMS shall communicate to third party systems such as Chillers, Boilers, Air-Handling Systems, Energy metering systems, Lighting Management System & other energy management systems, Fire-Life safety systems and other building management related devices with open, interoperable communication capabilities.

The IBMS framework shall utilize JAVA based automation products and services with built-in Internet connectivity to a broad range of distribution partners in the building automation, energy services, power/utility, and industrial sectors. The Framework shall bring together the computerization of control applications under the umbrella of single integrated system architecture. The suite of component software applications shall support true plug-and-play,

multi-vendor interoperability, resulting in lower automation and information infrastructure costs. The Network Area Controllers (NAC's) shall run a JAVA Virtual Machine (JVM) platform and use a common set of tools for accessing and integrating multiple protocols.

The Building Management System (BMS) shall be comprised of Network Area Controller or Controllers (NAC) / Routers. The NAC / Router shall connect to the local or wide area network, depending on configuration. Access to the system, either locally in each building, or remotely from a central site or sites, shall be accomplished through standard Web browsers, via the Internet and/or local area network. Each NAC shall communicate to LonMark/LonTalk and/or BACnet Direct Digital Controllers (DDC) and other open protocol systems/devices.

Following software packages shall be loaded into the system as minimum standard:

a. Complete system operational software
b. Site specific data manipulation software
c. Active graphics software
d. Energy management system software
e. Alarm indication software
g. Data Visualization Package
h. Internet Enabled Remote Monitoring Package.

3.2.1 SUBMITTAL

Eight copies of shop drawings of the components and devices for the entire control system shall be submitted and shall consist of a complete list of equipment and materials, including manufacturers catalog data sheets and installation instructions for all controllers, valves, dampers, sensors, routers, etc. Shop drawings shall also contain complete wiring and schematic diagrams, software descriptions, calculations, and any other details required to demonstrate that the system has been coordinated and will properly function as a system. Terminal identification for all control wiring shall be shown on the shop drawings. A complete written Sequence of Operation shall also be included with the submittal package. BMS contractors supplying products and systems, as part of their packages shall provide catalog data sheets, wiring diagrams and point lists to other contractors for proper coordination of work.

Submittal shall also include a trunk cable schematic diagram depicting operator workstations, control panel locations and a description of the communication type, media and protocol. BMS contractors shall provide these diagrams for their portions of work; the Systems Integrator shall be responsible for integrating those diagrams into the overall trunk cable schematic diagrams for the entire Wide Area Network (WAN).

Submittal shall also include a complete point list of all points to be connected to the BMS.

Upon completion of the work, provide a complete set of 'as-built' drawings and application software on compact disk. Drawings shall be provided as AutoCAD™ compatible files. Eight copies of the 'as-built' drawings shall be provided in addition to the documents on compact disk. BMS contractors shall provide as-built for their portions of work. The BMS contractor shall be responsible for as-built pertaining to overall BMS architecture and network diagrams. All as-built drawings shall also be installed into the BMS server in a dedicated directory.

3.2.2 SPECIFICATION NOMENCLATURE

Acronyms used in this specification are as follows:
FMCS Facility Management and Control System

BMS	Building Management System
NAC	Network Area Controller
DDC	Direct Digital Controller
IBC	Interoperable BACnet Controller
GUI	Graphical User Interface
WBI	Web Browser Interface
PMI	Power Measurement Interface
LAN	Local Area Network
WAN	Wide Area Network
OOT	Object Oriented Technology
PICS	Product Interoperability Compliance Statement

3.2.3 DIVISION OF WORK

The BMS contractor shall be responsible for all controllers (DDC), control devices, control panels, controller programming, controller programming software, controller input/output and power wiring and controller network wiring.

The BMS contractor shall also be responsible for the Network Area Controller(s) (NAC), software and programming of the NAC, graphical user interface software (GUI), development of all graphical screens, Web browser pages, setup of schedules, logs and alarms, LonWorks network management and connection of the NAC to the local or wide area network.

AGENCY AND CODE APPROVALS

All products of the BMS shall be provided with the following agency approvals. Verification that the approvals exist for all submitted products shall be provided with the submittal package. Systems or products not currently offering the following approvals are not acceptable.

UL-916; Energy Management Systems

C-UL listed to Canadian Standards Association C22.2 No. 205-M1983 “signal Equipment”

CE

FCC, Part 15, Subpart J, Class A Computing Devices

3.2.4 SOFTWARE LICENSE AGREEMENT

The CLIENT shall agree to the manufacturer's standard software and firmware licensing agreement as a condition of this contract. Such license shall grant use of all programs and application software to Owner as defined by the manufacturer's license agreement, but shall protect manufacturer's rights to disclosure of trade secrets contained within such software.

The CLIENT shall be the named license holder of all software associated with any and all incremental work on the project(s). In addition, CLIENT shall receive ownership of all job specific configuration documentation, data files, and application-level software developed for the project. This shall include all custom, job specific software code and documentation for all configuration and programming that is generated for a given project and/or configured for use with the NAC, BMS Server(s), and any related LAN/ WAN/ Intranet and Internet connected routers and devices. Any and all required IDs and passwords for access to any component or software program shall be provided to the owner. The owner shall determine which organizations to be named in the SI organization ID (“orgid”) of all software licenses. Owner shall be free to direct the modification of the “orgid” in any software license, regardless of supplier.

3.2.5 DELIVERY, STORAGE AND HANDLING

Provide factory-shipping cartons for each piece of equipment and control device. Maintain cartons through shipping, storage, and handling as required to prevent equipment damage. Store equipment and materials inside and protected from weather.

3.2.6 JOB CONDITIONS

Cooperation with Other Contractors: Coordinate the Work of this section with that of other sections to ensure that the Work will be carried out in an orderly fashion. It shall be this Contractor's responsibility to check the Contract Documents for possible conflicts between his Work and that of other crafts in equipment location, pipe, duct and conduit runs, electrical outlets and fixtures, air diffusers, and structural and architectural features.

3.3 MATERIALS

3.3.1 GENERAL

The Building Management System (BMS) shall be comprised of a network of interoperable, stand-alone digital controllers, a computer system, graphical user interface software, printers, network devices, valves, dampers, sensors, and other devices as specified herein. All systems and software within BMS shall be Year 2000 compliant and shall be supported by compliance documentation from the manufacturer.
The installed system shall provide secure password access to all features, functions and data contained in the overall BMS.

3.3.2 OPEN, INTEROPERABLE, INTEGRATED ARCHITECTURES

The intent of this specification is to provide a peer-to-peer networked, stand-alone, distributed control system with the capability to integrate ANSI/ASHRAE Standard 135-2001 BACnet, LonWorks technology, MODBUS, OPC, and other open and proprietary communication protocols in one open, interoperable system.

The supplied computer software shall employ object-oriented technology (OOT) for representation of all data and control devices within the system. In addition, adherence to industry standards including ANSI / ASHRAE™ Standard 135-2001, BACnet and LonMark to assure interoperability between all system components is required. For each LonWorks device that does not have LonMark certification, the device supplier must provide an XIF file and a resource file for the device. For each BACnet device, the device supplier must provide a PICS document showing the installed device's compliance level. Minimum compliance is Level 3; with the ability to support data read and write functionality. Physical connection of BACnet devices shall be via Ethernet (BACnet Ethernet/IP,) and/or RS-485 (BACnet MSTP) as specified.

All components and controllers supplied under this Division shall be true "peer-to-peer" communicating devices. Components or controllers requiring "polling" by a host to pass data shall not be acceptable.

The supplied system must incorporate the ability to access all data using standard Web browsers without requiring proprietary operator interface and configuration programs. An Open DataBase Connectivity (ODBC) or Structured Query Language (SQL) compliant server database is required for all system database parameter storage. This data shall reside on a supplier-installed server for all database access. Systems requiring proprietary database and user interface programs shall not be acceptable.

A hierarchical topology is required to assure reasonable system response times and to manage the flow and sharing of data without unduly burdening the customer's internal Intranet network. Systems employing a "flat" single tiered architecture shall not be acceptable.

Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 5 seconds for network connected user interfaces.
Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 60 seconds for remote or dial-up connected user interfaces.

3.3.3 NETWORKS

The Local Area Network (LAN) shall be a 100 Megabits/sec Ethernet network supporting BACnet, Java, XML, HTTP, and SOAP for maximum flexibility for integration of building data with enterprise information systems and providing support for multiple Network Area Controllers (NACs), user workstations and, if specified, a local server.
Local area network minimum physical and media access requirements:
Ethernet; IEEE standard 802.3
Cable; 100 Base-T, UTP-8 wire, category 5
Minimum throughput; 100 Mbps.

3.3.4 NETWORK ACCESS

Remote Access: For Local Area Network installations, provide access to the LAN from a remote location, via the Internet. The CLIENT shall provide a connection to the Internet to enable this access via high speed cable modem, asynchronous digital subscriber line (ADSL) modem, ISDN line, T1 Line or via the customer's Intranet to a corporate server providing access to an Internet Service Provider (ISP). Customer agrees to pay monthly access charges for connection and ISP.

3.3.5 NETWORK AREA CONTROLLER (NAC) / ROUTER

The BMS contractor shall supply one or more Network Area Controllers (NAC) / Router as part of this contract. Number of area controllers required is dependent on the type and quantity of devices provided in IO Summary.
The Network Area Controller (NAC) / Router shall provide the interface between the LAN or WAN and the field control devices, and provide global supervisory control functions over the control devices connected to the NAC / Router. It shall be capable of executing application control programs to provide:
Calendar functions
Scheduling
Trending
Alarm monitoring and routing
Time synchronization
Integration of LonWorks controller data and BACnet controller data
Network Management functions for all LonWorks based devices
The Network Area Controller must provide the following hardware features as a minimum:
One Ethernet Port – 10/100 Mbps
One RS-232 port
One LonWorks Interface Port – 78KB FTT-10A
One RS-485 ports
Battery Backup
Flash memory for long term data backup (If battery backup or flash memory is not supplied, the controller must contain a hard disk with at least 1 gigabyte storage capacity)
The NAC / Router must be capable of operation over a temperature range of 32 to 122°F
The NAC / Router must be capable of withstanding storage temperatures of between 0 and 158°F
The NAC / Router must be capable of operation over a humidity range of 5 to 95% RH, non-condensing
The NAC / Router shall provide multiple user access to the system and support for ODBC or

SQL. A database resident on the NAC / Router shall be an ODBC-compliant database or must provide an ODBC data access mechanism to read and write data stored within it.

The NAC / Router shall support standard Web browser access via the Intranet/Internet. It shall support a minimum of 32 simultaneous users.

Event Alarm Notification and actions
The NAC / Router shall provide alarm recognition, storage; routing, management, and analysis to supplement distributed capabilities of equipment or application specific controllers.
The NAC / Router shall be able to route any alarm condition to any defined user location whether connected to a local network or remote via dial-up telephone connection, or wide-area network.
Alarm generation shall be selectable for annunciation type and acknowledgement requirements including but limited to:
To alarm
Return to normal
To fault
Provide for the creation of a minimum of eight of alarm classes for the purpose of routing types and or classes of alarms, i.e.: Electricals, HVAC, Fire, etc.
Provide timed (schedule) routing of alarms by class, object, group, or node.
Provide alarm generation from binary object “runtime” and /or event counts for equipment maintenance. The user shall be able to reset runtime or event count values with appropriate password control.
Control equipment and network failures shall be treated as alarms and annunciated.
Alarms shall be annunciated in any of the following manners as defined by the user:
Screen message text
Email of the complete alarm message to multiple recipients. Provide the ability to route and email alarms based on:
Day of week
Time of day
Recipient
Pagers via paging services that initiate a page on receipt of email message
Graphic with flashing alarm object(s)
Printed message, routed directly to a dedicated alarm printer
The following shall be recorded by the NAC / Router for each alarm (at a minimum):
Time and date
Location (building, floor, zone, office number, etc.)
Equipment (air handler #, accessway, etc.)
Acknowledge time, date, and user who issued acknowledgement.
Number of occurrences since last acknowledgement.
Alarm actions may be initiated by user defined programmable objects created for that purpose.
Defined users shall be given proper access to acknowledge any alarm, or specific types or classes of alarms defined by the user.
A log of all alarms shall be maintained by the NAC / Router and/or a server (if configured in the system) and shall be available for review by the user.
Provide a “query” feature to allow review of specific alarms by user defined parameters.
A separate log for system alerts (controller failures, network failures, etc.) shall be provided and available for review by the user.
An Error Log to record invalid property changes or commands shall be provided and available for review by the user.
Data Collection and Storage

The NAC / Router shall have the ability to collect data for any property of any object and store this data for future use.
The data collection shall be performed by log objects, resident in the NAC / Router that shall have, at a minimum, the following configurable properties:
Designating the log as interval or deviation.
For interval logs, the object shall be configured for time of day, day of week and the sample collection interval.
For deviation logs, the object shall be configured for the deviation of a variable to a fixed value. This value, when reached, will initiate logging of the object.
For all logs, provide the ability to set the maximum number of data stores for the log and to set whether the log will stop collecting when full, or rollover the data on a first-in, first-out basis.
Each log shall have the ability to have its data cleared on a time-based event or by a user-defined event or action.
All log data shall be stored in a relational database in the NAC / Router and the data shall be accessed from a server (if the system is so configured) or a standard Web browser.
All log data, when accessed from a server, shall be capable of being manipulated using standard SQL statements.
All log data shall be available to the user in the following data formats:
HTML
XML
Plain Text
Comma or tab separated values
Systems that do not provide log data in HTML and XML formats at a minimum shall not be acceptable.
The NAC/ Router shall have the ability to archive its log data either locally (to itself), or remotely to a server or other NAC / Router on the network. Provide the ability to configure the following archiving properties, at a minimum:
Archive on time of day
Archive on user-defined number of data stores in the log (buffer size)
Archive when log has reached it's user-defined capacity of data stores
Provide ability to clear logs once archived

3.3.6 AUDIT LOG

Provide and maintain an Audit Log that tracks all activities performed on the NAC / Router. Provide the ability to specify a buffer size for the log and the ability to archive log based on time or when the log has reached its user-defined buffer size. Provide the ability to archive the log locally (to the NAC / Router), to another NAC / Router on the network, or to a server.
For each log entry, provide the following data:
Time and date
User ID
Change or activity: i.e., Change set point, add or delete objects, commands etc.

3.4 DATABASE BACKUP AND STORAGE

The NAC / Router shall have the ability to automatically backup its database. The database shall be backed up based on a user-defined time interval.
Copies of the current database and, at the most recently saved database shall be stored in the NAC / Router. The age of the most recently saved database is dependent on the user-defined database save interval.
The NAC / Router database shall be stored, at a minimum, in XML format to allow for user viewing and editing, if desired. Other formats are acceptable as well, as long as XML format is supported.

3.5 DIRECT DIGITAL CONTROLLERS (DDC)

Direct Digital Controllers shall be 16 bit microprocessor based Interoperable LonWorks Controllers.

The Network Area Controller (NAC) / Router will provide all scheduling, alarming, trending, and network management for the LonMark / LonWorks based devices.

- The DDC shall be 32-Bit Hi Performance controller.
- The DDC shall be a freely programmable native BacNet Controller
- It shall have 21 base I/Os onboard
- It shall have minimum 8 DO, 4 DI, 3 AO and 6 UI.
- The Analog Inputs shall have min 12 bit A/D resolution
- It shall have one MSTP port to connect over MSTP network.
- It shall allow peer to peer communication and sharing of data point values with other controllers over MSTP network.
- The DDCs shall communicate with the NAC / Router at a baud rate of not less than 78.8K baud. The DDC shall provide LED indication of communication and controller performance to the technician, without cover removal.
- All DDCs shall be fully application programmable. Controllers offering application selection only (non programmable), require a 10% spare point capacity to be provided for all applications. All control sequences within or programmed into the DDC shall be stored in non-volatile memory, which is not dependent upon the presence of a battery, to be retained.
- The BMS contractor supplying the DDC's shall provide documentation for each device, with the following information at a minimum:
- Network Variable Inputs (nvi's); name and type
- Network Variable Outputs (nvo's); name and type
- Network configuration parameters (nci, nco); name and type
- It is the responsibility of the BMS contractor to ensure that the proper Network Variable Inputs and Outputs (nvi and nvo) are provided in each DDC, as required by the point charts.
- The supplier of any programmable DDC shall provide one copy of the manufacturer's programming tool, with documentation, to the CLIENT.
- The controller shall be capable of either integrating with other LonMark™ devices or stand-alone operation.
- The controller shall have two microprocessors. The Host processor contains on-chip FLASH program memory, FLASH information memory, and RAM to run the main HVAC application. The second processor for LonWorks™ network communications.
  (a) FLASH Memory Capacity: 60 Kilobytes with 8 Kilobytes for application program.
  (b) FLASH Memory settings retained for ten years.
  (c) RAM: 2 Kilobytes
- The controller shall have an FTT transformer-coupled communications port interface for common mode-noise rejection and DC isolation.
- The controller shall have an internal time clock with the ability to automatically revert from a master time clock on failure.
  (a) Operating Range: 24 hour, 365 day, multi-year calendar including day of week and configuration for automatic day-light savings time adjustment to occur on configured start and stop dates.
  (b) Accuracy: ±1 minute per month at 77° F (25° C).
  (c) Power Failure Backup: 24 hours at 32° to 122° F (0° to 50° C).
- The controller shall have Significant Event Notification, Periodic Update capability, and Failure Detect when network inputs fail to be detected within their configurable time frame.
- Rated voltage: 20-30 VAC, 50/60 Hz
- The controller shall have an internal DC power supply to power external sensors.
  (a) Power Output: 20 VDC ±10% at 75 mA.

- The controller shall have a visual indication (LED) of the status of the device:
  (a) Controller operating normally.
  (b) Controller in process of download.
  (c) Controller in manual mode under control of software tool.
  (d) Controller lost its configuration.
  (e) No power to controller, low voltage, or controller damage.
  (f) Processor and/or controller is not operating.
- The minimum controller Environmental ratings:
  (a) Operating Temperature Ambient Rating: -40° to 150° F (-40° to 65.5° C).
  (b) Storage Temperature Ambient Rating: -40° to 150° F (-40° to 65.5° C).
  (c) Relative Humidity: 5% to 95% non-condensing.
- The controller shall have the additional approval requirements, listings, and approvals:
  (a) UL/cUL (E87741) listed under UL916 (Standard for Open Energy Management Equipment) with plenum rating.
  (b) CSA (LR95329-3) Listed
  (c) Meets FCC Part 15, Subpart B, Class B (radiated emissions) requirements.
  (d) Meets Canadian standard C108.8 (radiated emissions).
  (e) Conforms requirements European Consortium standard EN 61000-6-1; 2001 (EU Immunity)
  (f) Conforms requirements European Consortium standard EN 61000-6-3; 2001 (EU Emission)
- The controller shall have three analog outputs (AO).
  (a) Analog outputs (AO) shall be capable of being configured as digital outputs (DO).
  (b) Input and Output wiring terminal strips shall be removable from the controller without disconnecting wiring.
  (c) Input and Output wiring terminals shall be designated with color coded labels.
- The controller shall provide for “user defined” Network Variables (NV) for customized configurations.

3.6 GRAPHICAL USER INTERFACE SOFTWARE

3.6.1 Operating System:

The GUI shall run on Microsoft Windows XP Professional.

The GUI shall employ browser-like functionality for ease of navigation. It shall include a tree view (similar to Windows Explorer) for quick viewing of, and access to, the hierarchical structure of the database. In addition, menu-pull downs, and toolbars shall employ buttons, commands and navigation to permit the operator to perform tasks with a minimum knowledge of the HVAC Control System and basic computing skills. These shall include, but are not limited to, forward/backward buttons, home button, and a context sensitive locator line (similar to a URL line), that displays the location and the selected object identification.

Real-Time Displays: The GUI, shall at a minimum, support the following graphical features and functions:

Graphic screens shall be developed using any drawing package capable of generating a GIF, BMP, or JPG file format. Use of proprietary graphic file formats shall not be acceptable. In addition to, or in lieu of a graphic background, the GUI shall support the use of scanned pictures.

Graphic screens shall have the capability to contain objects for text, real-time values, animation, colour spectrum objects, logs, graphs, HTML or XML document links, schedule objects, hyperlinks to other URL’s, and links to other graphic screens.

Graphics shall support layering and each graphic object shall be configurable for assignment to a layer. A minimum of six layers shall be supported.

Modifying common application objects, such as schedules, calendars, and set points shall be accomplished in a graphical manner.

Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator.
Holidays shall be set by using a graphical calendar without requiring any keyboard entry from the operator.
Commands to start and stop binary objects shall be done by right-clicking the selected object and selecting the appropriate command from the pop-up menu. No entry of text shall be required.
Adjustments to analog objects, such as set points, shall be done by right-clicking the selected object and using a graphical slider to adjust the value. No entry of text shall be required.
System Configuration: At a minimum, the GUI shall permit the operator to perform the following tasks, with proper password access:

Create, delete or modify control strategies.

Add/delete objects to the system.

Tune control loops through the adjustment of control loop parameters.

Enable or disable control strategies.

Generate hard copy records or control strategies on a printer.

Select points to be alarmable and define the alarm state.

Select points to be trended over a period of time and initiate the recording of values automatically.

On-Line Help: Provide a context sensitive, on-line help system to assist the operator in operation and editing of the system. On-line help shall be available for all applications and shall provide the relevant data for that particular screen. Additional help information shall be available through the use of hypertext. All system documentation and help files shall be in HTML format.

Security: Each operator shall be required to log on to that system with a user name and password in order to view, edit, add, or delete data. System security shall be selectable for each operator. The system administrator shall have the ability to set passwords and security levels for all other operators. Each operator password shall be able to restrict the operators' access for viewing and/or changing each system application, full screen editor, and object. Each operator shall automatically be logged off of the system if no keyboard or mouse activity is detected. This auto log-off time shall be set per operator password. All system security data shall be stored in an encrypted format.

System Diagnostics: The system shall automatically monitor the operation of all workstations, printers, modems, network connections, building management panels, and controllers. The failure of any device shall be annunciated to the operator.
Programming software shall be same as GUI. The Same GUI can be used to configure the DDCs & NAC.

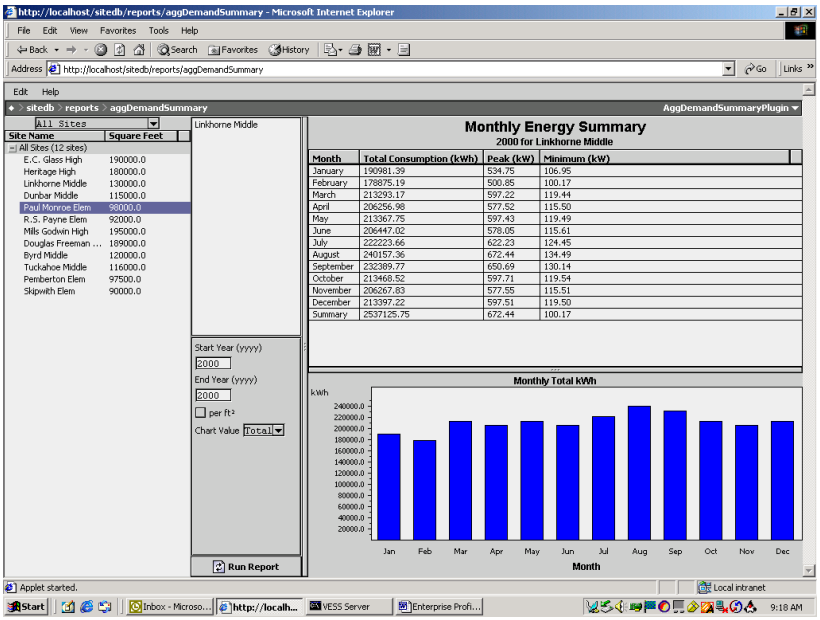
Alarm Console: The system will be provided with a dedicated alarm window or console. This window will notify the operator of an alarm condition, and allow the operator to view details of the alarm and acknowledge the alarm. The use of the Alarm Console can be enabled or disabled by the system administrator.
When the Alarm Console is enabled, a separate alarm notification window will supersede all other windows on the desktop and shall not be capable of being minimized or closed by the operator. This window will notify the operator of new alarms and un-acknowledged alarms. Alarm notification windows or banners that can be minimized or closed by the operator shall

not be acceptable.

3.7 SPECIAL ENERGY MANAGEMENT REPORTING AND PROFILING APPLICATIONS

These reports are defined below.

1. **Aggregate Demand Summary** - This report aggregates (totalizes) multiple points (meters) and shows the peak, minimum, average, and total consumption as well as computes load factor. By reducing peak consumption and leveling the total load, volatility is reduced and energy customers can make significant improvements in their energy procurement. This report will help identify favorable aggregation combinations and unattractive peaks. Once the user selects this report, they define parameters such as sites, meters, time period, and commodity. The following screen shot is an example of Aggregate Demand Summary.



2. **Summary Ranking Reports** - By selecting this report, the user can identify the 10 worst or 10 best sites in the database. Once the report type has been selected, parameters to define before the report can be generated will include the following:

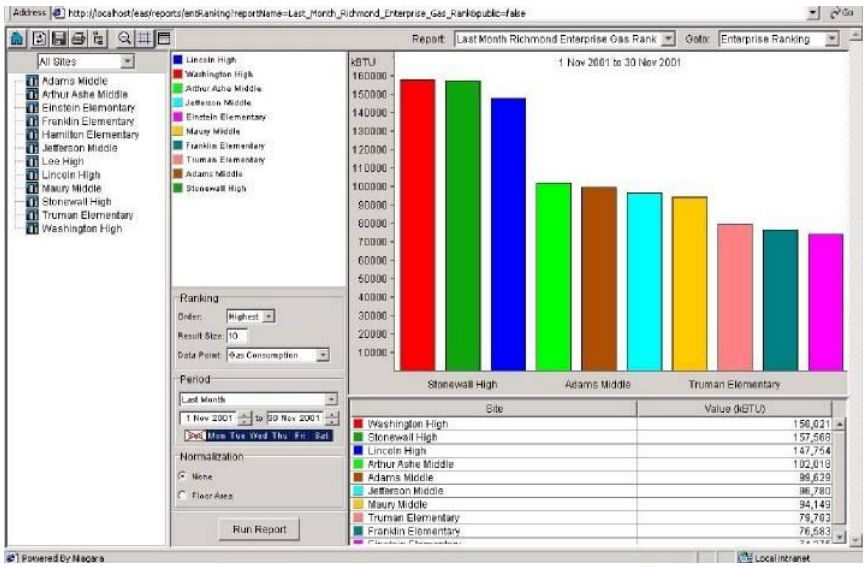
    a. Measurement unit – KW, therms, CCF gallons, PSI, etc. The database will search for all values matching the request.

    b. Compare an entire facility or normalize by square foot

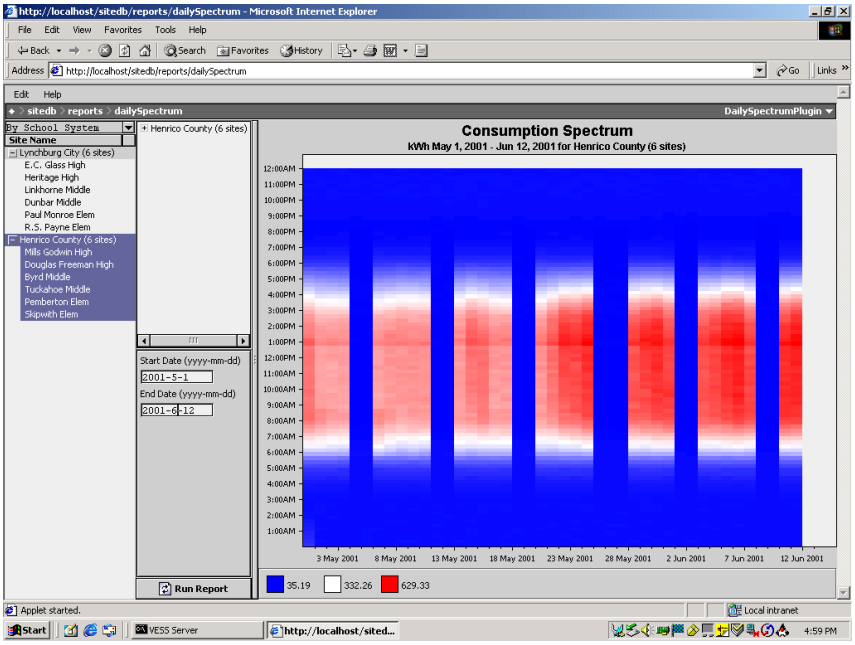
    c. Time periods to compare

    d. Highest values or lowest values – Will be able to view either the best or worst 10 points matching the defined parameters

    e. Cost or consumption in future revisions

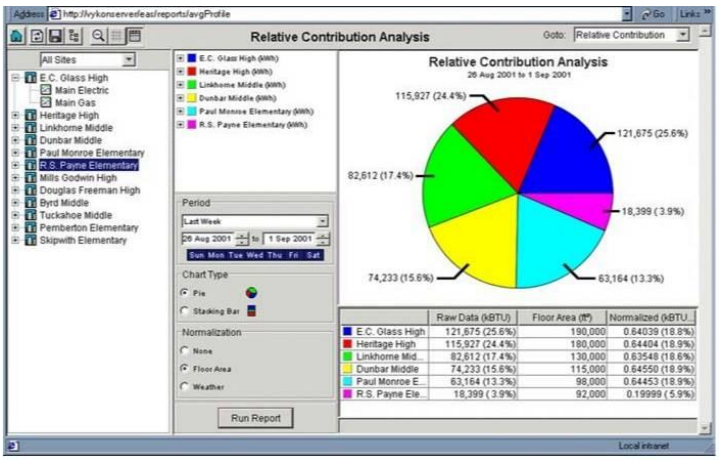


3. **Spectrum Summary Report –** A quick view of any point or aggregated point with color coding identifying the reasonableness of the data value. The chart can report on up to one year of data, with the ability to zoom to a higher definition. As data values approach and/or exceed historical ranges, the color on the graph will change to identify such. If all data values are within historical ranges, the user can move on to other functions. In the following screen shot, the Spectrum Summary Report is reporting on total electricity for an aggregated point, which consists of 6 schools. The reporting period is six weeks, with the blue identifying low loads overnight and on weekends. The fourth weekend in the report was a three day weekend which is identified by a larger blue gap. A user can also see rising consumption (red) as temperatures rise going into the summer season. When the user clicks on an area of the graph, the data value along with time stamp will appear. The colors and associated data value ranges are user definable. The following screen shot is an example of the Spectrum Summary Report.



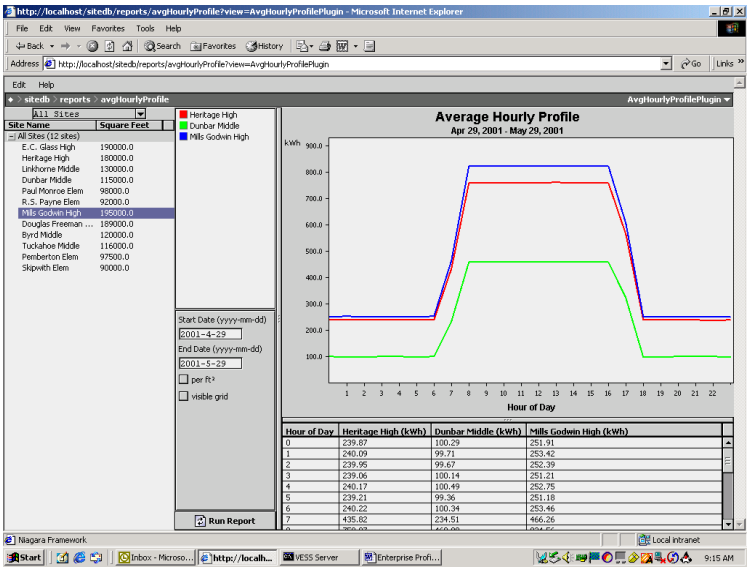
4. **Equipment Operation Reports** - Users will have the ability to analyze digital points and identify run times. Comparisons between sites or points can be made and run times can be graphed. For example, comparing lighting or HVAC run hours in a group of stores or comparing HVAC run hours in June for Store 1 versus Store 2. Data will be displayed in time and percentage.

5. **Relative Contribution Report** – This pie chart report will give users the ability to identify how individual points contribute to a total from a point group. The user would select a group of points, calculate the aggregate consumption of the group, and report on the individual contribution of each. Data will be displayed both graphically in a pie chart as well as in tabular format. Users could identify that HVAC is 48% of the building load; lighting is 42%, or Building 1 accounts for 14% of the total enterprise load and Building 2 contributes 19%. This report will allow users to identify inefficiencies and help perform budgeting.

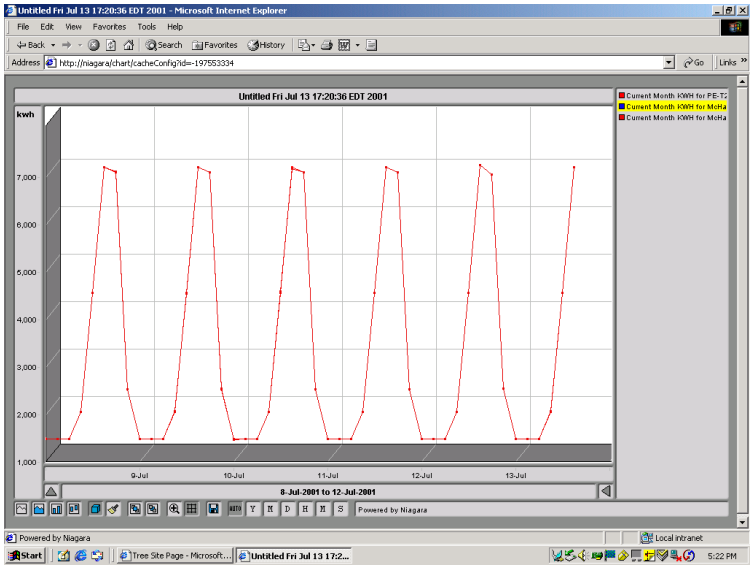


6. **Average Profile** – The report will allow the user to average the load for a single load across time periods and give the average load, and/or aggregate multiple meters (loads) and view the average aggregated load. This report will be very beneficial when negotiating with energy service providers because it includes the load profile and consumption totals. With the ability to filter by time periods, measurement units, points or point groups, weekdays, and weekends, load profiles with associated data will allow the user to procure exactly the amount of energy required. This reduces risk for the energy provider and therefore reduces cost for the end-user.

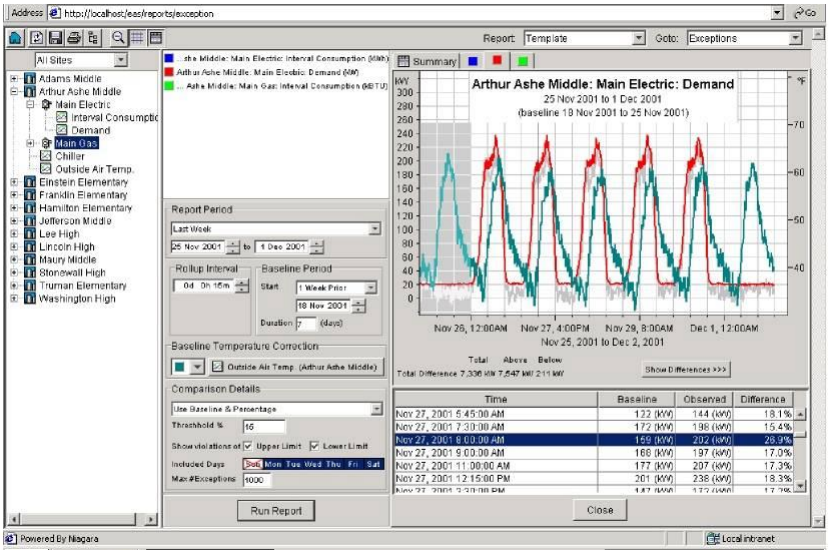
   The user will be able to manipulate between 1-minute intervals and hourly intervals. In addition, users will be able to choose between auto scale and manual scale. For example, if the minimum value is 100KW and the maximum is 500 kW, the user can have the chart automatically scale between those values or they can select any range to scale the 400kW range. When printing charts, this may be useful. This will be useful for sophisticated users who need a higher resolution of data. The following screen shot is an example of the Average Profile Report.



7. **Point Trending** – This report will allow the user to choose a single or multiple points and trend the values over a specified time period. Either analog or digital points can be trended and multiple variables can be selected to be report. For a visual representation of several point values, the user will view all points on the left Y-axis. If the user would like to perform a statistical analysis identifying correlation coefficient and standard deviation between variables, they will have the ability to select a single point for each Y-axis. If a point group has been created, it would be presented as a single point value. The same auto scale/manual scale feature discussed in Average Profile Report is available in Point Trending. The following screen shot is an example of the Point Trending Report.



8. **Exception Report –** This report will identify all data values for the specified period that does not fall in a user-defined range. Although the range will be user definable, the benchmark or baseline to be compared against will be historical data. Users can get to this report by selecting it among the library of report templates, or can automatically be taken here from the Average Profile Report or Point Trending Report by clicking on an “Exception” button once a profile is being viewed.



3.8 WEB BROWSER CLIENTS

The system shall be capable of supporting an unlimited number of clients using a standard Web browser such as Internet Explorer™ or Netscape Navigator™. Systems requiring additional software (to enable a standard Web browser) to be resident on the client machine, or manufacture-specific browsers shall not be acceptable.

The Web browser software shall run on any operating system and system configuration that is supported by the Web browser. Systems that require specific machine requirements in terms of processor speed, memory, etc., in order to allow the Web browser to function with the FMCS, shall not be acceptable.

The Web browser shall provide the same view of the system, in terms of graphics, schedules, calendars, logs, etc., and provide the same interface methodology as is provided by the Graphical User Interface. Systems that require different views or that require different means of interacting with objects such as schedules, or logs, shall not be permitted.

The Web browser client shall support at a minimum, the following functions:

User log-on identification and password shall be required. If an unauthorized user attempts access, a blank web page shall be displayed. Security using Java authentication and encryption techniques to prevent unauthorized access shall be implemented.

Graphical screens developed for the GUI shall be the same screens used for the Web browser client. Any animated graphical objects supported by the GUI shall be supported by the Web browser interface.

HTML programming shall not be required to display system graphics or data on a Web page. HTML editing of the Web page shall be allowed if the user desires a specific look or format.

Storage of the graphical screens shall be in the Network Area Controller (NAC), without requiring any graphics to be stored on the client machine. Systems that require graphics storage on each client are not acceptable.

Real-time values displayed on a Web page shall update automatically without requiring a manual “refresh” of the Web page.

Users shall have administrator-defined access privileges. Depending on the access privileges assigned, the user shall be able to perform the following:

Modify common application objects, such as schedules, calendars, and set points in a graphical manner.

Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator.

Holidays shall be set by using a graphical calendar, without requiring any keyboard entry from the operator.

Commands to start and stop binary objects shall be done by right-clicking the selected object and selecting the appropriate command from the pop-up menu. No entry of text shall be required.
View logs and charts
View and acknowledge alarms
Setup and execute SQL queries on log and archive information
The system shall provide the capability to specify a user's (as determined by the log-on user identification) home page. Provide the ability to limit a specific user to just their defined home page. From the home page, links to other views, or pages in the system shall be possible, if allowed by the system administrator.

i) Graphic screens on the Web Browser client shall support hypertext links to other locations on the Internet or on Intranet sites, by specifying the Uniform Resource Locator (URL) for the desired link.

3.9 SERVER FUNCTIONS AND HARDWARE

A central server shall be provided. The server shall support all Network Area Controllers (NAC) / Router connected to the customer's network whether local or remote.
Local connections shall be via an Ethernet LAN. Remote connections can be via ISDN, ADSL, T1 or dial-up connection.
It shall be possible to provide access to all Network Area Controllers via a single connection to the server. In this configuration, each Network Area Controller can be accessed from a remote Graphical User Interface (GUI) or from a standard Web browser (WBI) by connecting to the server.
The server shall provide the following functions, at a minimum:
Global Data Access: The server shall provide complete access to distributed data defined anywhere in the system.
Distributed Control: The server shall provide the ability to execute global control strategies based on control and data objects in any NAC / Router in the network, local or remote.

ii) The server shall include a master clock service for its subsystems and provide time synchronization for all Network Area Controllers (NAC) / Routers.

The server shall accept time synchronization messages from trusted precision Atomic Clock Internet sites and update its master clock based on this data.
The server shall provide scheduling for all Network Area Controllers and their underlying field control devices.
The server shall provide demand limiting that operates across all Network Area Controllers.
The server must be capable of multiple demand programs for sites with multiple meters and or multiple sources of energy. Each demand program shall be capable of supporting separate demand shed lists for effective demand control.
The server shall implement the BACnet Command Prioritization scheme (16 levels) for safe and effective contention resolution of all commands issued to Network Area Controllers / Routers. Systems not employing this prioritization shall not be accepted.
Each Network Area Controller / Router supported by the server shall have the ability to archive its log data, alarm data and database to the server, automatically. Archiving options shall be user-defined including archive time and archive frequency.
The server shall provide central alarm management for all Network Area Controllers / Routers supported by the server. Alarm management shall include:
Routing of alarms to display, printer, email and pagers
View and acknowledge alarms
Query alarm logs based on user-defined parameters
The server shall provide central management of log data for all Network Area Controllers / Routers supported by the server. Log data shall include process logs, runtime and event counter logs, audit logs and error logs. Log data management shall include:
Viewing and printing log data

Exporting log data to other software applications
Query log data based on user-defined parameters
Server Hardware Requirements: The server hardware platform shall have the following requirements:
The computer shall be an Intel Pentium M based computer (minimum processing speed of 2.4 GHz with 1 GB RAM and a 100-gigabyte minimum hard drive). It shall include a DVD-ROM/CD-RW Combination Drive, 2-parallel ports, 2-asynchronous serial ports and 2-USB ports. A minimum 17" flat panel color monitor, 1280 x 1024 optimal preset resolution, 25 ms response time shall also be included.
The server operating system shall be Microsoft Windows XP Professional. Include Microsoft Internet Explorer 6.0 or later.
Connection to the BMS network shall be via an Ethernet network interface card, 100 Mbps.
A system printer shall be provided. Printer shall be laser type with a minimum 600 x 600-dpi resolution and rated for 60-PPM print speed minimum.
For dedicated alarm printing, provide a dot matrix printer, either 80 or 132 column width. The printer shall have a parallel port interface.

3.10 SYSTEM PROGRAMMING

The Graphical User Interface software (GUI) shall provide the ability to perform system programming and graphic display engineering as part of a complete software package. Access to the programming functions and features of the GUI shall be through password access as assigned by the system administrator.
A library of control, application, and graphic objects shall be provided to enable the creation of all applications and user interface screens. Applications are to be created by selecting the desired control objects from the library, dragging or pasting them on the screen, and linking them together using a built in graphical connection tool. Completed applications may be stored in the library for future use. Graphical User Interface screens shall be created in the same fashion. Data for the user displays is obtained by graphically linking the user display objects to the application objects to provide "real-time" data updates. Any real-time data value or object property may be connected to display its current value on a user display. Systems requiring separate software tools or processes to create applications and user interface displays shall not be acceptable.

3.11 Programming Methods

Provide the capability to copy objects from the supplied libraries, or from a user-defined library to the user's application. Objects shall be linked by a graphical linking scheme by dragging a link from one object to another. Object links will support one-to-one, many-to-one, or one-to-many relationships. Linked objects shall maintain their connections to other objects regardless of where they are positioned on the page and shall show link identification for links to objects on other pages for easy identification. Links will vary in color depending on the type of link; i.e., internal, external, hardware, etc.
Configuration of each object will be done through the object's property sheet using fill-in the blank fields, list boxes, and selection buttons. Use of custom programming, scripting language, or a manufacturer-specific procedural language for configuration will not be accepted.
The software shall provide the ability to view the logic in a monitor mode. When on-line, the monitor mode shall provide the ability to view the logic in real time for easy diagnosis of the logic execution. When off-line (debug), the monitor mode shall allow the user to set values to inputs and monitor the logic for diagnosing execution before it is applied to the system.
All programming shall be done in real-time. Systems requiring the uploading, editing, and downloading of database objects shall not be allowed.
The system shall support object duplication within a customer's database. An application, once configured, can be copied and pasted for easy re-use and duplication. All links, other

than to the hardware, shall be maintained during duplication.

3.12 LonWorks NETWORK MANAGEMENT

The Graphical User Interface software (GUI) shall provide a complete set of integrated LonWorks network management tools for working with LonWorks networks. These tools shall manage a database for all LonWorks devices by type and revision, and shall provide a software mechanism for identifying each device on the network. These tools shall also be capable of defining network data connections between LonWorks devices, known as "binding". Systems requiring the use of third party LonWorks network management tools shall not be accepted.

Network management shall include the following services: device identification, device installation, device configuration, device diagnostics, device maintenance and network variable binding.

The network configuration tool shall also provide diagnostics to identify devices on the network, to reset devices, and to view health and status counters within devices.

These tools shall provide the ability to "learn" an existing LonWorks network, regardless of what network management tool(s) were used to install the existing network, so that existing LonWorks devices and newly added devices are part of a single network management database.

The network management database shall be resident in the Network Area Controller (NAC) / Router, ensuring that anyone with proper authorization has access to the network management database at all times. Systems employing network management databases that are not resident, at all times, within the control system, shall not be accepted.

3.13 OBJECT LIBRARIES

A standard library of objects shall be included for development and setup of application logic, user interface displays, system services, and communication networks.

The objects in this library shall be capable of being copied and pasted into the user's database and shall be organized according to their function. In addition, the user shall have the capability to group objects created in their application and store the new instances of these objects in a user-defined library.

In addition to the standard libraries specified here, the supplier of the system shall maintain an on-line accessible (over the Internet) library, available to all registered users to provide new or updated objects and applications as they are developed.

All control objects shall conform to the control objects specified in the BACnet specification.

The library shall include applications or objects for the following functions, at a minimum:

Scheduling Object. The schedule must conform to the schedule object as defined in the BACnet specification, providing 7-day plus holiday & temporary scheduling features and a minimum of 10 on/off events per day. Data entry to be by graphical sliders to speed creation and selection of on-off events.

Calendar Object. . The calendar must conform to the calendar object as defined in the BACnet specification, providing 12-month calendar features to allow for holiday or special event data entry. Data entry to be by graphical "point-and-click" selection. This object must be "linkable" to any or all scheduling objects for effective event control.

Duty Cycling Object. Provide a universal duty cycle object to allow repetitive on/off time control of equipment as an energy conserving measure. Any number of these objects may be created to control equipment at varying intervals

Temperature Override Object. Provide a temperature override object that is capable of overriding equipment turned off by other energy saving programs (scheduling, duty cycling etc.) to maintain occupant comfort or for equipment freeze protection.

Start-Stop Time Optimization Object. Provide a start-stop time optimization object to provide the capability of starting equipment just early enough to bring space conditions to desired conditions by the scheduled occupancy time. Also, allow equipment to be stopped before

the scheduled un-occupancy time just far enough ahead to take advantage of the building's "flywheel" effect for energy savings. Provide automatic tuning of all start / stop time object properties based on the previous day's performance.

Demand Limiting Object. Provide a comprehensive demand-limiting object that is capable of controlling demand for any selected energy utility (electric, oil, and gas). The object shall provide the capability of monitoring a demand value and predicting (by use of a sliding window prediction algorithm) the demand at the end of the user defined interval period (1-60 minutes). This object shall also accommodate a utility meter time sync pulse for fixed interval demand control. Upon a prediction that will exceed the user defined demand limit (supply a minimum of 6 per day), the demand limiting object shall issue shed commands to either turn off user specified loads or modify equipment set points to effect the desired energy reduction. If the list of sheddable equipment is not enough to reduce the demand to below the set point, a message shall be displayed on the users screen (as an alarm) instructing the user to take manual actions to maintain the desired demand. The shed lists are specified by the user and shall be selectable to be shed in either a fixed or rotating order to control which equipment is shed the most often. Upon suitable reductions in demand, the demand-limiting object shall restore the equipment that was shed in the reverse order in which it was shed. Each sheddable object shall have a minimum and maximum shed time property to effect both equipment protection and occupant comfort.

The library shall include control objects for the following functions. All control objects shall conform to the objects as specified in the BACnet specification.

Analog Input Object - Minimum requirement is to comply with the BACnet standard for data sharing. Allow high, low and failure limits to be assigned for alarming. Also, provide a time delay filter property to prevent nuisance alarms caused by temporary excursions above or below the user defined alarm limits.

Analog Output Object - Minimum requirement is to comply with the BACnet standard for data sharing.

Binary Input Object - Minimum requirement is to comply with the BACnet standard for data sharing. The user must be able to specify either input condition for alarming. This object must also include the capability to record equipment run-time by counting the amount of time the hardware input is in an "on" condition. The user must be able to specify either input condition as the "on" condition.

Binary Output Object - Minimum requirement is to comply with the BACnet standard for data sharing. Properties to enable minimum on and off times for equipment protection as well as interstart delay must be provided. The BACnet Command Prioritization priority scheme shall be incorporated to allow multiple control applications to execute commands on this object with the highest priority command being invoked. Provide sixteen levels of priority as a minimum. Systems not employing the BACnet method of contention resolution shall not be acceptable.

PID Control Loop Object - Minimum requirement is to comply with the BACnet standard for data sharing. Each individual property must be adjustable as well as to be disabled to allow proportional control only, or proportional with integral control, as well as proportional, integral and derivative control.

Comparison Object - Allow a minimum of two analog objects to be compared to select either the highest, lowest, or equality between the two linked inputs. Also, allow limits to be applied to the output value for alarm generation.

Math Object - Allow a minimum of four analog objects to be tested for the minimum or maximum, or the sum, difference, or average of linked objects. Also, allow limits to be applied to the output value for alarm generation.

Custom Programming Objects - Provide a blank object template for the creation of new custom objects to meet specific user application requirements. This object must provide a simple BASIC-like programming language that is used to define object behavior. Provide a library of functions including math and logic functions, string manipulation, and e-mail as a

minimum. Also, provide a comprehensive on-line debug tool to allow complete testing of the new object. Allow new objects to be stored in the library for re-use.
Interlock Object - Provide an interlock object that provides a means of coordination of objects within a piece of equipment such as an Air Handler or other similar types of equipment. An example is to link the return fan to the supply fan such that when the supply fan is started, the return fan object is also started automatically without the user having to issue separate commands or to link each object to a schedule object. In addition, the control loops, damper objects, and alarm monitoring (such as return air, supply air, and mixed air temperature objects) will be inhibited from alarming during a user-defined period after start up to allow for stabilization. When the air handler is stopped, the interlocked return fan is also stopped, the outside air damper is closed, and other related objects within the air handler unit are inhibited from alarming thereby eliminating nuisance alarms during the off period.
Temperature Override Object - Provide an object whose purpose is to provide the capability of overriding a binary output to an “On” state in the event a user specified high or low limit value is exceeded. This object is to be linked to the desired binary output object as well as to an analog object for temperature monitoring, to cause the override to be enabled. This object will execute a Start command at the Temperature Override level of start/stop command priority unless changed by the user.
Composite Object - Provide a container object that allows a collection of objects representing an application to be encapsulated to protect the application from tampering, or to more easily represent large applications. This object must have the ability to allow the user to select the appropriate parameters of the “contained” application that are represented on the graphical shell of this container.
The object library shall include objects to support the integration of devices connected to the Network Area Controller (NAC) / Router. At a minimum, provide the following as part of the standard library included with the programming software:
LonMark/LonWorks devices. These devices shall include, but not be limited to, devices for control of HVAC, lighting, access, and metering. Provide LonMark manufacturer-specific objects to facilitate simple integration of these devices. All network variables defined in the LonMark profile shall be supported. Information (type and function) regarding network variables not defined in the LonMark profile shall be provided by the device manufacturer. For devices not conforming to the LonMark standard, provide a dynamic object that can be assigned to the device based on network variable information provided by the device manufacturer. Device manufacturer shall provide an XIF file, resource file and documentation for the device to facilitate device integration.
For BACnet devices, provide the following objects at a minimum:
Analog In
Analog Out
Analog Value
Binary
Binary In
Binary Out
Binary Value
Multi-State In
Multi-State Out
Multi-State Value
Schedule Export
Calendar Export
Trend Export
Device

For each BACnet object, provide the ability to assign the object a BACnet device and object instance number.

For BACnet devices, provide the following support at a minimum
Segmentation
Segmented Request
Segmented Response
Application Services
Read Property
Read Property Multiple
Write Property
Write Property Multiple
Confirmed Event Notification
Unconfirmed Event Notification
Acknowledge Alarm
Get Alarm Summary
Who-has
I-have
Who-is
I-am
Subscribe COV
Confirmed COV notification
Unconfirmed COV notification
Media Types
Ethernet
BACnet IP Annex J
MSTP
BACnet Broadcast Management Device (BBMD) function
Routing

3.14 DDE DEVICE INTEGRATION

The Network Area Controller / Router shall support the integration of device data via Dynamic Data Exchange (DDE), over the Ethernet Network. The Network Area Controller shall act as a DDE client to another software application that functions as a DDE server.
Provide the required objects in the library, included with the Graphical User Interface programming software, to support the integration of these devices into the BMS. Objects provided shall include at a minimum:
DDE Generic AI Object
DDE Generic AO Object
DDE Generic BO Object
DDE Generic BI Object

3.15 MODBUS SYSTEM INTEGRATION

The Network Area Controller / Router shall support the integration of device data from Modbus RTU, Ascii, or TCP control system devices. The connection to the Modbus system shall be via an RS-232, RS485, or Ethernet IP as required by the device.
Provide the required objects in the library, included with the Graphical User Interface programming software, to support the integration of the Modbus system data into the BMS. Objects provided shall include at a minimum:
Read/Write Modbus AI Registers
Read/Write Modbus AO Registers
Read/Write Modbus BI Registers
Read/Write Modbus BO Registers

All scheduling, alarming, logging and global supervisory control functions, of the Modbus

system devices, shall be performed by the Network Area Controller.
The BMS supplier shall provide a Modbus system communications driver. The equipment system vendor that provided the equipment utilizing Modbus shall provide documentation of the system's Modbus interface and shall provide factory support at no charge during system commissioning.

3.16 OPC SYSTEM INTEGRATION

The Network Area Controller / Router shall act as an OPC client and shall support the integration of device data from OPC servers. The connection to the OPC server shall be Ethernet IP as required by the device. The OPC client shall support third party OPC servers compatible with the Data Access 1.0 and 2.0 specifications.
Provide the required objects in the library, included with the Graphical User Interface programming software, to support the integration of the OPC system data into the BMS. Objects provided shall include at a minimum:
Read/Write OPC AI Object
Read/Write OPC AO Object
Read/Write OPC BI Object
Read/Write OPC BO Object
Read/Write OPC Date/Time Input Object
Read/Write OPC Date/Time Output Object
Read/Write OPC String Input Object
Read/Write OPC String Output Object

All scheduling, alarming, logging and global supervisory control functions, of the OPC system devices, shall be performed by the Network Area Controller / Router.
The BMS supplier shall provide an OPC client communications driver. The equipment system vendor that provided the equipment utilizing OPC shall provide documentation of the system's OPC server interface and shall provide factory support at no charge during system commissioning.

3.17 GRAPHICAL USER INTERFACE COMPUTER HARDWARE (DESKTOP)

The browser workstation shall be an Intel Pentium based computer (minimum processing speed of 2.4 Ghz with 1.0 GB RAM and a 100-gigabyte minimum hard drive). It shall include a DVD-ROM/CD-RW Combination Drive, 2-parallel ports, 2-asynchronous serial ports and 2-USB ports. A minimum 17"flat panel color monitor, 1280 x 1024 optimal preset resolution, 25 ms response time, shall also be included.
Connection to the BMS network shall be via an Ethernet network interface card, 10 Mbps. A system printer shall be provided. Printer shall be laser type with a minimum 600 x 600-dpi resolution and rated for 8 PPM print speed minimum.

3.18 OTHER CONTROL SYSTEM HARDWARE

3.18.1 ELECTRIC AND ELECTRONIC CONTROLS RELATED EQUIPMENT

General Requirements

All controls shall be capable of operating in ambient conditions varying between 0-55 deg. C and 90% R.H. non-condensing.
All Control devices shall have a 20 mm conduit knockout. Alternatively, they shall be supplied with adaptors for 20 mm conduit.

Ancillary Items

When items of equipment are installed in the situations listed below, the BAS contractor shall include the following ancillary items :

(i) Weather Protection
All devices required to be weatherproofed are detailed in the Schedule of Quantities. IP ratings for the equipment is mentioned in the respective section.

(ii) Pipework Immersion
Corrosion resisting pockets of a length suitable for the complete active length of the device, screwed ½" (13 mm) or ¾" (20 mm) NPT suitable for the temperature, pressure and medium.

(iii) Duct Mounting (Metal or Builders Work)
Mounting flanges, clamping bushes, couplings, locknuts, gaskets, brackets, sealing glands and any special fittings necessitated by the device.

Additional features

(i) Concealed Adjustment : All two position switching devices shall have concealed adjustment unless detailed otherwise in the Schedule of Quantities.

(ii) Operating Voltage : All two position switching devices shall operate on 230 v a.c and all accessible live parts shall be shrouded. An earth terminal shall be provided.

3.18.2 TEMPERATURE SENSOR

Temperature sensors for space, pipes and ducts, shall be of the Resistance Temperature detector (RTD) type or thermistor. These shall be two wire type and shall conform to the following specifications :

1) Immersion sensors shall be high accuracy type with a high resistance versus temperature change. The accuracy shall be atleast ± 0.33 degrees F and sensitivity of atleast 2 ohm/F.

2) Immersion sensors shall be provided with separate stainless steel thermo well. These shall be manufactured from bar stock with hydrostatic pressure rating of atleast 10 kgf/cm2.

3) The connection to the pipe shall be screwed ¾ inch NPT (M). An aluminum sleeve shall be provided to ensure proper heat transfer from the well to the sensor. Terminations to be provided on the head. Flying leads shall not be acceptable.

4) The sensor housing shall plug into the base so that the same can be easily removed without disturbing the wiring connections.

5) Duct temperature sensors shall be with rigid stem and of averaging type. These shall be suitable for duct installation.

6) Outdoor air temperature sensor shall be provided with a sun shield.

7) The sensors shall not be mounted near any heat source such as windows, electrical appliances etc.

The temperature sensors may be of any of the following types:

1) PT 100, PT 1000, PT 3000
2) NI 100, NI 1000
3) Balco 500.
4) Thermistor

3.18.3 HUMIDITY SENSOR

Space and duct humidity sensors shall be of capacitance type with an effective sensing range of 10% to 90% RH. Accuracy shall be + 3% or better. Duct mounted humidity sensors shall be provided with a sampling chamber. Wall mounted sensors shall be provided with a housing. The sensor housing shall plug into the base so that the same can be easily removed without disturbing the wiring connections. The sensors shall not be mounted near any heat source such as windows, electrical appliances etc.

3.18.4 FLOW METER

Water flow meters shall be either Ultrasonic type or electromagnetic type. For electromagnetic flow meter, teflon lining with 316 SS electrodes must be provided. The housing shall have IP 55 protection. Vendors shall have to get their design/ selection approved by the Consultant, prior to the supply.

The exact ranges to be set shall be determined by the contractor at the time of commissioning. It should be possible to 'zero' the flow meter without any external instruments, with the overall accuracy of atleast ± 1% full scale.

3.18.5 PRESSURE TRANSMITTER FOR WATER

Pressure transmitters shall be piezo-electric type or diaphragm type. (Bourdon Tube type shall not be acceptable). Output shall be 4-20mA or 0-10V DC and the range as specified in the data sheet depending on the line pressure. Power supply shall be either 24 V AC, 24 V DC or 230 V AC. Connection shall be as per manufacturer's standards. The pressure detector shall be capable of withstanding a hydraulic test pressure of twice the working pressure. The set point shall fall within 40%-70% of the sensing range and detector shall have sensitivity such that change of 1.5% from the stabilized condition shall cause modulation of the corrective element. The sensor must be pressure compensated for a medium temperature of -10 o C to 60o C with ambient ranging between 0 o C to 55 deg C.

3.18.6 DIFFERENTIAL PRESSURE SWITCH FOR PIPE WORK

These shall be used to measure pressure differential across suction and discharge of pumps. The range shall be as specified in the data sheet. Switch shall be ON with increase in differential. Housing for these shall be weather proof with IP 55 protection. The pressure switch shall be capable of withstanding a hydraulic test pressure of 1.5 times the working pressure. The set point shall fall in 40-70% of the scale range and shall have differentials adjustable over 10%-30% of the scale range. The switches shall be provided with site adjustable scale and with 2 NO/NC contacts.

3.18.7 DIFFERENTIAL PRESSURE SWITCH FOR AIR SYSTEMS

These shall be diaphragm operated. Switches shall be supplied with air connections permitting their use as static or differential pressure switches.

The switch shall be of differential pressure type complete with connecting tube and metal bends for connections to the duct. The housing shall be IP 54 rated. The pressure switches shall be available in minimum of 3 ranges suitable for applications like Air flow proving, dirty filter, etc. The set point shall be concealed type. The contact shall be SPDT type with 230 VAC, 1 A rating.

The switch shall be supplied suitable for wall mounting on ducts in any plane. It should be mounted in such a way that the condensation flow out of the sensing tips. Proper adaptor shall be provided for the cables.

The set point shall fall within 40%-70% of the scale range and l has differentials adjustable over 10%-30% of the scale range.

The switches shall be provided with site adjustable scale and with 2 NO/NC contacts.

3.18.8 AIR FLOW SWITCHES

Air flow switches shall be selected for the correct air velocity, duct size and mounting attitude. If any special atmospheric conditions are detailed in the Schedule of Quantity the parts of the switches shall be suitably coated or made to withstand such conditions. These shall be suitable for mounting in any plane. Output shall be 2 NO/NC potential free. Site adjustable scale shall also be provided.

3.18.9 AIR PRESSURE SENSOR

The pressure sensor shall be differential type. The construction shall be spring loaded diaphragm type. The movement of the membrane in relation to the pressure should be converted by an inductive electromagnet coupling which would give an output suitable for the controller. The pressure sensor shall be in a housing having IP 54 ratings in accordance with IEC 529. Suitable mounting arrangement shall be available on the sensor. The sensor shall come complete with the PVC tubes & probes.

3.18.10 WATER FLOW SWITCH

These shall be paddle type and suitable for the type of liquid flowing in the line. Output shall be 2NO/2NC potential free.

3.18.11 TRANSDUCERS FOR ELECTRICAL SERVICES

Electrical transducers shall be integrated electronic type and rack mounted on the field. These shall work on 230 V supply with the output being standard type i.e. 4-20 mA, 0- 10 Volts etc.

Power factor, Voltage, Current, Frequency and Kilowatt transducers shall have standard output signal for measurement for the specified variable.

Kilowatt-Hour metering (if any) shall be poly-phase; three- element with current transformer (CT) operated type. The metering shall feature high accuracy with no more than +/- 1% error over the expected load range. The coils shall be totally encapsulated against high impulse

levels.

3.18.12 LEVEL SWITCH

The level switches shall have to meet the following requirement:

Type	:	Float Type/Capacitance type/Conductivity type
Mounting	:	To suit application.
Connection	:	Flanged ANSI 150 lbs RF Carbon steel
Float material	:	316 SS
Stem Material	:	316 SS
Output	:	2 NO, 2 NC potential free
Switch Enclosure	:	IP 55

3.18.13 DIGITAL THERMOSTATS

Thermostats for FCU's should be Digital on/off OR Modulating Type for Actuating 2 way or 3 way Valves (On-off/Modulating)

Thermostats should display Room Temp and Set point simultaneously which is easy to read from atleast 6-8 feet distance.

Thermostats should have Fan Speed Control Switch (Low-Med-High-Auto). Auto Mode should be able to save energy by automatically reducing the Fan Speed when Room Temp Achieves Set Point.

LCD Display should be available in Blue or Green Backlit for ease in viewing the Room Temperature and Setpoint.

Thermostats should work on 230V PS for on-off models and 24V for Modulating Thermostats

The User Settings should be retained in Thermostat Memory in case of Power Failure

The Switching Relays should be separately wired and should be mounted inside the Junction Box, so that the Thermostat front is sleek in mounting. Thermostat Thickness should be 17mm or less.

Thermostats should have Energy Savings Feature with dual setpoint which can be interlocked with Occupancy Sensor or Hotel Key Card input. This should be indicated in the LCD Display in the mode it is being operated. This Programming should be possible by maintenance Staff.

Thermostats should be similar or equivalent to Honeywell Halo Series Digital Thermostats Model T6861(on/off) or T6865(modulating) version.

3.18.14 Pressure Independent Dynamic Balancing Valve (ranges from25mm to 150mm)

The Valve should have self Dynamic Flow Control Valves that are pressure independent, two way, Modulating to accept digital/ analog input BMS/ Controller signals and should provide position feedback signal to the control system. The Feedback signal should have the feedback feature of the Valve/ Actuator itself without any need of any additional accessory/ instrument/ device.

- **PICV should be capable of maintaining the max flow rate atleast +/-4%** Accuracy
- The PICV Should be capable of maintaining **Linear Temperature Control, Pressure Independence and Electric Modulation in one Valve body.**
- The Flow rates should be **field settable electronically upto 60% of the valve Max set Flow rate**
- The Differential Pressure Ranges for which the valve can maintain the flow rates should be mentioned in the Product literature
- Valve Actuator housing shall be rated to **IP54**
- Actuator shall be driven by a 24Vac power supply and shall accept universal Input signals like 0/2-10Vdc or 4-20mA signal
- Actuator shall be capable of providing feedback Signal of 0/2-10Vdc to the Control System/BMS
- PICV should have an **option for adjusting the Flow Characteristics as per AHU in every PICV to ensure Linear Temp Control.**
- PICV should have an option for changing the Max Flow Rates in future and no additional Instrument should be required. Flow Values can be changed by entering in LCD Display only and not by any DIP Switches or Setting Dial to improve accuracy.
- PICV shall provide **full valve Authority**
- PICV Valve body shall be rated at least **PN16**
- **Max Close off Pressure** shall be mentioned in the Product Datasheet.
- Min Working Differential Pressure shall be **30Kpa**
- Valve shall be Internal BSP Threaded from DN25 to DN50 and Flanged end Connection for DN65 to DN150
- Min Stroke Length of the Valve shall be **20mm**
- Media Temperature : **0-130 deg C**
- Valve shall be of Brass/Bronze Construction upto DN50 and Cast Iron upto DN150
- Shut off Leakage shall be **0.1 Kvs**

3.18.15 Motorized Butterfly Valve

Valve Body

Type of Valve	:	Butterfly Valve
Body Material	:	Cast Iron or Ductile Iron Body
Disc Material	:	Nickel plated Ductile Iron
Stem	:	SS416
Liner Material	:	EPDM
Nominal Static Body Rating	:	PN16
Tightness	:	Bubble Tight
Medium Temperature	:	-10 dec C to 120 deg C
Pipe Connection	:	ISO7005-2

Actuator

Type	:	Electric
Motor Supply	:	230 Vac, 50hz/60Hz
Travel Angle	:	90 deg +/- 5 deg
Enclosure	:	IP67 Waterproof
Indicator	:	Continuous Position Indicator
Space Heater	:	15W 220V Anti Condensation
Stall Protection	:	Built-in thermal protection Cut off at 125 ± 5 Reset at 95 ± 5
Manual Override	:	By Handwheel, nonclutch design

Torque Limit Switches	:	2 nos
External Coating	:	Dry Aluminium Alloy in Painted Black

3.18.16 On/Off type FCU valves

Two way on/off type FCU valve

The two way FCU valve should be design in such a way that it can withstand a static pressure of 20 bar and a burst pressure of 100 bar.

The ports are designated in such a way that flow through the two way valve can be in either direction.

The valve shall be designed to handle the fluid temperature from1degreeC to 95degreeC

It can withstand the differential pressure upto 4 Bar.

The valve is of bronze body with stainless steel stem and Noryl cover.

The FCU valve shall have a minimum stroke length of 10mm so that it has the sufficient distance to travel.

The hydronic FCU valves shall been designed to meet the European standard EN 60730-2-8.

The actuator shall require the power supply of 220 Volts AC so that no transformer is required.

The actuator is easily removable from the valve so that in case the actuator fails at site it can be easily replaced without affecting the integrity of the water system.

The actuator shall have the provision to operate manually.

The actuator shall meet the low voltage directive 73/23/EEC. The actuator shall be selected in such a way that the maximum power consumed by the actuator is 6 Watt.

The valve should be as per list of approved makes but equivalent to Honeywell VC6013 version.

3.18.17 Snap Acting Digital Thermostats

Thermostats for FCU's should be Digital on/off for Actuating 2 way or 3 way Valves (On-off/Modulating)

Thermostats should display Room Temp and Set point simultaneously which is easy to read from at least 6-8 feet distance.

Thermostats should have Fan Speed Control Switch (Low-Med-High-Auto). Auto Mode should be able to save energy by automatically reducing the Fan Speed when Room Temp Achieves Set Point.

LCD Display should be available in Blue or Green Backlit for ease in viewing the Room

Temperature and Set point.

Thermostats should work on power supply of 230V for on-off models.

The User Settings should be retained in Thermostat Memory in case of Power Failure

The Switching Relays should be separately wired and should be mounted inside the Junction Box, so that the Thermostat front is sleek in mounting. Thermostat Thickness should be 17mm or less

Thermostats should have Energy Savings Feature with dual set point which can be interlocked with Occupancy Sensor or Hotel Key Card input. This should be indicated in the LCD Display in the mode it is being operated. This Programming should be possible by maintenance Staff.

Thermostats should be as per list of approved makes but equivalent to Honeywell Halo Series Digital Thermostats Model T6861 (on/off) version.

EXECUTION

INSTALLATION

All work described in this section shall be performed by system integrators or contractors that have a successful history in the design and installation of integrated control systems.
Install system and materials in accordance with manufacturer's instructions, and as detailed on the project drawing set.
Drawings of the BMS network are diagrammatic only and any apparatus not shown, but required to make the system operative to the complete satisfaction of the Architect shall be furnished and installed without additional cost.
Line and low voltage electrical connections to control equipment shown specified or shown on the control diagrams shall be furnished and installed by this contractor in accordance with these specifications.
Equipment furnished by the HVAC Contractor that is normally wired before installation shall be furnished completely wired. Control wiring normally performed in the field will be furnished and installed by this contractor.

WIRING

All electrical control wiring and power wiring to the control panels, NAC, computers and network components shall be the responsibility of the contractor.
The electrical contractor shall furnish all power wiring to electrical starters and motors.
All wiring shall be in accordance with the Project Electrical Specifications, the National Electrical Code and any applicable local codes. All BMS wiring shall be installed in the conduit types specified in the Electrical Specifications unless otherwise allowed by the National Electrical Code or applicable local codes. Where BMS plenum rated cable wiring is allowed it shall be run parallel to or at right angles to the structure, properly supported and installed in a neat and workmanlike manner.

WARRANTY

Equipment, materials and workmanship incorporated into the work shall be warranted for a period of one year from the time of system acceptance.
Within this period, upon notice by the CLIENT, any defects in the work provided under this section due to faulty materials, methods of installation or workmanship shall be promptly (within 48 hours after receipt of notice) repaired or replaced by this contractor at no expense to the CLIENT.

WARRANTY ACCESS

The CLIENT shall grant to this contractor, reasonable access to the BMS during the warranty period.

The CLIENT shall allow the contractor to access the BMS from a remote location for the purpose of diagnostics and troubleshooting, via the Internet, during the warranty period.

SOFTWARE LICENSE

CLIENT shall be the named license holder of all software associated with any and all incremental work on the project(s). The owner, or his appointed agent, shall determine which organizations to be named in the “orgid” of all software licenses.

CLIENT, or his appointed agent, shall be free to direct the modification of the “orgid” in any software license, regardless of supplier.

The owner, or his appointed agent, shall receive ownership of all job specific software configuration documentation, data files, and application-level software developed for the project. This shall include all custom, job specific software code and documentation for all configuration and programming that is generated for a given project and /or configured for use within based controllers and/or servers and any related LAN / WAN / Intranet and Internet connected routers and devices. Any and all required Ids and passwords for access to any component or software program shall be provided to the owner.

ACCEPTANCE TESTING

Upon completion of the installation, this contractor shall load all system software and start-up the system. This contractor shall perform all necessary calibration, testing and de-bugging and perform all required operational checks to insure that the system is functioning in full accordance with these specifications.

This contractor shall perform tests to verify proper performance of components, routines, and points. Repeat tests until proper performance results. This testing shall include a point-by-point log to validate 100% of the input and output points of the DDC system operation.

Upon completion of the performance tests described above, repeat these tests, point by point as described in the validation log above in presence of CLIENT's Representative, as required. Properly schedule these tests so testing is complete at a time directed by the CLIENT's Representative. Do not delay tests so as to prevent delay of occupancy permits or building occupancy.

System Acceptance: Satisfactory completion is when BMS contractor have performed successfully all the required testing to show performance compliance with the requirements of the Contract Documents to the satisfaction of CLIENT Representative. System acceptance shall be contingent upon completion and review of all corrected deficiencies.

OPERATOR INSTRUCTION AND TRAINING

During system commissioning and at such time acceptable performance of the BMS hardware and software has been established this contractor shall provide on-site operator instruction to the owner's operating personnel. Operator instruction shall be done during normal working hours and shall be performed by a competent representative familiar with the system hardware, software and accessories.

This contractor shall provide 40 hours of instruction to the CLIENT's designated personnel on the operation of the BMS and describe its intended use with respect to the programmed functions specified. Operator orientation of the systems shall include, but not be limited to; the overall operation program, equipment functions (both individually and as part of the total integrated system), commands, systems generation, advisories, and appropriate operator intervention required in responding to the System's operation.

The training shall be in three sessions as follows:

Initial Training: One day session (8 hours) after system is started up and at least one week

before first acceptance test. Manual shall have been submitted at least two weeks prior to training so that the owners' personnel can start to familiarize themselves with the system before classroom instruction begins.
First Follow-Up Training: Two days (16 hours total) approximately two weeks after initial training, and before Formal Acceptance. These sessions will deal with more advanced topics and answer questions.
Warranty Follow Up: Two days (16 hours total) in no less than 4 hour increments, to be scheduled at the request of the owner during the one year warranty period. These sessions shall cover topics as requested by the owner such as; how to add additional points, create and gather data for trends, graphic screen generation or modification of control routines.

3.19 EXISTING INFRASTRUCTURE

In addition to the proposed BMS system (I/O summary may be referred below in table no. 08008.II.001), the contractor shall also upgrade and integrate existing BMS system. The contractor shall ensure that the the system installed by the contractor shall be compatible with the existing system which is of Honeywell make. The I/O summary is attached as Annexure-I to this technical specification. The proposed system developed by the contractor shall be fully compatible with the existing infrastructure. The contractor shall upgrade the existing system to monitoring + control. The rate quoted by the contractor shall be inclusive of the same and no extra payment shall be made to the contractor on this account.

TABLE NO - 08008.II.001 : I/O SUMMARY

S.NO.	ITEM DESCRIPTION	QTY	AI	AO	DI	DO	Field Devices
	ELECTRICAL						
1	**DG SETS**	3					
I	MODBUS integration of DG- 20 points MODBUS over RS485						
TOTAL			**0**	**0**	**0**	**0**	
2	**HT PANELS INCOMING (11 kV Panel)**	1					
I	Main breaker ON/OFF Status		x	x	1	x	Volt free contact from panel
ii	Trip status		x	x	1	x	Volt free contact from panel
4	**OUTGOING PANELS (11 kV Panel)**	4					
I	Main breaker ON/OFF Status		x	x	4	x	Volt free contact from panel
ii	Trip status		x	x	4	x	Volt free contact from panel
TOTAL -ESS			**0**	**0**	**10**	**0**	
	Fire Alarm System						
I	Monitoring of Fire Alarm control panel data through software integration						Bacnet/Modbus output by Fire alarm control panel networked at one port
TOTAL - F.A			**0**	**0**	**0**	**0**	
	Lifts & Escalators	10					
I	ON-OFF Status		x	x	10	x	Volt free contact from panel
ii	Trip status		x	x	10	x	Volt free contact from panel
Modbus integration of lifts - 10 points for each lift on MODBUS- RS485							
TOTAL - Lifts			**0**	**0**	**20**	**0**	

TABLE NO - 08008.II.001 : I/O SUMMARY

S.NO.	ITEM DESCRIPTION	QTY	AI	AO	DI	DO	Field Devices
	PLUMBING						
1	**RO Plant**	**1**					
I	RO Plant Status		x	x	1	x	Relay Output
ii	RO Plant On-Off		x	x	x	1	Relay Output
iii	RO Plant Trip Status		x	x	1	x	DP switch
1	**Borewell Pumps**	**1**					
I	Pump Status		x	x	1	x	Relay Output
ii	PumpOn-Off		x	x	x	1	PFC
iii	PumpTrip Status		x	x	1	x	DP switch
1	**Water Treatment Plant**	**1**					
I	WTP pump ON/OFF Status		x	x	1	x	Relay Output
ii	WTP pump On-Off command		x	x	x	1	PFC
iii	WTP pump Trip Status		x	x	1	x	DP switch
iv	WTP tank level status		x	x	2	x	Water level switch
1	**Effluent Treatment Plant**	**1**					
I	ETP ON/OFF pump Status		x	x	1	x	Relay Output
ii	ETP pump On-Off control		x	x	x	1	PFC
iii	ETP Pump Trip Status		x	x	1	x	DP switch
2	**Soft Water Pumps**	**2**					
I	Pump Status		x	x	2	x	Relay Output
ii	PumpOn-Off		x	x	x	2	PFC
iii	PumpTrip Status		x	x	2	x	DP switch
8	**Fire Pumps inc;luding Downcomer**	**3**					
ii	Jockey/Hydrant/Sprinkler/ Engine /terrace pumps run Status		x	x	3	x	Current relay
v	Line pressure		1	x	x	x	Pressure Sensor
9	**Tanks**						
I	Overhead tanks Hi/Lo status	4	X	x	4	x	Level Switch
ii	Under ground tank Hi/Lo status	2	X	x	2	x	Level Switch
	Sub Total for Fire Fighting						
TOTAL - PLUMBING		**15**	**1**	**0**	**23**	**6**	
10	**HVAC**	10					
1	Duct Type Temp sensor			x	10	x	
2	Ceiling mounted FCU for fan status		x	x	10	x	
TOTAL - HVAC		**10**	**0**	**0**	**20**	**0**	

SOLAR PV PLANT

4. GENERAL

4.1 SCOPE OF WORK

The scope of the work covers design, supply, installation, commissioning of direct on line hybrid Solar PV Power Plants of Total capacity 350 kWp. as per the enclosed technical specifications & approval of MNRE. The quoted rates should be inclusive of comprehensive maintenance (AMC) for 5 years.

The Solar Power Plants will be in units of capacity 12 KWp, 15 KWp, 25 KWp, 50 KWp or 100 KWp as per availability of area for installation of PV panels. The PV Modules of the units will be installed on the roof-tops of the Parking Sheds & Terrace of the proposed building for Office Of Connectivity. The solar power units single or in groups shall be connected to the AC Bus bar of the Electrical Distribution system of the nearest building. The Solar power system shall be suitable for On-Line operation with both mains supply and DG supply.

The contractor shall prepare Detailed Project Report with detailed design, drawings and equipment datasheet etc. for the complete Solar Power System, which will be submitted to the MNRE for Approval. After approval & confirmation of the subsidy from MNRE the work will be executed at site.

The work shall be executed on turnkey bases and shall be inclusive of all material equipment and labour required for the Solar PV Plant. Any material / equipment not specifically mentioned but is required shall be deemed to be inclusive in the scope of work.

The equipment and materials for Grid Tied Solar Photovoltaic Power Plant of capacities mentioned above with associated power evacuation system shall include but not limited to the supply, erection, testing, commissioning and integration of the followings:

a) Solar PV modules of composite capacity as mentioned above including mounting frames, structures, array foundation and module inter connection,
b) Array Junction boxes.
c) Power Conditioning Units that are communicable on Modbus Protocol.
d) Common AC power evacuation panel with bus bars and circuit breakers.
e) Metering and protection /Isolation systems. Meters to be communicable on MODBUS Protocol
f) LV Power and Control Cables including end terminations and other required accessories for both AC & DC power.
g) Earthing/ & lightning protection system for PV Array, DC power system, AC power system and LT equipment etc. for control room, PCU, Data acquisition system with remote monitoring facilities1.
h) Transportation of equipment from works to site.
i) Unloading, loading in of all supplied equipment's on foundations at their respective places
j) Pre-Commissioning & Commissioning of all supplied equipment's
k) Test running of Grid Connect Solar Plant as well as load trials at site.
l) Contractor shall be responsible for obtaining all statutory clearances including but not limited from Electrical Inspector regarding operation of the Plant. Purchaser shall however facilitate to ensure that the same is obtained successfully.
m) The system should be capable of providing all the data including that of meter and

PCU to the central software on IEC-104 protocol. All the equipment's / hardware / software for complying with the same will be in the contractor's scope.

n) The contractor has to submit the cable route plan/diagram for getting the approval of ROW from the client department.
o) Solar PV Plants connections
p) The Power Output of 12 / 15 KWp Solar PV Plant on rooftop of Parking Sheds shall be synchronized with the existing LT supply bus of the nearest existing building
q) The Power Output of 2x100 KWp Solar PV Plant on rooftop of OOC BLOCK shall be synchronized with the LT supply bus of the local distribution board of the building itself.

Subsidy from MNRE shall be claimed directly by the Owner from the ministry. The contractor shall provide required documents & assistance as required to the owner or his representative to get approval of the Solar Power System and claim subsidy from the Ministry.

4.2 Codes and standards:

The quality of equipment supplied shall be controlled to meet the guidelines for engineering design. The items / components of the SPV plant supplied shall conform to the latest standards and codes listed in the relevant IEC/ISI and other standards/ MNRE specifications:

- Solar PV Modules----IEC 61215 /IS14286
- Requirements of construction, testing & safety of PV modules------IEC 61730 (part1&2)
- Salt Mist corrosion testing of PV modules-----IEC 61701
- Solar PV system setting, environment testing & efficiency ----IEC 60364-712 &IEC 60068-2
- Charge Controller/MPPT units----------IEC 60068-2
- PCU / Inverters---------IEC 61683
- Cables &Wires---IS 694 & IS1554 (1&2)
- Switches / Circuit Breakers / Connectors----IS 60947 part I, II& III
- Junction boxes/Inverters/charge controllers----IP 64 (for outdoor) & IP 21 (for Indoors) as per IEC 529
- National Electrical Safety Code ANSI C2-(USA) or equivalent national standard.
- The inverter manufacturer should attach efficiency certificate from Independent Third Party Testing laboratory i.e. IEC, TUV, SNL/ERTL or STQC.

The work shall be executed as per CPWD & MNRE General Specifications for electrical works and as relevant IS codes or codes specified in the Technical Specifications and as per directions of the Engineer-in-Charge.

4.3 Spare Parts

Contractor shall mention recommended spares with their price in their offer. They are also required to furnish the availability of essential spares at their nearest service centre.

4.4 Ambient Condition & Solar Insulation

Contractors will seek from relevant database / source, all the data pertaining to the ambient conditions like temperature, humidity, wind load, rain, weather condition and historical solar radiation etc., pertaining to the site location and optimize the design accordingly. All design calculations shall be submitted.

4.5 Bill of Materials

A complete bill of materials inclusive of Solar PV Modules, array junction box, main junction box, cables, PCU, Array mounting structures, etc shall be provided along with the offer. The numbers of each component proposed for supply shall be clearly specified. The items not listed in BOM but required for successful installation/ commissioning of SPV power plant shall also be considered to be part of the supply scope without any extra cost to the owner.

5. EQUIPMENT SPECIFICATION

5.1 Solar PV Module (Electrical Features)

5.1.1 Solar PV module array will be made by utilizing Crystalline high efficiency Silicon Solar PV cells. The total solar power array capacity should not be less than the specified KWp of the plant. Minimum power output guarantee offered for the SPV Module shall not be less than 20 years. Individual solar module rating will not be less than 80 Wp @ STC. Preference will be given to contractors offering bigger solar PV module (>80 Wp). Each Solar PV module offered shall meet following min. requirement.

- Fill Factor, FF - 0.68%
- Efficiency of cell, Ef,c - 14%
- Efficiency of module, Ef,m - 12.5%

Solar PV modules shall conform to IEC-61215 standards. Documentary evidence towards IEC-61215 certification shall be submitted with the bid• IEC 61215 / IS14286. In addition, the modules must conform to IEC 61730 Part 1(requirements for Construction) & Part 2 (requirements for testing, for safety qualification). Further, the PV modules must also qualify the Salt Mist Corrosion Testing as per IEC 61701/ IS 61701.

5.1.2 The PV modules shall perform satisfactorily in humidity up to 100 % with temperature between -40ºC to +85ºC. Since the modules would be used in a high voltage circuit, the high voltage insulation test shall be carried out on each module and a test certificate to that effect be provided.

5.1.3 The prescribed electrical degradation shall not be less than 10 (ten) percent of the full rated original output at the end of the period of 12 years and not less than 20 (twenty) percent of the full rated original output at the end of 25 years.

5.1.4 Manufacturers/suppliers should confirm whether they are supplying PV modules using a RF identification tag (RFID), which must contain the following information. The RFID shall be placed inside the module laminate, and must be able to withstand harsh environmental conditions.

Name of Manufacturer of PV module & Solar Cells,
Month & Year of Manufacture,
Country of origin,
I-V curve for Module
Peak Wattage, Im,Vm & FF for the module
SNo & Model No Of module
Ref. of obtaining IEC & test Lab. And other information as per ISO 9000. Etc

5.1.5 Test Certificate/ Reports from Authorized testing laboratories/ centers: Manufactures shall get the samples of solar PV modules tested as per the new format/ procedure and submit valid test certificates from authorized testing laboratories/ centres.

5.1.6 Warranty for PV Modules: PV modules used in solar power plants/ systems must be warranted for their output peak watt capacity, which should not be less than 90% at the end of 12 years and 80% at the end of 25 years.

5.2 Solar PV Module (Mechanical Features)

Solar PV Module design will conform to following Mechanical requirement

- Toughened, low iron content, high transmissivity front glass.
- Anodized Aluminium Frame
- Ethyl Vinyl Acetate (EVA) encapsulant
- Silicon edge sealant around laminate
- Tedlar / Polyester trilaminate back surface
- ABS plastic terminal box for the module output termination with gasket to prevent water moisture.
- Resistant to water, abrasion, hail impact, humidity & other environment factor for the worst situation at site.
- Bypass diode.

5.3 Module mounting structure

The array structure shall be made of hot dip galvanized MS angles of size not less than 50mm x 50mm x 6mm size. The minimum thickness of galvanized shall be at least 80 microns. All nuts & bolts shall be made of good quality stainless steel.

The work should be completed with supply, fitting fixing of clamps, saddles, nut & bolts etc. While quoting the rate, the contractor may mention the design & type of structure offered. All nuts & bolts shall be made of very good quality stainless steel.
The structure shall be designed to allow easy replacement of any module and shall be in line with site requirements.

The structure shall be designed for simple mechanical and electrical installation. It shall support SPV modules at a given orientation, absorb and transfer the mechanical loads to the ground properly. There shall be no requirement of welding or complex machinery at site.
The array structure shall be so designed that it will occupy minimum space without sacrificing the output from SPV panels & shall withstand heavy winds.

The supplier/ manufacturer shall specify installation details of the PV modules and the support structures with appropriate diagrams and drawings.

5.4 Junction Boxes

The junction boxes shall be dust, vermin and waterproof of IP 64 rating for outdoors & IP 21 for indoors and made of FRP / Thermo Plastic. The terminals shall be connected with copper lugs to copper bus bars of proper size. The junction boxes shall have suitable cable entry

points fitted with cable glands of appropriate sizes for both incoming and outgoing cables. Suitable marking shall be provided on the bus bars or lugs for easy identification and cable ferrules shall be fitted at the cable termination points for identification. The junction boxes shall have suitable arrangement for the following:

- Complete groups of modules into independent charging sub-arrays that shall be wired to the controller.
- Provide arrangement/suitable fuses for disconnection for each of the groups/strings.
- To provide groups array isolation.
- The rating of the JB's shall be suitable with adequate safety factor to inter connect
- the Solar PV array.
- Surge arrestors & Overload protection shall be provided inside the array Junction Boxes

5.5 Power Conditioning Unit (PCU)

The PCU is a combination of Solar Charger (MPPT), Inverter, AC Charger and data logger all housed in a single unit. Maximum power point tracker (MPPT) shall be integrated into the PCU to maximize energy drawn from the solar PV array. MPPT shall be microprocessor/micro controller based to minimize power losses and maximize energy utilization. The efficiency of MPPT shall not be less than 94%. MPPT should have provision of manual setting for constant voltage operation and the unit should conform to IEC:62093 for design and IEC:600682 for environmental testing.

Power conditioning unit will comply the following requirements.

- 415V AC + 5% 50Hz, 3 Phase
- Overload capacity – 150% for 60sec.
- Output wave shape: sine wave with <3% total harmonic distortion (THD).

5.6 Inverter

Inverter is the main component of the system and does the function of inverting DC to AC. The Inverter will convert DC power produced by SPV modules, in to AC power and adjust the voltage & frequency levels to suit the local grid /DG supply conditions and shall feed directly the electrical load through AC distribution board of individual blocks.
The Inverter shall have efficiency greater than 90% at full load under ambient condition of 40 degree C and shall be suitable for the following solar PV plant capacity.

S. No.	Name of the Building	Proposed Solar PV Plant Capacity	Inverter Size/ Continuous Rating
1	Parking Sheds	12 or 15 KWp	Suitable rating as per capacity of solar PV plant.
2	OOC Block	2x100 KWp	Suitable rating as per capacity of solar PV plant.

It should be possible to maintain the inverter easily. There should be a provision to isolate input & output connections. It should also be possible to monitor & log the salient parameters through a standard bus on a PC. RJ 232 provision should be available in PCU to log system performance and energy generation data through a PC.

Data logger is part of the PCU and contractor shall supply Desk Top Computer (I-5 INTEL Processor, >3.4 GHz speed, 4 GB DDR, 500 GB HDD, DVD-ROM Drive, and 18" Colour Monitor of reputed make) with an Inkjet printer and allied network cables to connect the RJ 232 port of the PCU.

5.7 Common Technical Specification

- Control Type: Voltage source, microprocessor assisted, output regulation
- Output Voltage: 3 phase, 415 Vac (+12.5%, -20% Vac)
- Frequency: 50 Hz (+3 Hz, -3 Hz)
- Continuous rating: As per SPV plant capacity
- DC link voltage range: 0 to 800 V
- Nominal Power: As per SPV plant capacity
- Total Harmonic Distortion: less than 3%
- Maximum current ripple: 4% PP
- Reactive Power: 0.95 inductive to 0.95 capacitive
- Operating Temperature Range: 0 to 55 deg C
- Housing Cabinet: INVERTER to be housed in suitable switch cabinet, within IP 65 Degree of ingress protection
- Inverter efficiency: 94% and above at full load,
- Power Control: MPPT

5.8 Other Important Features/ Protections required in the INVERTER

- Automatic morning wake-up and nightly shutdown
- Mains (Grid) over-under voltage and frequency protection
- Fool Proof protection against ISLANDING
- Designed to withstand starting in – rush current when pump is started and provide trip free operation
- Included authentic tracking of the solar array's maximum power operation voltage (MPPT)
- Array ground fault detection
- LCD and piezoelectric keypad operator interface Menu driven
- Automatic fault conditions reset for all parameter like voltage, frequency and/or black out.
- MOV type surge arrester on AC and DC terminals for over voltage protection from lightening-induced surges.
- INVERTER should be rated to operate at 0-55 deg. centigrade unless provision for air conditioning is included in INVERTER
- All parameters should be accessible through an industry standard communication link.

- Overload capacity (for 10 sec) should be 150% of continuous rating.
- The PCU shall give the preference to feed the loads from Solar Energy being produced and shall draw the additional power from mains /DG set to meet the load requirements in case the load is more than the solar energy being produced.
- PCU shall be capable to synchronize independently & automatically/to be phase locked with DG supply/ Grid Power Supply line frequency to attain synchronization & export power generated by the solar panel to the load through existing distribution system.
- Since the INVERTER is to be used in solar photovoltaic energy system, it should have high operational efficiency. The DC to AC conversion efficiency shall at least be 95percent at full load. The idling current at no load must not exceed 2 percent of the full load current.
- Transformer less inverters shall be preferred. Restriction of DC components on AC side shall be achieved.
- The INVERTER output shall be 415 VAC, 50 Hz 3 phase.
- The INVERTER shall be capable of operating in parallel with the grid utility service/DG Supply and shall be capable of interrupting line-to-line fault currents and line-to-ground fault currents.
- The INVERTER shall be able to withstand an unbalance output load to the extent of 30%.
- The INVERTER shall include appropriate self-protective and self-diagnostic features to protect itself and the PV array damage in the event of INVERTER component failure or from parameters beyond the INVERTER's safe operating range due to internal or external causes. The self-protective features shall not allow signals from the INVERTER front panel to cause the INVERTER to be operated in a manner which may be unsafe or damaging. Faults due to malfunctioning within the INVERTER, including commutation failure, shall be cleared by the inverter protective devices and not by the existing site utility grid service circuit breaker.
- The INVERTER shall go to shut down/standby mode, with its contacts open, under the following conditions before attempting an automatic restart after an appropriate time delay;

I. Insufficient Solar Power Input

When the solar available from the PV array is insufficient to supply the losses of the INVERTER, the INVERTER shall go to a standby/shutdown mode. The INVERTER control shall prevent excessive cycling during rightly shut down or extended periods of insufficient solar radiation.

II. Utility-Grid Over or Under Voltage

The INVERTER shall restart after an over or under voltage shutdown where the utility grid voltage has returned to within limits for a minimum of two minutes.

III. Utility-Grid Over or Under Frequency

The INVERTER shall restart after an over or under frequency shutdown when the utility grid voltage has returned to within limits for minimum of two minutes.

The contractor shall supply all installation accessories, which are required to install and successfully commission the power plant.

Over Voltage Protection: Over Voltage Protection against atmospheric lightening discharge to the PV array is required. Protection is to be provided against voltage fluctuations in the grid itself and internal faults in the power conditioner, operational errors and switching transients.
Earth fault supervision: An integrated earth fault device shall have to be provided to detect eventual earth fault on DC side and shall send message to the supervisory system

Cabling practice: Cable connections must be made PVC Cu. cable, as per BIS standards
The INVERTER enclosure shall be weatherproof and capable of surviving climatic changes and should keep the INVERTER intact under all conditions in the room where it will be housed. The INVERTER shall be located indoor and should be wall/pad mounted, Moisture condensation and entry of rodents and insects shall be prevented in the INVERTER enclosure.

cable connections must be made using suitable terminations for effective contact. The PVC Cu cables must be run in GL trays with covers for protection.
Fast acting semiconductor type current limiting fuses at the main bus-bar to protect from the grid short circuit contribution.
The INVERTER shall include an easy accessible emergency OFF button located at an appropriate position on the unit.
The INVERTER shall include ground lugs for equipment and PV array grounding. The DC circuit ground shall be a solid single point ground connection in accordance with WEC 69042.
All exposed surfaces of ferrous parts shall be thoroughly cleaned, primed and painted or otherwise suitably protected to survive a nominal 30 years design life of the unit. Internal Faults: In built protection for internal faults including excess temperature, communication failure, and overload and cooling fan failure (if fitted) is obligatory.

Components and circuit boards mounted inside the enclosures shall be clearly identified with appropriate permanent designations, which shall also serve to identify the items on the supplied drawings. Galvanic Isolation: Galvanic Isolation is required to avoid any DC component being injected into the grid and the potential for AC components appearing at the array. All doors, covers, panels and cable exists shall be gasketed or otherwise designed to limit the entry of dust and moisture. All doors shall be equipped with locks. All openings shall be provided with grills or screens with openings no larger than 0.95 cm. (about 3x8 inch).

In the design and fabrication of the INVERTER the site temperature (50 to 550 C), incident sunlight and the effect of ambient temperature on component life shall be considered carefully. Similar considerations shall be given to the heat sinking and thermal for blocking diodes and similar components.

5.9 DC and AC Distribution Board

Each Solar PV plant shall have its separate DC Distribution panel to receive the DC output from the array field with analog measurement meter for voltage, current and power from different MJB's to check any failure in the array field.

DC DB's shall be dust & vermin proof. The Bus bars are to be made of copper desired size. Suitable capacity MCBs to be provided for controlling the DC power output to the Inverter along with necessary surge arrestor.

DB's shall be provided in between PCU and loads. The AC power from inverter from each individual solar PV plant shall be fed into its dedicated AC distribution panel. Thereafter the outputs shall be terminated into the main LT supply board of respective blocks.

AC Distribution panel board shall control the AC power from the inverter and should have necessary surge arrestor. Interconnection from AC DB to Mains at LT panels bus-bar is to be carried out and complete equipments with metering is to be installed in AC DB.

All switches and circuit breaker, connection should confirm to IEC 60947.

5.10 Cable and accessories

All the cables shall be supplied conforming to IS 694 & shall be of 650 V/ 1.1 kV grade as per requirement. Only FRLS PVC copper cables shall be used. The size of the cables between array interconnections, array to junction boxes, junction boxes to DCDB, DCDB to PCU etc shall be so selected to keep the voltage drop and losses to the minimum. Contractors are required to mention each size of cables used and should consider their resistance/ impedance in the design optimization. Such calculation should be submitted along with the bid.

5.11 Earthing/ Lightning Protection

Each array structure of PV yard should be grounded properly using adequate number of earthing kits. All metal casing / shielding of the plant shall be thoroughly grounded to ensure safety of the power plant. In addition, suitable number of Lightening arrestor should also be provided inside the array field. Provision should be kept for shorting and grounding of the PV array at the time of maintenance work. All metal casing/ shielding of plant should be thoroughly grounded in accordance with Indian Electricity Act/ IE rules. Earth resistance should be tested in presence of the Engineer-In-Charge or his representative. Inverter ACDB and DCDB should also be earthed properly. Lightening protection provided should meet the safety rules as per Indian Electricity Act.

6. TESTING AND INSTALLATION

6.1 Type tests

Type test reports of all major equipments (Solar module, battery & PCU) shall be submitted to the owner. The type test report shall be within 5 years from bid opening date, in absence of which fresh type test shall be done without any cost to owner.

- The INVERTER shall be tested to demonstrate operation of its control system and the ability to be automatically synchronized and connected in parallel with a utility service, prior to its shipment.
- Operation of all controls, protective and instrumentation circuits shall be demonstrated by direct test if feasible or by simulation operation conditions for all parameters that cannot be directly tested.
- Special attention shall be given to demonstrate utility service interface protection circuits and functions, including calibration and functional trip tests of faults and isolation protection equipment.
- Operation of startup, disconnect and shutdown controls shall also be tested and demonstrated. Stable operation of the INVERTER and response to control signals shall also be tested and demonstrated.
- Factory testing shall not only be limited to measurement of phase currents, efficiencies, harmonics content and power factor, but shall also include all other necessary tests/simulations required and requested by the Purchasers Engineers. Tests may be performed at 25, 50, 75 and 100 percent of the rated nominal power.
- A factory Test Reports (FTR) shall be supplied with the unit after all tests. The FTR shall include detailed description of all parameters tested qualified and warranted.
- Factory testing of the INVERTER should be carried out and witnessed by the Purchaser's Engineers at the manufacturers premises.

6.2 Installation and commissioning

The contractor will be responsible for arranging all tools & plants for installation and commissioning the complete system. The contractor shall submit the erection, testing & commissioning procedure for approval to the owner. These procedures will form integral part of the acceptance report for successful erection and commissioning the system. These reports will be prepared and signed by contractor's representative & the owner concerned with project.

6.3 Packing, shipping and marking

The contractor shall be responsible for assuring that all commodities shipped are properly packed and protected to prevent damage or deterioration during shipment, packaging and shipping costs shall be borne by the supplier.

6.4 Insurance

The contractor shall provide insurance coverage ex-factory until commissioning and acceptance for replacement of repair of any part of the consignment due to damage or loss.

6.5 Inspection

All major equipment like solar PV modules, power conditioning units, batteries, battery rack, ACDB, DCDB, cables would be inspected by customer representative before their dispatch. The contractor will seek owner's approval of all equipment drawings & data sheet before manufacturing/ procuring/ outsourcing.

6.6 Training & after sales service

Training and after sales service is an important component of supply. The terms and conditions for training and after sales supply and service are to be presented clearly in the proposal and the extent and duration of after sales support clearly defined. An explanation of preventative maintenance schedule, plan of operation, scope and implementation of the after sales service is to be defined.

6.7 Documentation

Two sets of installation manual/ user manual shall be supplied along with each power plant. The manual shall include complete system details such as array layout, schematic of the system, inverter details, working principle etc. Step by step maintenance and troubleshooting procedures shall be given in the manuals. The contractor shall supply two sets of soft copies (in CD form) of all documents including drawings and user manual.

7. SPECIAL CONDITIONS

7.1 Sub-contractor Experience

The contractor/ sub-contractor should be Channel Partner accredited by MNRE, Govt. of India for On-Line Grid tied Solar PV-System Integrator. The Channel partner should have allocation from the MNRE for plants of capacity 250KWp and above for claiming the subsidy. The contractor/ sub-contractor should have experience in Design, Manufacture, Supply and Installation of Solar PV Plants of for plants of capacity 250KWp and above. To this effect, the contractor shall submit necessary documentary evidence while submitting credentials for approval of the sub-contractor as per provisions of this tender.

7.2 Maintenance & Performance warranty

Contractor shall provide performance warranty for a period of Five Years from the date of completion/ acceptance of the solar system work carried out by the contractor.

The equipment and work including the mechanical structures, electrical works, power conditioner, inverters, Maximum power points tracker units, distribution boards, Digital meters/ switchgears etc. and overall workmanship of the Solar PV plants/ systems must be warranted against any manufacturing/ design/ Installation defects for a minimum period of 5 years from the date of completion and commissioning of the SPV systems.

7.3 Guaranteed Generation

The contractor shall give guaranteed generation of minimum 4 units (kWh) per kWp per day from SPV Power Plant during 300 sunny days in a year during Maintenance Phase. In case the contractor is not able to generate the minimum guaranteed generation of 4 units (kWh) per kWp per day, the owner shall at its own discretion impose a price reduction at the rate of Rs. 30 per unit as penalty for the no. of units not supplied against the guaranteed generation. Sealed & tested energy meters shall be provided at consumption side of SPV Power Plants to measure energy output.

7.4 Additional Precautions

7.4.1 The contractor shall take care of all safety precautions pertaining to construction of work, such as excavation, trenching, demolition, provision of scaffolding, ladder, working

platforms, gangways, mixing asphaltic materials, electric arc/ gas welding, use of hoist and construction machinery. He shall be governed by relevant provisions of safety code and as directed by the Engineer-in-charge and nothing extra shall be payable on this account.

7.4.2 The contractor shall take all precautions to avoid accidents by exhibiting necessary caution boards day and night, speed limit boards, red flags, red lights and providing barriers. He shall be responsible for all damages and accidents caused to existing/ new work due to negligence on his part. No hindrance shall be caused to traffic during the execution of the work.

7.4.3 The work will be carried out in the manner complying, in all respects, with the requirements of relevant bye-laws of the local body under the jurisdiction of which the work is to be executed or as directed by the Engineer-in-Charge and nothing extra shall be paid on this account.

7.4.4 The work of electrical installations shall be carried out as per Indian Electricity rule or such local body bye-laws and the contractor shall produce necessary completion certificates/ approvals, wherever required, from such authorities after completion of work.

7.4.5 The contractor shall use materials bearing ISI Certification Mark unless otherwise specified or allowed in writing by the Engineer-in-Charge. Any material banned by the department shall not be used in the work.

7.4.6 The contractor shall submit to the Engineer-in-charge samples of all materials for approval. Such samples of materials which affect aesthetics of the work shall also be got approved from the Engineer-in-Charge/ Architect of the project before procuring bulk supplies. These approved samples shall be preserved and retained in the custody of the Engineer-in-charge as standards of materials till the completion of the work. The cost of such samples shall be borne by the Contractor and nothing shall be payable on this account over the Agreement rates.

7.4.7 The contractor shall be responsible for completing the work and for satisfying all terms and conditions of the Contract without any extra payment over his quoted rates unless otherwise specified. The contractor shall quote his rates for various items of work accordingly and no claim whatsoever shall be entertained for any incidental or extra work involved in the execution of the work as per nomenclature of the item and the specifications indicated in the tender documents.

7.4.8 Subject to the nomenclature of the item as per schedule of quantities, the specification indicated in the tender documents, the rates quoted shall include cost of all materials including royalty and taxes if any, labour, sundry inputs, execution of work at all heights, levels, pattern and design for all leads, lifts and depths including overhead charges and contractor's profit. Nothing extra shall be paid on this account.

7.4.9 The rates shall be inclusive of making any holes in walls/ RCC work for fixing any fixture/ frame work and making good the structure to its original shape and finish.

7.4.10 Other agencies doing works related with this project will also simultaneously execute the works and the contractor shall afford necessary co-ordination for unhindered completion of these sub-works

7.4.11 The contractor shall leave necessary holes, openings etc. as may be directed by the Engineer-in-charge for laying, burying or fixing, conduits, pipes, boxes, hooks, fans etc. Conduits for electrical wiring/ cables will be laid in a way that they leave enough space for concreting and do not adversely affect structural members.

7.4.12 The work shall be carried out strictly in accordance with CPWD & MNRE specifications for Electrical Works and Solar PV Plants as amended up to date and in accordance with Indian Electricity Rules, 1956, Indian Electricity Act, 2003.

7.4.13 The shop drawings and design shall be submitted for approval and work shall be carried out as per approved drawings and as per instructions of the Engineer-in-Charge who will have the right to change the layout as per requirement at site and the contractor shall not have any claim due to change in layout.

7.4.14 The contractor shall give a satisfactory performance test of installations individually and as a whole to ensure their proper functioning before the work is finally declared completed and accepted.

7.4.15 Notwithstanding the schedule of quantities, all items of interrelated works considered necessary to make the installation complete and operative are deemed to be included in the scope of item/work and shall be provided by the contractor at no extra cost.

MAINTENANCE WORKS

1. GENERAL

1.1 SCOPE OF WORK

The scope of the work covers the following:

(a) 3 years comprehensive maintenance of Elevators starting after completion of one year of Defect Liability Period.

(b) 3 years comprehensive maintenance of BMS works starting after completion of one year of Defect Liability Period.

(c) 3 years annual maintenance of HVAC works starting after completion of one year of Defect Liability Period.

(d) 5 years comprehensive maintenance of Solar PV works starting after completion of one year of Defect Liability Period.

1.2 SERVICES

- On-site maintenance of all the equipments and their components supplied in setting up the basic infrastructure in the proposed Data Centre.
- After the completion of the installation and before handing over of each equipment by the contractor, comprehensive maintenance service for the equipment furnished shall be provided as per provisions of this tender. This service shall include regular examination of the installation by trained employees, replacement of defective or worn out items/ parts. The comprehensive maintenance shall also include providing and replacing the consumables like oils, battery, gas re-fill etc. but excluding diesel and Water & Electricity charges and manufacturer's warrantee/ guarantee of such items & consumables replaced/ repaired during the period of comprehensive maintenance. Particular attention shall be taken to ensure that all spares are easily available during the normal course of life of the installation.
- Routine, Proactive, reactive, breakdown and preventive maintenance, repair and replacement of defective components which is installed by the contractor. The cost of repair and replacement shall be borne by the Contractor.
- Provide & maintain necessary documents on monthly basis to Owner, manage various system and vendors to ensure timely services, spares & maintenance contract services.
- Contractor shall provide emergency local call back service facility and shall furnish full details of such facilities available. The service shall be throughout the year – 24 hours a day, 7 days a week for all the 365 days in a year.
- Special tools/ instruments if required for the maintenance/ checking the parameters shall be arranged by the Contractor.
- Contractor shall maintain sufficient spares inventory for maintenance at its own cost.
- Daily reports of installed systems in format duly certified by Owner shall be submitted to Owner on daily basis.

2. ELEVATOR

2.1 Penalty Clause

If the contractor during maintenance period fails to attend the complaint call, given by owner within 24 hours, the owner shall at its own discretion impose a price reduction at the rate of

Rs. 500 per hour, for every hour of delay after the first 24 hours of complaint call, subject to a maximum of Rs. 50,000. The penalty shall be affected from the RA bill due to the contractor during the maintenance period. The decision of the Owner in this case shall be final and binding upon the contractor. However, shutdown for routine maintenance of the system, taken by the contractor with prior permission of the owner shall not be counted as breakdown.

3. BMS WORKS

3.1 Software shall include diagnostic routines which check hardware for correct operation. All hardware faults shall be annunciated on the integrated system operator displays.

3.2 Software shall be regularly updated.

3.3 Any problems/ issues with the system installed by the contractor and existing infrastructure shall also be attended to by the Contractor during the maintenance period.

3.4 Penalty Clause

If the contractor during maintenance period fails to attend the complaint call, given by owner within 24 hours, the owner shall at its own discretion impose a price reduction at the rate of Rs. 500 per hour, for every hour of delay after the first 24 hours of complaint call, subject to a maximum of Rs. 50,000. The penalty shall be affected from the RA bill due to the contractor during the maintenance period. The decision of the Owner in this case shall be final and binding upon the contractor. However, shutdown for routine maintenance of the system, taken by the contractor with prior permission of the owner shall not be counted as breakdown.

4. HVAC SYSTEM

4.1 Any problems/ issues with the system installed by the contractor shall be attended to by the Contractor during the maintenance period.

4.2 Penalty Clause

If the contractor during maintenance period fails to attend the complaint call, given by owner within 24 hours, the owner shall at its own discretion impose a price reduction at the rate of Rs. 250 per hour, for every hour of delay after the first 24 hours of complaint call, subject to a maximum of Rs. 25,000. The penalty shall be affected from the RA bill due to the contractor during the maintenance period. The decision of the Owner in this case shall be final and binding upon the contractor. However, shutdown for routine maintenance of the system, taken by the contractor with prior permission of the owner shall not be counted as breakdown.

5. SOLAR PV SYSTEM

5.1 Guaranteed Generation:

The contractor shall give guaranteed generation of minimum 4 units (kWh) per kWp per day from SPV Power Plant during 300 sunny days in a year during Maintenance Phase. In case the contractor is not able to generate the minimum guaranteed generation of 4 units (kWh) per kWp per day, the owner shall at its own discretion impose a price reduction at the rate of Rs. 30 per unit as penalty for the no. of units not supplied against the guaranteed generation. Sealed & tested energy meters shall be provided at consumption side of SPV Power Plants to measure energy output.

5.2 Penalty Clause:

In addition to the above, if the contractor during maintenance period fails to attend the complaint call, given by owner within 24 hours, the owner shall at its own discretion impose a price reduction at the rate of Rs. 250 per hour, for every hour of delay after the first 24 hours

of complaint call, subject to a maximum of Rs. 25,000. The penalty shall be affected from the RA bill due to the contractor during the maintenance period. The decision of the Owner in this case shall be final and binding upon the contractor. However, shutdown for routine maintenance of the system, taken by the contractor with prior permission of the owner shall not be counted as breakdown.

BIO-TECH PARK, FARIDABAD

S.No.	Description	DI	AI	DO	AO	DEVICE	FIELD REMARKS
	WATER COOLED CHILLERs - 3 nos						
	Chiller Integration						**Bacnet Port on Chillers**
1	Chiller ON/OFF			3		PFC-3 nos	Volt Free Contact From Chiller Panel
2	Chiller Auto/Manual Status	3				PFC-3 nos	Volt Free Contact From Chiller Panel
3	Chiller Trip Status	3				PFC-3 nos	Volt Free Contact From Chiller Panel
4	Chiller Header Supply & Retun Temp		2			ITS-1 & 2	Immerssion Temp Sensor
5	Pressure transducer on Supply and Return Header Lines		2			PT-1 & 2	Prseesure Transducer
6	Chiller Isolation BFY Valve ON/OFF			3		PFC-3 nos	Relay Output by BMS
7	Chiller Isolation BFY Valve Open Close Status	6				PFC-3 nos	Volt Free Contact From Limit Switch
	CONDENSORS - 3 nos						
8	Condensor Isolation Valve ON/OFF			3		PFC-3 nos	Relay Output by BMS
9	Condensor Isolation Valve Open/Close	6				PFC-3 nos	Volt Free Contact From Limit Switch
10	Condensor Header Supply & Retun Temp		2			ITS-3 & 4	Immerssion Temp Sensor
11	Condensor Water Pumps ON/OFF			3		PFC-3 nos	Relay Output by BMS
12	Condensor Water Pumps Status	3				DPSW- 1,2, & 3	Water Differential Pressure Switch
13	Condensor Water Pumps Auto/Manual Status	3				PFC-3 nos	Volt Free Contact From Limit Switch
	PRIMARY CHILLED WATER PUMPS - 3 nos						
14	Primary Chilled Water Pumps ON/OFF			3		PFC-3 nos	Relay Output by BMS
15	Primary Chilled Water Pumps Auto/manual Status	3				PFC-3 nos	Volt Free Contact by Pump Panel
16	Primary Chilled Water Pumps Run Status	3				DPSW- 4,5 & 6	Water Differential Pressure Switch
	SECONDARY CHILLED WATER PUMPS - 3 nos						
	Secondary Chilled Water Pumps						**Modbus Integration**
17	Secondary Chilled Water Pumps Run Status	3				DPSW-7,8 & 9	Water Differential Pressure Switch
	COOLING TOWERS - 3 nos						
18	Cooling Tower ON/OFF			3		PFC-3 nos	Relay Output by BMS
19	Cooling Tower Auto/Manual Status	3				PFC-3 nos	Volt Free Contact from CT Panel
20	Cooling Tower Run Status	3				PFC-3 nos	Volt Free Contact from CT Panel
21	Cooling Tower Isolation Valve ON/OFF			6		PFC-3 nos	Relay Output by BMS
22	Cooling Tower Isolation Valve Open/Close Status	6				PFC-3 nos	Volt Free Contact From Limit Switch
23	Coling Tower Low Level Alarm	3				LLS-1,2 & 3	Low Level Switch
24	CT Sump Temperature		1			ITS-5	Immerssion Temp Sensor

OUTSIDE PARAMETERS - 1 no							
25	Outdoor Temperature Monitoring		1			OT-1	Outdoor Temperature Sensor
26	Outdoor Humidity Monitoring		1			OH-1	Outdoor Humidity Sensor
27	Outdoor CO2 Sensor		1			OCO2-1	Outdoor CO2 Sensor
FLOW MONITORING - 1 no							
29	Flow Meter in Chilled Water Return Header		1			FM-1	Electromagnetic/Ultrasonic Type Flow Meter
PH MONITORING - 1 no							
30	PH Monitoring		1			PH-1	PH Analyser

AIR HANDLING UNITS - 36 nos							
1	AHU Enable/ Disable Command			36		PFC-36 nos	Volt Free Contact from AHU Panel
2	AHU Auto/Manual Status	36				PFC-36 nos	Volt Free Contact from AHU Panel
3	AHU Run Status	36				DPA1- 1 to 36	Differential Air Switch
4	AHU Filter Status	36				DPA2- 1 to 36	Differential Air Switch
5	AHU VFD Speed Modulation				36	PFC- 36 nos	0-10 VDC/ 4-20mA Signal from BMS
6	Room Air Temperature Monitoring		36			DTS- 1 to 36	Duct Temperature Sensor
7	Return Air Humidity Monitoring		36			DHS- 1 to 36	Duct Humidity Sensor
8	Cooling Coil Valve Modulation Position Feedback and Command		36		36	CWCV-1 to 36	0-10 VDC/ 4-20mA Command from BMS. Valve Actuator Feedback.
9	Fresh Air Damper Control and Position Feedback		36		36	FAD- 1 to 36	0-10 VDC/ 4-20mA Command from BMS. Fresh Air Damper Actuator Feedback.
10	CO2 Monitoring for Ventilation Air		28			DCO2- 1 to 28	Duct CO2 Sensor

COMPOSITE WORK FOR CONSTRUCTION OF NCR BIOTECH SCIENCE CLUSTER PHASE-II WORKS AT FARIDABAD, HARYANA

LIST OF APPROVED MAKES

LIST OF APPROVED MANUFACTURERS/ MAKES

List of Makes of materials approved by the Engineer-in-Charge are listed below (Refer materials whichever are applicable for the scope of work). However, approved equivalent materials of any other specialized firms may be used, in case it is established that the brands specified below are not available in the market subject to approval of the alternate brand by the Engineer-in-Charge.

Sl. No.	Item/Material	Manufacturer/ Supplier/ Make
CIVIL , STRUCTUAL & ARCHITECTURAL ITEMS		
1.1	Cement	As per SCC & Annexure
1.2	White Cement	As per SCC & Annexure
1.3	Reinforcement Steel	As per SCC & Annexure
1.4	Structural Steel	As per SCC & Annexure
1.5	Admixture for Concrete	FOSROC, SIKA, CICO, BASF
1.6	Aluminium Sections	HINDALCO, JINDAL, MAHABIR, INDAL
1.7	Ready Mixed Concrete (RMC)	ACC, L&T, AHLCON, JK CEMENT, UNITECH, GRASIM
1.8	Insulation	UP TWIGA, LLOYD INSULATION INDIA LTD, SUPREME
1.9	Ceramic Tiles	1st QUALITY OF KAJARIA, ORIENT, JOHNSON, NITCO, SOMANY, ASIAN
1.10	Vitrified Tiles	1st QUALITY OF KAJARIA, ORIENT, JOHNSON, NITCO, SOMANY, ASIAN
1.11	Wooden Flooring	NEMO, PRIMA, PERGO, ARMSTRONG
1.12	Anodized Aluminium Fittings for Doors/ Windows	CROWN, ALANS, CLASSICS, BHARAT, ARGENT
1.13	Mosaic & P.C. Tiles	NITCO, MODERN, MRIDUL
1.14	Waterproofing compound	FOSROC, CICO, PIDILITE
1.15	Waterproofing Membrane	FIRESTONE, CARLISLE, STP
1.16	Stainless Steel Section/ Sheet	JINDAL, SAIL, GOLDEN, SALEM STEEL
1.17	False Ceiling (Gypsum Board)	SAINT GOBAIN, LAFARGE, BORAL
1.18	False Ceiling (Mineral Fibre)	LLOYD, NITTBO, ARMSTRONG, ROCKFON
1.19	Kerb stones/ Interlocking Paver Blocks/ Chequered Tiles/ Saucer Drain	HINDUSTAN TILES, NIMCO PREFAB, K.K, NITCO
1.20	Distemper and Paints	1st QUALITY OF ASIAN, BERGER, NEROLAC, ICI
1.21	Texture Finish	ASIAN, BERGER, NEROLAC, ICI
1.22	Waterproof Cement Paint	SNOWCEM, ASIAN PAINT, BERGER

Sl. No.	Item/Material	Manufacturer/ Supplier/ Make
1.23	Steel and wood primer	ICI, NEROLAC, BERGER, ASIAN PAINTS
1.24	Enamel painting on pipes	ASIAN, BERGER, JENSON & NICHOLSON
1.25	Silicon Sealant	DOW CORNING, WACKER, GE
1.28	Wall Putty	BIRLA, JK, GOLDSIZE PUTTY BY SHALIMAR PAINTS LTD
1.29	Welding Electrodes	ESAB, ADVANI
1.30	Flush Doors shutters	DURABOARD, ALPRO, MERINO, KITPLY, GREEN PLY, CENTURY PLY, ARCHID
1.31	Laminate Sheet	MERINO, GREEN PLY, ARCHID, CENTURY PLY
1.32	Pre-laminated particle board	NOVOPAN, MERINO, ANCHORLAM, BHUTAN BOARD, ARCHID PLY
1.33	Wood Veneer	GREENLAM, MERINO , CENTURY
1.34	M.S. Butt Hinges/ Piano Hinges	JOLLY, GARG, AMIT, ASI SUPREME
1.35	Fire rated doors	NAVAIR, SUKRI, SUPER STEEL, RADIANT, GODREJ
1.36	Panic Bars	BRITON, DORMA, DORSET, GODREJ
1.37	Locks/ Latches	DORSET, DORMA, GODREJ
1.38	Door Handles	DORSET, GODREJ , OZONE, HAFLE
1.39	Hydraulic door Closer/ floor spring	DORSET, DORMA, GODREJ
1.40	Misc. door fittings (Tower Bolts, Stopper etc.)	DORMA, DORSET,HAFELE, GEZE,GODREJ, OZONE,
1.41	Adhesive & grouts	KERAKOLL, BAL ENDURA, FOSROC, PIDILITE, VAMICOL
1.42	Glass	SAINT GOBAIN, MODI FLOAT, ASAHI
1.43	Brick-coba waterproofing and acrylic impregnation treatment	OVERSEAS W.P.CO, ROOFRS COMBINE, DEVICON INTERNAZIONALE, HINDUSTAN WATERPROOFING
1.44	Mirror	SAINT GOBAIN, MODI FLOAT, ASAHI
1.45	Polycarbonate Sheet	DANPALON, SUNPAL, POLYGAL
1.46	Bitumen impregnated board	SHALIMAR, ARMOUR
1.47	Block Board/ Ply	PHENOL BONDED BOARDS OF MERINO, DURO, SAMRAT, KITPLY, ALPRO, BHUTAN BOARD, ARCHID
1.48	Frosted Film	LIUMAR, 3M, AVERY, IQUE
1.49	Expansion Hold Fastener	HILTI, CANON, CHILLI
1.50	Anchor Fasteners/ Dash Fasteners	HILTI, FISCHER, CANON, CHILLY
1.51	Friction stay hinges	EBCO, JOLLYGARD, AMIT, ASI SUPREME

Sl. No.	Item/Material	Manufacturer/ Supplier/ Make
1.52	SS Cramps	HILTI, CANON, FISCHER
1.53	Nuts, bolts and screws	KUNDAN, PUJA, ATUL
1.54	Tile adhesive	CICO, PIDILITE, BAL, LATECRETE
1.55	Floor Hardener	AKZO NOBEL, SIKA
1.56	PVC Water Stop Seal	MARUTI RUBBER UDYOG, JYOTI, FOSROC, FIXOPAN, SYNTEX
1.57	Gypsum Partitions	SAINT GOBIAN, LAFARGE, GYPROC
1.58	Grab Bars	MERINO,HAFELE, JAQUAR, HINDWARE
PLUMBING AND SANITARY ITEMS		
2.1	Sanitary ware fixtures	HINDWARE, PARRYWARE, CERA
2.2	Seat Covers	COMMANDER (HEAVY DUTY), HINDWARE, PARRYWARE, CERA
2.3	C.P. Fittings	GEM, PARKO, JAQUAR, KINGSTON, MARC
2.4	Stainless steel sinks	JAYNA, NEELKANTH, AMC
2.5	Automatic Flushing for Urinals	ANGASH INTERNATIONAL, KOPAL
2.6	PVC Storage Tank & Doors for Toilets	SINTEX, UNIPLAS, DURAPLAST
2.7	G.I. Pipe	TATA, JINDAL, SURYA, PRAKASH
2.8	G.I. Fittings	UNIK, R BRAND, KS, ZOLOTO-M
2.9	Ball valves	ZOLOTO, AM, LEADER
2.10	Butterfly valves	AUDCO, INTERVALVE, KEYSTONE, VENUS, KSB
2.11	Non-return Valves	LEAER, ZOLOTO, KIRLOSKAR, VC
2.12	Balancing Valves	DANFOSS, FLOWCAN, TA, BELIMO, OVENTROP
2.13	C.I. Pipes/ Fittings & Manhole Covers	RIF, NECO, SRIF, BIC
2.14	C.I. Pipes 'Class LA'	IISCO, KESORAM, ELECTRO STEEL
2.15	Stoneware Pipes/ Traps	PERFECT, BURN, ANAND
2.16	UPVC Pipes/ Fittings	SUPREME, FINOLEX, POLYPACK, PRINCE, SFMC
2.17	Flush Valve	GEM, JAQUAR, ORIENT
2.18	M.S. Pipes	TATA, JINDAL
2.19	R.C.C. Pipes	I.H.P., AKSHAY, KK, PRAGATI
2.20	Anti-vibration Mountings/ Vibration Eliminators	KANWAL, DUNLOP, RESISTROFLEX
2.21	Gate Valves	LEADER, DRP, SANT, ZOLOTO,TBS, RB, DANFOS

Sl. No.	Item/Material	Manufacturer/ Supplier/ Make
2.22	Float Valves	LEADER, ZOLOTO, SANT
2.23	SRFC/ RCC Manhole, Covers & Gratings	K.K. MANHOLES, MOONLITE, S.K. PRECAST CONCRETE, PRAGATI CONCRETE
2.24	Anti-corrosive Pipe Treatment	IWL - PYPKOAT, RUSTECH-COATEK, MAKPOLYCOAT
2.25	G.I. Hangers for Pipes/ Adjustable Hanger	CHILLY, EURO CLAMP, KANWAL
2.26	DWC/ HDPE Pipes	DURALINE, ORIPLAST, HALLMARK, PIUNEER
2.27	Drainage pumps	GRUNDFOS, KSB, DP, EBARA, WILO
2.28	PVC Pipes and fittings	SUPREME, FINOLEX,POLYPACK, PRINCE
2.29	Cockroach Trap	CHILLY (CCT), NEER, CAMRY
2.30	Standard M.S. fittings	UNIK, TRUE FORGE, R BRAND
2.31	Forged steel fittings	VS ENGINEERING, TRUE FORGE, B&M
2.32	Temper switch	SYSTEM SENSOR, SWITZER, DANFOSS
ELECTRICAL ITEMS		
3.1	L.T. Panel/ Bus Duct/ DG Panel/ APFC Panel/ PLC Panel	TRICOLITE, CONTROL AND SWITCHGEAR VEEKAY STEEL, ADLEC SYSTEMS, L&T, ADVANCE
3.2	Moulded Case Circuit Breaker	L&T (D-SINE), SIEMENS (3VT), GE POWER (RECORD PLUS), ABB (ISOMAX), LEGRAND (DPX3)
3.3	MCB	L&T, HAGER, LEGRAND, SIEMENS
3.4	Relay	L&T, ABB, AREVA, SCHNEIDER, SIEMENS, C&S
3.5	Contactors	L&T, ABB, HAGER, SIEMENS
3.6	Meters, CT etc.	KAPPA, C&S, L&T, MAXWELL, GILBERT
3.7	Starters	SIEMENS, L&T, CUTLER HAMMER
3.8	Push button and indication lamps	SIEMENS, VAISHNOV, L&T, SCHNEIDER
3.9	Voltmeter/ Ammeter	MECO, UNIVERSAL, RISHAB, AE, HAGER
3.10	Digital meters and Intelligent Multifunction Meter	CONZERVE, HPL, TRINITY, L&T, SIEMENS
3.11	Timers & Time Switch	L&T, SIEMENS, ABB, LEGRAND, SCHNEIDER
3.12	Selector Switch/ Push Button Switch/ Emergency Switch	KAY CEE, L&T, SALZER
3.13	Fuse Disconnector Switch/ Switch Fuse Units	L&T, SIEMENS, GE POWER
3.14	HRC Control Fuses	L&T, SIEMENS, GE POWER
3.15	PLC	ABB, SIEMENS, SCHNEIDER, L&T
3.16	Cable tray	SLOTCO, PILCO, STEEL WAYS, RICCO STEEL
3.17	Raceway	LEGRAND, MK, L&T

Sl. No.	Item/Material	Manufacturer/ Supplier/ Make
3.18	Transformer	ABB, KIRLOSKAR, CROMPTON GREAVES, UNIVERSAL
3.19	Air Circuit Breaker	L&T (UPOWER OMEGA MTX4.5), ABB (EMAX PR123), LEGRAND (DMX3 MP4), SCHNEIDER (MASTERPACT NW-7.0A)
3.20	Flow Switch	SYSTEM SENSOR, SWITZER, DANFOSS
3.21	Change Over Switch	H.P.L. SOCOMEC, L&T, C&S
3.22	Pressure Gauge	H GURU, FIEBIG, EMERALD
3.23	Single Phasing Preventer/ Overload Protection Unit	OMERON, SHNEIDER, L&T-MNX, ABB-A RANGE, SIEMENS
3.24	Pressure Switch	SYSTEM SENSOR, INDFOS
3.25	Water Level Controllers & Indicators	AUTO PUMP, MINILEC, DANFOSS, TECHTROL
3.26	PVC conduit & accessories (ISI marked)	BEC, AKG, M KAY
3.27	M.S. conduit & accessories (ISI marked)	BEC, AKG, NIC, M KAY, STEEL CRAFT
3.28	PVC insulated copper cable (ISI marked)	SKYTONE, GRANDLAY, FINOLEX, KEI, HAVELS, BATRA HENLAY
3.29	FRLS PVC insulated copper conductor cable (ISI marked)	SKYTONE, FINOLEX, NATIONAL, RR CABLE, KEI, PLAZA, HAVELS
3.30	Telephone Tag Block	KRONE, IS, ERICSSON
3.32	Modular plate type switches & sockets, TV Outlet, Fan Regulators, Telephone Outlet	ANCHOR-ROMA, MK, LEGRAND, CRABTREE NORTHWEST, PHILIPS
3.33	Industrial sockets	LEGRAND, ABB, SCHNEIDER, L&T, SIEMENS, HAVELS
3.34	ELCB/ RCCB (ISI marked)	HAGER, SIEMENS, LEGRAND, SCHNEIDER, L&T, GE, HENSELS
3.35	Earthing Wire	JINDAL, T.T. SWASTIK, SURYA
3.36	Distribution Boards	LEGRAND, HAGER, L&T, GE, SEIMENS, HENSELS
3.37	Cable glands (single/double compression)	COMMET, DOWELL, ELETROMAC, SEIMENS, BRACO, INDIANA
3.38	Termination Kits	RAYCHEM, 3M, M SEAL
3.39	Lugs/ Ferrules & Thimbles	DOWELLS, JAINSONS, ELETROMAC, SEIMENS, BRACO, INDIANA
3.40	Sensor (Light & Occupancy)	PHILIPS, L&T, LEGRAND, WIPRO, SCHNEIDER
3.41	Rubber/ Synthetic Insulating	DL MILLER & CO, SINTEX (INSULATICA) PREMIER

Sl. No.	Item/Material	Manufacturer/ Supplier/ Make
	mats	POLYFILM, RMG POLYVINYL INDIA
3.42	UPS	EATON, MITSUBISHI, APC
3.43	Batteries	EXIDE, AMCO, PRESTOLITE, AMARON STANDARD FURUKAWA
3.44	XLPE Insulated H.T. Cables (ISI Marked)	GLOSTER, SKYTONE, TORRENT, HAVELS, RAVIN, KEI, CCI, UNIVERSAL, RPG (ASIAN), BATRA HENLAY
3.45	L.T. Power Cables & Control Cables (ISI Marked)	CCI, GLOSTER ,NICCO, UNIVERSAL, RPG (ASIAN), SKYTONE, KEI, RAVIN, HAVELS, BATRA HENLAY
3.46	Exhaust fans	CROMPTON, BAJAJ, USHA, GEC
3.47	Ceiling Fans	CROMPTON, BAJAJ, USHA, GEC, ORIENT
3.48	Internal light fixtures (CFL, LED etc.)	PHILIPS, BAJAJ, WIPRO, CROMPTON
3.49	Aviation Warning Light	WIPRO, GEC, BAJAJ
3.50	LED indicating Lamps & Push Buttons	SIEMENS, VAISHNOV, L&T
3.51	Street light Poles and Fixtures	PHILIPS, BAJAJ, WIPRO, CROMPTON
3.52	Fire Alarm & Detection System	SIEMENS, CEASEFIRE, HOCHIKI, HONEYWELL NOTIFIER, SCHRACK, COOPER
ELEVATORS		
4.1	Elevators	KONE, THYSSENKRUPP, MITSUBISHI
FIRE FIGHTING WORKS		
5.1	Fire Hydrant Valve/ Landing Valve	MINIMAX, GUARDS, NEWAGE, SAFEX
5.2	Fire Hose Flexible Pipe (R.R.L.)	JYOTI, MINIMAX, TIGER, MARUTI
5.3	Coupling/ Branch Pipe & Nozzle	MINIMAX, GUARDS, NEWAGE, PADMINI, SAFEX
5.4	Fire Water Pumps	KIRLOSKAR, CROMPTON GREAVES, MATHER & PLATT, KSB, GRUNDFOS
5.5	Electric Motor	ABB, SIEMENS, KIRLOSKAR, CROMPTON GREAVES
5.6	Fire Hose Cabinet	MINIMAX, PADMINI, SAFEX
5.7	Fireman Axe	NEWAGE, GUARDS, MINIMAX, SAFEX
5.8	Fire Hose Reel	NEWAGE, GUARDS, MINIMAX, SAFEX
5.9	Fire Extinguishers	NEWAGE, GUARDS, MINIMAX, SAFEX
5.10	Strainers	EMARALD, WJ, SRAINWEL, SANT
5.11	Sluice Valve	LEADER, KIRLOSKAR, ZOLOTO
5.12	Mechanical Seal	SEALOL, BURGMAN, DURAMAT
5.13	Dual Plate Check Valve	ADVANCE, KIRLOSKAR, AUDCO, ECONOSTO

Sl. No.	Item/Material	Manufacturer/ Supplier/ Make
5.14	Installation Control Valve	TYCO, VIKING, HD
5.15	Underground Pipe Protection Wrapping	IWL-PYPKOTE, RUSTECH-COATEK
5.16	Sprinkler Head/ Unbraided Flexible Sprinkler Pipe	TYCO, VIKING, NEWAGE, SAFE FIRE
CCTV, HVAC & BMS WORKS		
6.1	CCTV Camera (along with mounting etc.)	VICON, PELCO, SIEMENS, HONEYWELL, BOSCH, AXIS, DVTEL, SONY
6.2	Network video management and recording Software	VICON, PELCO, SIEMENS, HONEYWELL, BOSCH, AXIS, DVTEL, SONY
6.3	Network video recorder/ video management Server	IBM-E SERVERS, DELL-POWER EDGE, HP-DL360-DL380, BOSCH, NICE, HONEYWELL, SONY, DVTEL, PELCO, SIEMENS
6.4	Network Attached Storage	DELL, IBM, HP ,EMC , HITACHI , BOSCH , PELCO
6.5	Client PC	DELL, IBM, HP
6.6	Network Switches	CISCO , HP , JUNIPER
6.7	LCD/TFT monitors	SAMSUNG, PANASONIC, SONY, LG , BOSCH , PELCO
6.8	Printer	HP, SHARP, CANON
6.9	UTP Cables	DIGILINK, SYSTIMAX, MOLEX, TELIFLEX, POLYCAB, UNIFLEX, BELDEN, HEW, KRAPEN, LEONI
6.10	Batteries for CCTV System	ROCKET, QUANTA, PANASONIC, AMCO, HBL
6.11	Power Supply Unit	PELCO, SIEMENS, HONEYWELL, BOSCH, AXIS, SONY
6.12	Supply/ Return Air Grill	AIRMASTER, RUSKINTITUS, SYSTEMAIR, AIR FLOW
6.13	Water Cooled Chillers	CARRIER, TRANE, YORK, DAIKIN
6.14	Condenser Water Pump	ITT, GRUNDFOS, ARMSTRONG, WILO, KIRLOSKAR
6.15	Primary Chilled Water Pump	ITT, GRUNDFOS, ARMSTRONG, WILO, KIRLOSKAR
6.16	Secondary Chilled Water Pump	ITT, GRUNDFOS, ARMSTRONG, WILO
6.17	Cooling Tower	PAHARPUR, MIHIR, ADVANCE, MARLEY, BELL
6.18	AHUs with Cooling coils	BLUE STAR, VOLTAS, ETA, CARRIER, TRANE, ZECO, EDGETECH, WAVES, CARRYAIR, FEDDERS LLOYD, SUVIDHA-SAIVER
6.19	VFD	DANFOSS, SIEMENS, ABB, ALLEN BRADLEY
6.20	Fancoil units	BLUESTAR, VOLTAS, DAIKIN, CARRIER, ETA, ZECO, WAVES, HI TECH
6.21	Centrifugal fans	KRUGER, NICOTRA, COMEFRI, GREENHECK
6.22	Tube Axial fans	KRUGER, NOCOTRA, COMEFREE, FLAKWOOD, WOLTER, GREENHECK, NUAIRE, SYSTEMAIR
6.23	Propeller fan	ALSTHOM, CROMPTON, GE, OSTBREG, KRUGER,

Sl. No.	Item/Material	Manufacturer/ Supplier/ Make
		NUAIRE
6.24	In Line fan	KONAFLAKT, KRUGER, OSTBERGG, ALSTOM, NUAIRE
6.25	Grill/ Diffuser/ Dampers	CARRYAIR, RAVISTAR, AIRMASTER, DYNA CRAFT, FEDDERS LLOYD
6.26	Fire Dampers	RAVISTAR, DYNA CRAFT, CARRYAIR, AIRMASTER, CONAIR
6.27	G.I. Sheets	JINDAL, SAIL, TATA, ESSAR
6.28	Factory fabricated duct	ZECO, TECHNO, ROLASTAR, VOLTAS, ALPHA DUCT, DUCTOFAB
6.29	Hessian (fire treated)	NAVAIR, PYROGUARD
6.30	Pre-insulated chilled water pipe	ZECO, SEVEN STAR
6.31	Thermometer	TAYLOR, H GURU, FIEBIG, EMERALD, ANERGY
6.32	Air Washer	AIR FLOW, BRIGHT FLOW, AMBASSADOR, ROOTS
6.33	Air Washer Fan	KRUGER, NICOTRA, COMFERI
6.34	Air Washer Pump	KIRLOSKAR, BEACON, CROMPTON
6.35	Air Scrubber	AIR FLOW, BRIGHT FLOW, AMBASSADOR, ROOTS
6.36	Suction Guide	ANERGY, EMERALD
6.37	2/3 way modulating valve for AHU	HONEYWELL, SIEMENS, DANFOSS, BELIMO, JOHNSON CONTROL, SCHNEIDER
6.38	Room thermostat/ humidistat & Safety thermostat	HONEYWELL, SIEMENS, DANFOSS, BELIMO, JOHNSON CONTROL, SCHNEIDER
6.39	Dial thermometer (capillary Type)	PENN, H GURU, FEIBIG, EMERALD, TADINGTON
6.40	Cooling/ Heating Mode changer	SIEMENS, HONEYWELL
6.41	Pre-moulded PUF section for insulation	LLYOD, MALANPUR, BEARDSEL, SUPREME
6.42	Nitrite Insulation	ARMACEL, VIDOFLEX, SUPREME, K-FLEX, LLYOD INSULATION
6.43	PUF pipe supports	MALANPUR, LLOYD, BEARDSEL
6.44	Aluminium tape	JOHNSON, BIRLA, 3M
6.45	Expansion tank (pressurized) and Air Separator	ITT, WESSELS, GRUNFOSS, ANERGY, ARMSTRONG
6.46	Heat Recovery Wheels	DESICCANT ROTORS INTERNATIONAL (DRI), NOVELAIR TECHNOLOGY, EVENTUS (OSTERBERG), FLAKWOOD, BRYAIR
6.47	Filters (in Air-Conditioning System)	THERMODYNE, PUROLATOR, ANFILCO

Sl. No.	Item/Material	Manufacturer/ Supplier/ Make
6.48	Temperature Sensor	SONTAY, KELE, MAMAC
6.49	Ultra violet germicidal Irradiation system	RUKS, TRIMED, OMNISCENT TREATMENT TECH
6.50	Precision AC units	EMERSON, BLUE BOX, STULZ
6.51	Aluminium sheets	HINDALCO, BALCO, NALCO
6.52	Closed cell fire retardant XLPE	PARAMOUT, ARMACELL, AEROFLUX, TROCELLEN, EUROBATAX, SUPREME, PILON-THERMOSHIELD
6.53	Expanded polystyrene	METTURBEARDSELL, STRYNE PACKING, SUPREME, COCOLITE, DEBS PRODUCTS, INDIAN PACKAGING, TOSHIBA
6.54	Fibreglass rigid Board	UP TWIGA, OWEN CORNING, KIMCO, LLYOD INSULATION
6.55	Tarfelt/ CPRX compound	SHALIMAR, ASIAN
6.56	Copper refrigerant piping	DIAMOND, STAR, RAJCO
6.57	Building Management System (Control & Monitoring)	SIEMENS, HONEYWELL, JOHNSON, CARRIER, TRANE
SOLAR PV SYSTEM		
7.1	Solar PV System	MOSERBAER, PHOTON, TATA BP, EMVEE, BHEL, CEL

COMPOSITE WORK FOR CONSTRUCTION OF NCR BIOTECH SCIENCE CLUSTER PHASE-II WORKS AT FARIDABAD, HARYANA

SOIL INVESTIGATION REPORT

PROJECT NO.3697
RESTRICTED

PROJECT : REPORT ON
SOIL INVESTIGATION WORK FOR
NCR BIOSCIENCE CENTRE LAND
AT FARIDABAD (HARYANA).

CLIENT : M/S NATIONAL INSTITUTE OF
IMMUNOLOGY
ARUNA ASAF ALI MARG
NEW DELHI -110067

SUBMITTED BY

MAGMA INFRASTRUCTURE PRIVATE LIMITED
(FORMERLY NAMED AS MAGMA SOIL & FOUNDATION CONSULTANTS PVT. LTD.)
Off:F-301, Aditya Complex, Plot No.11,L.S.C., Savita Vihar, Delhi-110092
Phone No. 22147759,22145500,43060909Mob.9910460525, 9868127370, Telefax- 22145600
Email ID: magmasoil_2003@yahoo.co.in
jsdahiyah@gmail.com

TABLE INDEX

FIGURE INDEX

				SOIL PROFILE		Name of Project: Subsoil Investigation for NCR Bioscience Centre land at Faridabad (Haryana)				Boring Date / co-ordinates N-10120 E-5070		Termination Depth: 11.00 m.below E.G.L. / Water table: Not met with			Table No. 1 / Bore hole No 1			SHEET NO. 1 / 18		
RL (m)	N Value	Depth (m)	Sample No	Soil Description	IS Class	Grain Size Analysis: Gravels %	Sand %	Silt %	Clay %	Liquid limit %	Plastic limit %	Dry Density gm/cc	Wet Density gm/cc	Water content %	Shear parameter: Test Method	C kg/cm²	φ degree	Void Ratio	Compression index	SPG
		0.00	DS-1	Sandy silt	ML	0	32	68	0	N	P									
	>100	0.50	SPT-1	severely weathered rock (Murram)																
		1.00		Moderately fractured/fragmented brownish hard rock/large boulders																
		3.00		Moderately fractured/fragmented greyish hard rock/large boulder																
		6.00		Moderately fractured/fragmented brownish hard rock/large boulder																
		11.00																		

Table -Record of Rock Drilling and Rock properties

Name of work . Subsoil Investigation for N C R Bioscience Centre land at Faridabad (Haryana)

Co-ordinates N-10120, E-5070, Depth of Bore Hole : 11.00 m below EGL.
BH NO. : BH-1 Depth of ground water table : Not met with

RL from (m)	RL to (m)	Rock Profile	Description of rock	From (m)	To (m)	Run (m)	Rock Recovery (cm)	%Rock Recovery	RQD %	Water Loss %	Moisture content %	Dry Density gm/cc	specific gravity	Uniaxial Compressive strength kg/cm²	Point Load Strength kg/cm²
			severely weathered rock (Murram)	0.5	1.0	0.5	Nil	Nil	Nil	60					
			Moderately fractured/ fragmented brownish hard rock/large boulder	1.0	2.5	1.5	64	42.67	27.33	40	0.42	2.7	2.85	107.2	
			Moderately fractured/ fragmented greyish hard rock/large boulder	2.5	3.0	0.5	33.5	67	44	40					
				3.0	4.5	1.5	95	63.33	38	30	0.44	2.72	2.83	242.4	
				4.5	6.0	1.5	106.5	71	41	30					
			Moderately fractured/ fragmented brownish hard rock/large boulder	6.0	7.5	1.5	97.5	65	53	20	0.44	2.71	2.84	316	
				7.5	9.0	1.5	111	74	37	20					
				9.0	10.5	1.5	92	61.33	46	20	0.43	2.71	2.84	289.5	
				10.5	11.0	0.5	34.3	68.6	57	20					

SOIL PROFILE

Name of Project: Subsoil Investigation for NCR Bioscience Centre land at Faridabad (Haryana)

Boring Date

co-ordinates
N-10055
E-5200

Termination Depth: 11.00 m.b.g.l
Water table: Not met with

Table No. 1

Bore hole No. 2

SHEET NO 1

2a

RL (m)	N Value	Depth (m)	Sample No	Soil Description	IS Class	Grain Size Analysis: Gravels %	Sand %	Silt %	Clay %	Liquid limit %	Plastic limit %	Dry Density gm/cc	Wet Density gm/cc	Water content %	Shear parameter: Test Method	C Kg/cm²	φ degree	Void Ratio	Compression Index	SPG
		0.00	DS-1	Sandy silt	ML	0	34	66	0	N	P									
	67	1.50	SPT-1																	
		2.10		Severely weathered rock (Murram)																
		2.30		Moderately fractured bouldedly greyish hard rock																
		4.50		Moderately fractured/fragmented greyish hard rock/large boulder																
		7.00		Moderately fractured/fragmented brownish hard rock/large boulder																
		11.00																		

Table -Record of Rock Drilling and Rock properties

Name of work : Subsoil Investigation for N C R Bioscience Centre land at Faridabad (Haryana)

Co-ordinates N-10055, E-5200, Depth of Bore Hole : 11.00 m below EGL.

BH NO. : BH-2 Depth of ground water table : Not met with

RL from (m)	RL to (m)	Rock Profile	Description of rock	From (m)	To (m)	Run (m)	Rock Recovery (cm)	%Rock Recovery	RQD %	Water Loss %	Moisture content %	Dry Density gm/cc	specific gravity	Uniaxial Compressive strength kg/cm²	Point Load Strength kg/cm²
			Severely weathered rock (Murram)	2.1	2.3	0.2	Nil	Nil	Nil	60					
			Moderately fractured boulderly/ greyish hard rock	2.3	3.0	0.7	21	30	Nil	60					
				3.0	4.5	1.5	42	28	18	60	0.45	2.71	2.84	94.6	
			Moderately fractured/ fragmented greyish hard rock/large boulder	4.5	6.0	1.5	54	36	24	50					
				6.0	7.0	1.0	32	32	27	50	0.43	2.72	2.83	242.0	
			Moderately fractured/ fragmented brownish hard rock/large boulder	7.0	8.0	1.0	45	45	38	20					
				8.0	9.0	1.0	59	59	41	20	0.40	2.72	2.82	278.4	
				9.0	10.0	1.0	67	67	52	20					
				10.0	11.0	1.0	43	43	41	20					

SOIL PROFILE				Name of Project: Subsoil Investigation for NCR Bioscience Centre land at Faridabad (Haryana)					Boring Date		Termination Depth: 11.00 m.b.g.l.			Table No. 1			SHEET NO. 1		
									co-ordinates N-10148 E-5300		Water table: Not met with			Bore hole No. 3			22		
RL (m)	N Value	Depth (m)	Sample No	Soil Description	IS Class	Grain Size Analysis				Liquid limit %	Plastic limit %	Dry Density gm/cc	Wet Density gm/cc	Water content %	Shear parameter			Void Ratio	Compression index	SPG
						Gravels %	Sand %	Silt %	Clay %						Test Method	C kg/cm²	φ degree			
		0.00	DS-1	Sandy silt	ML	0	33	67	0	N	P									
	>100	0.50	SPT-1	severely weathered rock (Murram)																
		1.00		Moderately fractured brownish bouldedy hard rock																
		3.00		Moderately fractured/fragmented greyish hard rock/large boulder																
		6.50		Moderately fractured/fragmented brownish hard rock/large boulder																
		11.00																		

Table -Record of Rock Drilling and Rock properties

Name of work . Subsoil Investigation for N C R Bioscience Centre land at Faridabad (Haryana)

Co-ordinates N-10148.3, E-5300, Depth of Bore Hole : 11.00 m below EGL.
BH NO. : BH-3 Depth of ground water table : Not met with

RL from (m)	RL to (m)	Rock Profile	Description of rock	From (m)	To (m)	Run (m)	Rock Recovery (cm)	%Rock Recovery	RQD %	Water Loss %	Moisture content %	Dry Density gm/cc	specific gravity	Uniaxial Compressive strength kg/cm²	Point Load Strength kg/cm²
			Severely weathered rock (Murram)												
				0.5	1.0	0.5	Nil	Nil	Nil	40					
			Moderately fractured brownish boulderly hard rock												
				1.0	2.0	1.0	33	33	12	40	0.44	2.71	2.85	96.3	
				2.0	3.0	1.0	28	28	17	40					
			Moderately fractured /fragmented greyish hard rock/large boulder												
				3.0	4.5	1.5	51	34	32	20					
				4.5	5.5	1.0	43	43	37	20	0.42	2.73	2.84	141.7	
				5.5	6.5	1.0	59	59	41	20					
			Moderately fractured/fragmented brownish hard rock/large boulder												
				6.5	8.0	1.5	74	49.33	49.33	30	0.43	2.72	2.84	237.0	
				8.0	9.0	1.0	87	87	64	30					
				9.0	10.0	1.0	78	78	57	30	0.41	2.73	2.83	269.2	
				10.0	11.0	1.0	84	84	76	30					

SOIL PROFILE		Name of Project: Subsoil Investigation for NCR Bioscience Centre land at Faridabad (Haryana)		Boring Date		Termination Depth: 11.00 m b.g.l.			Table No. 1			SHEET NO. 1
				co-ordinates N-10280 E-5265		Water table: Not met with			Bore hole No. 4			24

RL. (m)	N Value	Depth (m)	Sample No	Soil Description	IS Class	Grain Size Analysis				Liquid limit %	Plastic limit %	Dry Density gm/cc	Wet Density gm/cc	Water content %	Shear parameter			Void Ratio	Compression index	SPG
						Gravels %	Sand %	Silt %	Clay %						Test Method	C kg/cm²	φ degree			
		0.50	DS-1	Sandy silt	ML	2	31	67	0	N	P									
	>100	0.50	SPT-1	Severely weathered rock (Murram)																
		1.50		Moderately fractured greyish boulderly rock																
		3.00		Moderately fractured/fragmented brownish hard rock/large boulder																
		6.00		Moderately fractured/fragmented greyish hard rock/large boulder																
		10.00																		

Table -Record of Rock Drilling and Rock properties

Name of work : **Subsoil Investigation for N C R Bioscience Centre land at Faridabad** (Haryana)

Co-ordinates N-10280, E-5265, Depth of Bore Hole : 11.00 m below EGL.
BH NO. : BH-4 Depth of ground water table : Not met with

RL from (m)	RL to (m)	Rock Profile	Description of rock	From (m)	To (m)	Run (m)	Rock Recovery (cm)	%Rock Recovery	RQD %	Water Loss %	Moisture content %	Dry Density gm/cc	specific gravity	Uniaxial Compressive strength kg/cm²	Point Load Strength kg/cm²
			Severely weathered rock (Murram)												
				0.5	1.5	1.0	0	0	Nil	80					
			Moderately fractured greyish boulderly rock												
				1.5	3.0	1.5	99	66	48.67	50	0.45	2.70	2.85	79.1	
			Moderately fractured/ fragmented brownish hard rock/large boulder												
				3.0	4.5	1.5	63	42	34.67	20					
				4.5	6.0	1.5	68	45.33	40	20	0.43	2.72	2.84	164.8	
			Moderately fractured/ fragmented greyish hard rock/large boulder												
				6.0	7.5	1.5	97	64.67	51.33	20					
				7.5	8.5	1.0	78	78	78	10	0.42	2.73	2.84	227.0	
				8.5	10.0	1.5	78	52	6.67	10					

SOIL PROFILE				Name of Project: Subsoil Investigation for NCR Bioscience Centre land at Faridabad (Haryana)					Boring Date		Termination Depth: 10.00 m.b.g.l.			Table No. 1			SHEET NO. 1		
									co-ordinates N-10010 E-5425		Water table: Not met with			Bore hole No. 5			26		
RL (m)	N Value	Depth (m)	Sample No	Soil Description	IS Class	Grain Size Analysis				Liquid limit %	Plastic limit %	Dry Density gm/cc	Wet Density gm/cc	Water content %	Shear parameter			Void Ratio	Compression Index	SPG
						Gravels %	Sand %	Silt %	Clay %						Test Method	C kg/cm²	φ degree			
		0.00	OS-1	Sandy silt	ML	0	36	64	0	N	P									
	>100	0.20	SPT-1	Severely weathered rock (Murram)																
		0.35		Moderately fractured/fragmented greyish hard rock/large boulder																
		3.00		Moderately fractured/fragmented brownish hard rock/large boulder																
		6.00		Moderately fractured/fragmented greyish hard rock/large boulder																
		10.00																		

Table -Record of Rock Drilling and Rock properties

Name of work : Subsoil Investigation for N C R Bioscience Centre land at Faridabad (Haryana)

Co-ordinates N-10010, E-5425 Depth of Bore Hole : 10.00 m below EGL.
BH NO. : BH-5 Depth of ground water table : Not met with

RL from (m)	RL to (m)	Rock Profile	Description of rock	From (m)	To (m)	Run (m)	Rock Recovery (cm)	%Rock Recovery	RQD %	Water Loss %	Moisture content %	Dry Density gm/cc	specific gravity	Uniaxial Compressive strength kg/cm²	Point Load Strength kg/cm²
			Severely weathered rock (Murram)	0.20	0.35	0.15	Nil	Nil	Nil	60					
			Moderately fractured/ fragmented greyish hard rock/large boulder	0.35	1.5	1.15	28	24.3	Nil	30					
				1.5	3.0	1.5	51	34	24	30	0.45	2.71	2.84	112	
			Moderately fractured/ fragmented brownish hard rock/large boulder	3.0	4.5	1.5	63	42	38.67	30					
				4.5	6.0	1.5	55	36.67	36.67	30	0.43	2.72	2.83	149.1	
			Moderately fractured/ fragmented greyish hard rock/large boulder	6.0	7.5	1.5	71	48	48	20					
				7.5	9.0	1.5	93	62	42	20	0.42	2.73	2.83	257.0	
				9.0	10	1.0	78	78	53	20					

SOIL PROFILE				Name of Project: Subsoil Investigation for NCR Bioscience Centre land at Faridabad (Haryana)						Boring Date / co-ordinates N-10240 E-5215		Termination Depth: 10.00 m.b.g.l. Water table: Not met with			Table No. 1 / Bore hole No. 6			SHEET NO. 1: 28		
RL. (m)	N Value	Depth (m)	Sample No	Soil Description	IS Class	Grain Size Analysis				Liquid limit %	Plastic limit %	Dry Density gm/cc	Wet Density gm/cc	Water content %	shear parameter			Void Ratio	Compression index	SPG
						Gravels %	Sand %	Silt %	Clay %						Test Method	C kg/cm²	φ degree			
		0.00	DS-1	Sandy silt	ML	0	35	65	0	N	P									
		0.50	SPT-1	Moderately fractured fragmented brownish hard rock/large boulder																
		1.50		Moderately fractured fragmented greyish hard rock/large boulder																
		5.00		Moderately fractured/fragmented brownish hard rock/large boulder																
		8.50		Moderately fractured/fragmented brownish hard rock/large boulder																
		10.00																		

Table -Record of Rock Drilling and Rock properties

Name of work : Subsoil Investigation for N C R Bioscience Centre land at Faridabad (Haryana)

Co-ordinates N-10240, E-5215 Depth of Bore Hole : 10.00 m below EGL.
BH NO. : BH-6 Depth of ground water table : Not met with

RL from (m)	RL to (m)	Rock Profile	Description of rock	From (m)	To (m)	Run (m)	Rock Recovery (cm)	%Rock Recovery	RQD %	Water Loss %	Moisture content %	Dry Density gm/cc	specific gravity	Uniaxial Compressive strength kg/cm²	Point Load Strength kg/cm²
			Moderately fractured/ fragmented brownish hard rock/large boulder	0.5	1.5	1.0	55	55	27	40	0.46	2.7	2.85	83.4	
			Moderately fractured fragmented greyish hard rock/large boulder	1.5	3.0	1.5	38	25.33	11.33	40					
				3.0	4.0	1.0	45	45	45	40	0.45	2.72	2.84	192.7	
				4.0	5.0	1.0	58	58	42	20					
			Moderately fractured/ fragmented brownish hard rock/large boulder	5.0	6.5	1.5	63	42	42	20	0.41	2.73	2.84	261.9	
				6.5	7.5	1.0	20	20	Nil	20					
				7.5	8.5	1.0	52	52	36	20					
			Moderately fractured/ fragmented greyish hard rock/large boulder	8.5	10.0	1.5	74	49.33	10	20	0.42	2.73	2.83	274.6	

SOIL PROFILE				Name of Project: Subsoil Investigation for NCR Bioscience Centre land at Faridabad (Haryana)					Boring Date		Termination Depth: 11.00 m.b.g.l.			Table No. 1			SHEET NO. 1		
									co-ordinates N-10125 E-5135		Water table: Not met with			Bore hole No. 7			30		
RL (m)	N Value	Depth (m)	Sample No	Soil Description	IS Class	Grain Size Analysis: Gravels %	Sand %	Silt %	Clay %	Liquid limit %	Plastic limit %	Dry Density gm/cc	Wet Density gm/cc	Water content %	shear parameter: Test Method	C kg/cm²	φ degree	Void Ratio	Compression Index	SPG
		0.00	OS-1	Sandy silt	ML	3	29	68	0	N	P									
	>100	0.30	SPT-1	Severely weathered rock																
		0.75		Moderately fractured/fragmented greyish hard rock/large boulder																
		3.00		Moderately fractured/fragmented brownish hard rock/large boulder																
		6.60		Moderately fractured/fragmented greyish hard rock/large boulder																
		10.00																		

Table -Record of Rock Drilling and Rock properties

Name of work : Subsoil Investigation for N C R Bioscience Centre land at Faridabad (Haryana)

Co-ordinates N-10125, E-5135, Depth of Bore Hole : 10.00 m below EGL.
BH NO. : BH-7 Depth of ground water table : Not met with

RL from (m)	RL to (m)	Rock Profile	Description of rock	From (m)	To (m)	Run (m)	Rock Recovery (cm)	%Rock Recovery	RQD %	Water Loss %	Moisture content %	Dry Density gm/cc	specific gravity	Uniaxial Compressive strength kg/cm²	Point Load Strength kg/cm²
			Severely weathered rock (Murram)	0.30	0.75	0.5	Nil	Nil	Nil	80					
			Moderately fractured/ fragmented greyish hard rock/large boulder	0.75	2.0	1.25	18	14.4	Nil	60					
				2.0	3.0	1.0	22	22	10	60	0.48	2.7	2.85	107.2	
			Moderately fractured/ fragmented brownish hard	3.0	4.5	1.5	62	41.33	22	40	0.45	2.72	2.84	179.4	
				4.5	6.0	1.5	70	46.67	34.67	40					
			Moderately fractured/ fragmented greyish hard rock/large boulder	6.0	7.5	1.5	69	46	46	20	0.44	2.72	2.83	242.4	
				7.5	9.0	1.5	105	70	60	20					
				9.0	10	1.0	74	74	61	20	0.43	2.71	2.83	289.5	

SOIL PROFILE						Name of Project: Subsoil Investigation for NCR Bioscience Centre land at Faridabad (Haryana)				Boring Date		Termination Depth: 10.00 m.b.g.l.			Table No: 1			SHEET NO: 1		
										co-ordinates N-10215 E-5085		Water table: Not met with			Bore hole No. 8			32		
RL (m)	N Value	Depth (m)	Sample No	Soil Description	IS Class	Grain Size Analysis				Liquid limit %	Plastic limit %	Dry Density gm/cc	Wet Density gm/cc	Water content %	Shear parameter			Void Ratio	Compression Index	SPG
						Gravels %	Sand %	Silt %	Clay %						Test Method	C kg/cm²	φ degree			
		0.00	DS-1	Sandy silt	ML	0	33	67	0	N	P									
		0.30	SPT-1	Moderately fractured/fragmented greyish hard rock/large boulder																
		3.50		Moderately fractured/fragmented brownish hard rock/large boulder																
		7.00		Moderately fractured/fragmented greyish hard rock/large boulder																
		10.00																		

Table -Record of Rock Drilling and Rock properties

Name of work : Subsoil Investigation for N C R Bioscience Centre land at Faridabad (Haryana)

Co-ordinates N-10215, E-5085, Depth of Bore Hole : 10.00 m below EGL.
BH NO. BH-8 Depth of ground water table : Not met with

RL from (m)	RL to (m)	Rock Profile	Description of rock	From (m)	To (m)	Run (m)	Rock Recovery (cm)	%Rock Recovery	RQD %	Water Loss %	Moisture content %	Dry Density gm/cc	specific gravity	Uniaxial Compressive strength kg/cm²	Point Load Strength kg/cm²
			Moderately fractured/ fragmented brownish hard rock//large boulder	0.3	1.5	1.2	16	13.33	Nil	80					
				1.5	2.5	1.0	22	22	Nil	80					
				2.5	3.5	1.0	48	48	34	20	0.44	2.71	2.84	88.1	
			Moderately fractured/ fragmented greyish hard rock/large boulder	3.5	5.0	1.5	57	38	38	40					
				5.0	6.0	1.0	44	44	31	40	0.42	2.72	2.83	176.4	
				6.0	7.0	1.0	55	55	43	40					
			Moderately fractured/ fragmented brownish hard rock/large boulder	7.0	8.5	1.5	93	62	49.33	30	0.43	2.72	2.83	254.0	
				8.5	10.0	1.5	96	64	50	30					

SOIL PROFILE				Name of Project: Subsoil Investigation for NCR Bioscience Centre land at Faridabad (Haryana)					Boring Date / co-ordinates: N-10120 E-5200		Termination Depth: 10.00 m.b.g.l. Water table: Not met with			Table No. 1 / Bore hole No. 9			SHEET NO. 1: 34		
RL (m)	N Value	Depth (m)	Sample No	Soil Description	IS Class	Grain Size Analysis: Gravels %	Sand %	Silt %	Clay %	Liquid limit %	Plastic limit %	Dry Density gm/cc	Wet Density gm/cc	Water content %	shear parameter: Test Method	C kg/cm²	φ degree	Void Ratio	Compression Index	SPG
		0.00	DS-1	Sandy silt	ML	0	35	65	0	N	P									
	>100	0.40	SPT-1	Severely weathered rock (Murram)																
		0.75		Moderately fractured/fragmented greyish hard rock/large boulder																
		2.50		Moderately fractured/fragmented brownish hard rock/large boulder																
		6.50		Moderately fractured/fragmented greyish hard rock/large boulder																
		10.00																		

Table -Record of Rock Drilling and Rock properties

Name of work : Subsoil Investigation for N C R Bioscience Centre land at Faridabad (Haryana)

Co-ordinates N-10120, E-5200, Depth of Bore Hole : 11.00 m below EGL.
BH NO. : BH-9 Depth of ground water table : Not met with

RL from (m)	RL to (m)	Rock Profile	Description of rock	From (m)	To (m)	Run (m)	Rock Recovery (cm)	%Rock Recovery	RQD %	Water Loss %	Moisture content %	Dry Density gm/cc	specific gravity	Uniaxial Compressive strength kg/cm²	Point Load Strength kg/cm²
			Severely weathered rock (Murram)												
				0.40	0.75	0.35	Nil	Nil	Nil	60					
			Moderately fractured/ fragmented greyish hard rock/large	0.75	1.5	0.75	14	18.67	Nil	40					
				1.5	2.5	1.0	27	27	22	40	0.43	2.7	2.84	96.2	
			Moderately fractured/ fragmented brownish hard rock/large boulder	2.5	4.0	1.5	45	30	30	20					
				4.0	5.5	1.5	60	40	30	20	0.41	2.72	2.83	176.1	
				5.5	6.5	1.0	43	43	34	20					
			Moderately fractured/fragmented greyish hard rock/large boulder	6.5	8.0	1.5	62	41.33	32	50	0.40	2.72	2.82	279.0	
				8.0	9.0	1.0	59	59	45	50					
				9.0	10.0	1.0	60	60	41	50	0.42	2.73	2.82	318.0	

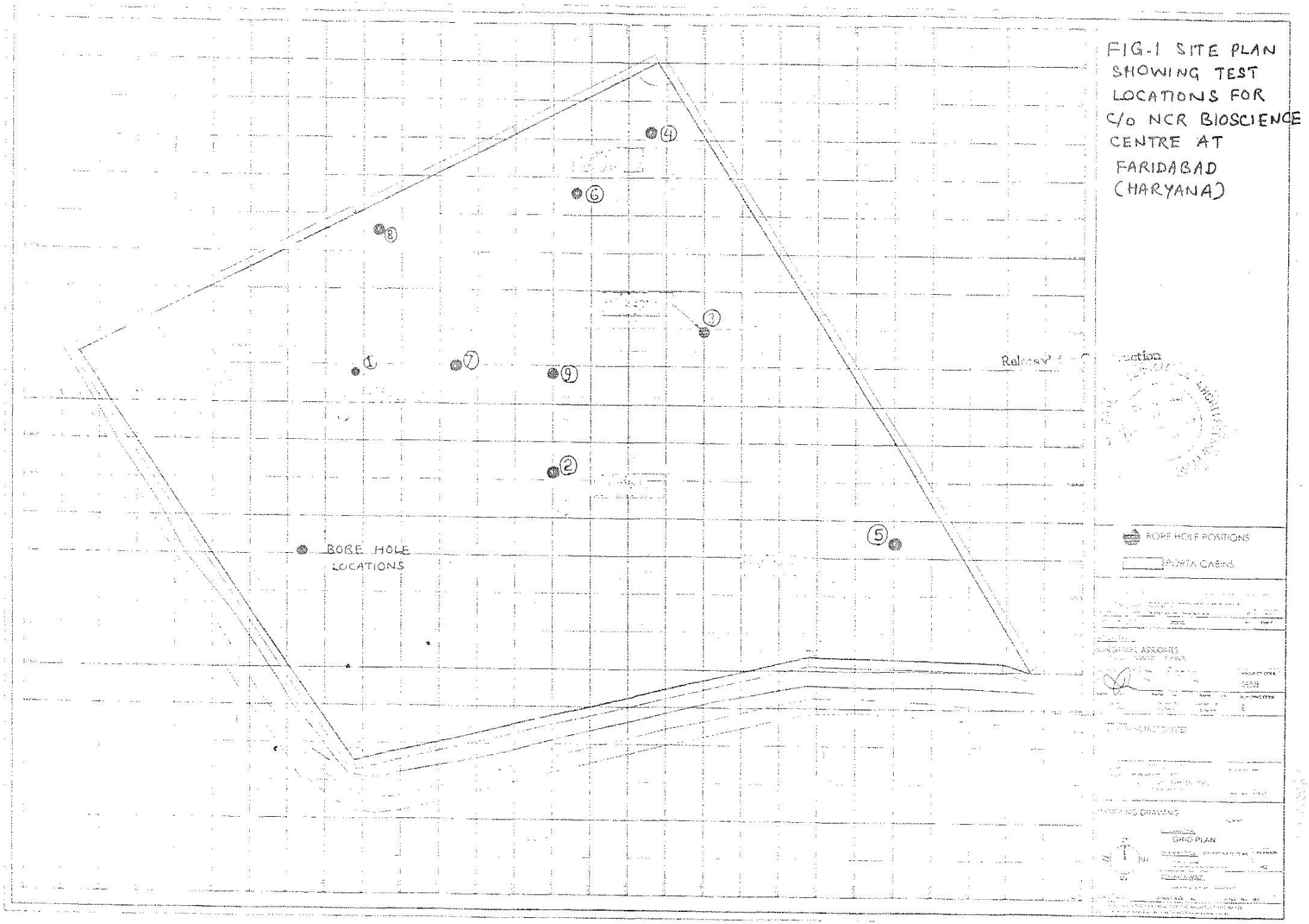
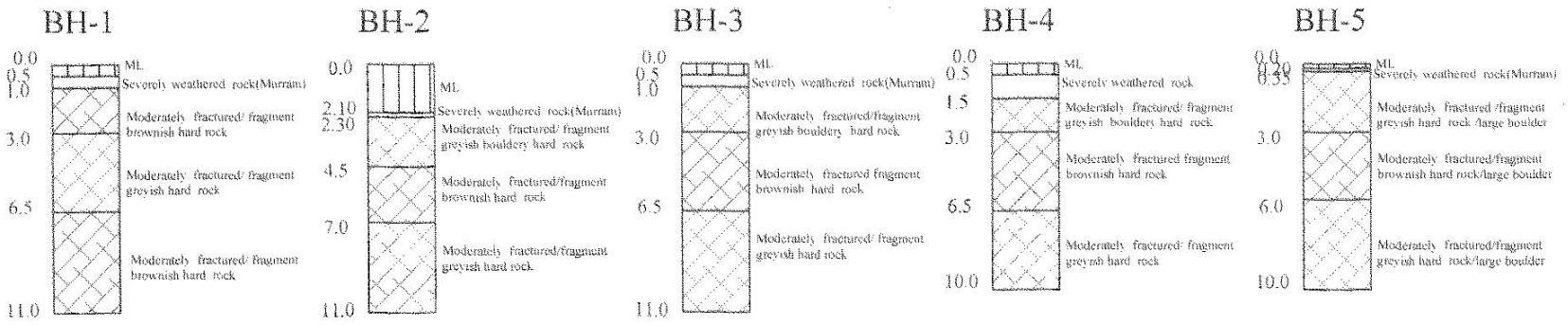


FIG-1 SITE PLAN SHOWING TEST LOCATIONS FOR C/o NCR BIOSCIENCE CENTRE AT FARIDABAD (HARYANA)
BORE HOLE LOCATIONS
BORE HOLE POSITIONS
PORTA CABINS
GRID PLAN

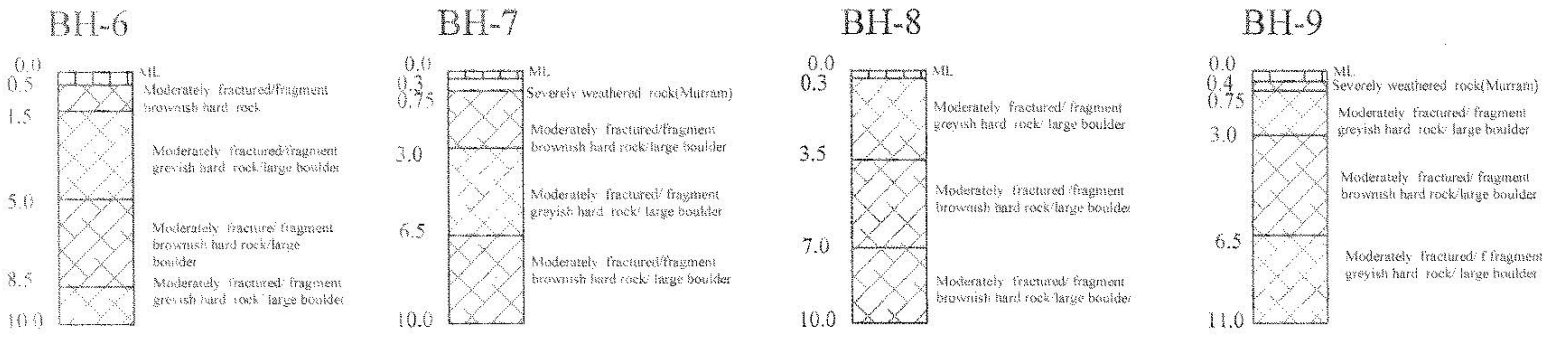
MAGMA INFRASTRUCTURE PRIVATE LIMITED SHEET NO.



SUB SOIL PROFILE

Subsoil Investigation work For NCR Bioscience Centre land at Faridabad (Haryana).

MAGMA INFRASTRUCTURE PRIVATE LIMITED SHEET NO.



SUB SOIL PROFILE

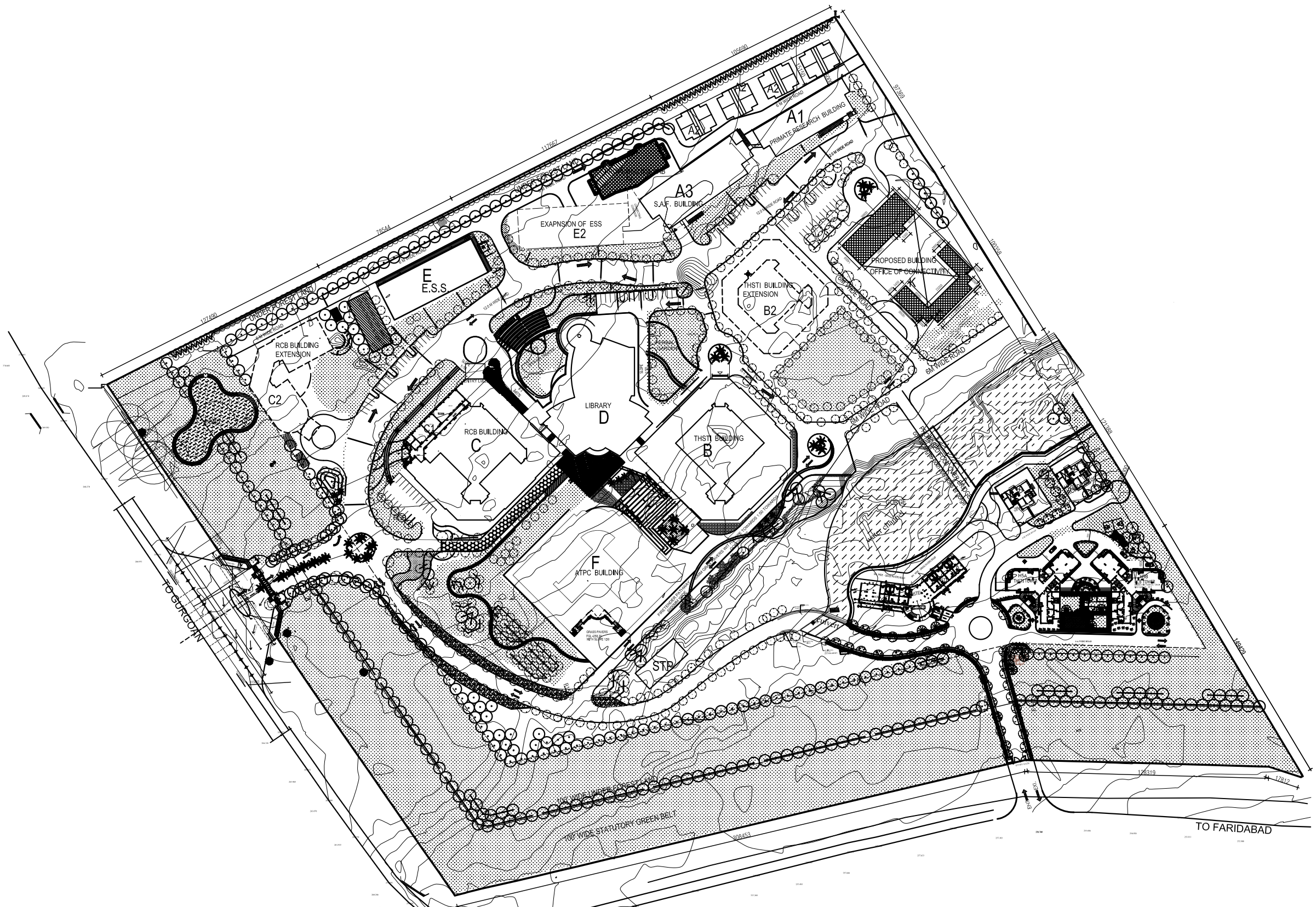
Subsoil Investigation work For NCR Bioscience Centre land at Faridabad (Haryana).

COMPOSITE WORK FOR CONSTRUCTION OF NCR BIOTECH SCIENCE CLUSTER PHASE-II WORKS AT FARIDABAD, HARYANA

LIST OF DRAWINGS

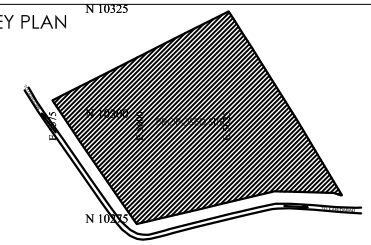
LIST OF DRAWINGS

S.No.	Drawing No.	Drawing Title
MASTER PLAN		
1	08008-(PH2)-MP-S5-AP-001	Site Layout Plan
2	08008-(PH2)-MP-S5-AP-001	Site Layout Plan (160 Acre)
3	08008-(PH2)-MP-S5-AD-905	Typical Fencing Detail
4	08008-(PH2)-MP-S5-AD-906	Typical Boundry wall Detail
5	08008-(PH2)-MP-S5-AD-901	Typical Car Shade
6	08008-(PH2)-MP-S5-AD-902	Car Shade Detail
7	08008-(PH2)-MP-S5-AD-903	Foot over Bridge
BSL3 LAB		
Architectural		
8	08008-(PH2)-A4-S5-AP-001	Ground Floor Plan
9	08008-(PH2)-A4-S5-AP-002	First Floor Plan
10	08008-(PH2)-A4-S5-AP-003	Terrace Floor Plan
11	08008-(PH2)-A4-S5-AREA-001	Area Chart
12	08008-(PH2)-A4-S5-AE-001-004	Elevation
13	08008-(PH2)-A4-S5-AS-001	Sections
Plumbing		
14	08008-(PH2)-A4-S5-PL-001	Ground Floor Plan Plumbing Layout
15	08008-(PH2)-A4-S5-PL-002	First Floor Plan Plumbing layout
16	08008-(PH2)-A4-S5-PL-003	Terrace Floor Plan Plumbing Layout
Fire Fighting		
17	08008-(PH2)-A4-S5-PL-001	Ground Floor Plan Fire Fighting
18	08008-(PH2)-A4-S5-PL-002	First Floor Plan Fire Fighting
19	08008-(PH2)-A4-S5-PL-003	Terrace Floor Plan Fire Fighting
OFFICE OF CINNECTIVITY		
Architectural		
20	08008-(PH2)-K-S5-AP-001	Ground Floor Plan
21	08008-(PH2)-K-S5-AP-002	First Floor Plan
22	08008-(PH2)-K-S5-AP-003	Second Floor Plan
23	08008-(PH2)-K-S5-AP-004	Terrace Floor Plan
24	08008-(PH2)-K-S5-AE-001	Elevation & Section
25	08008-(PH2)-K-S5-AS-001	Staircase 2(Fire) Fighting
26	08008-(PH2)-K-S5-AD-901	Typical Room Detail
27	08008-(PH2)-K-S5-AD-902	Typical Dinning & Kitchen Detail
28	08008-(PH2)-K-S5-AD-903	Typical Conference Room Detail
Plumbing		
29	08008-K-S5-PL-001	Ground Floor Plumbing Plan
30	08008-K-S5-PL-002	First Floor Plumbing Plan
31	08008-K-S5-PL-003	Secound Floor Plumbing Plan
32	08008-K-S5-PL-004	Terrace Floor Plumbing Plan
33	08008-K-S5-PL-005	Water Supply Schematic Diagram
Electrical		
34	08008-K-S5-EL-001	Ground Floor Electrical Layout
35	08008-K-S5-EL-002	First Floor Electrical Layout
36	08008-K-S5-EL-003	Second Floor Electrical Layout
37	08008-K-S5-PL-SLD-001	SLD Plan Electrical Layout
SMALL ANIMAL FACILITY		
38	08008-(PH2)-A3-S5-AP-001	Proposed Stand by Ahu At Ground Floor
39	08008-(PH2)-A3-S5-AP-002	Proposed Stand by Ahu At First Floor
40	08008-(PH2)-A3-S5-AP-001	Doors And Window Details



Note:-
This Drawing is for reference only

KEY PLAN



*AREA DETAIL :-

* Plot Area= 160542.835 Sq. Mt. (39.670 Acre)
*Area under 100' wide statutory green belt
=23142.76 sq.mt.(5.7 acre)

LEGEND

PHASE- I

A. ANIMAL RESEARCH
A1. PRIMATE RESEARCH BUILDING
A2. OPEN ENCLOSURE FOR ANIMALS
A3. SMALL ANIMAL RESEARCH BUILDING
B. THSTI
C. RCB
D. LIBRARY +AUDITORIUM+LECTURE HALLS
E. ELECTRIC SUB STATION -

PHASE- I EXT.

C1. R.C.B FOURTH WING
F. ADVANCE TECHNOLOGY PLATFORM CENTER (ATPC)
G. HOSTEL
H5A. HOUSING THSTI TOWER -G+7 STORY)
H5B. HOUSING RCB TOWERS - G+7 STORY)

H6A. THSTI DIRECTOR'S RESIDENCE:-
H6B. RCB DIRECTOR'S RESIDENCE:-

PHASE- II

K. CLUSTER FACILITIES
A4. BSL- 3 LAB
G EXT . HOSTEL EXPANSION
C2 . RCB EXPANSION
B2 . THSTI EXPANSION
E2. ELECTRIC SUB STATION EXPANSION -

LEGEND

DESCRIPTION	SYMBOL
TREE	
BOUNDARY WALL	
ROAD	
FENCE	
CULVERT N 10025	
DITCH	

NOTE- THIS DRAWING IS FOR REFERENCE ONLY

DATE	REV.	REV.BY	DESCRIPTION	DATE	NOS	ISSUED TO

ARCHITECT

SURESH GOEL & ASSOCIATES
ARCHITECTS . ENGINEERS . PLANNERS

DWG ISSUED ON: 20-08-2016	AT: NEW DELHI		PROJECT CODE
Sig:	Sig:	Sig:	08008
Name: NS	Name: NS	Name: MLG	BUILDING CODE
Originated by Architect	Checked by Architect	Validated by Engineer	MP

PROJECT

NCR BIO TECH SCIENCES CLUSTER -PHASE -2 UNDER THE DEPARTMENT OF BIOTECHNOLOGY (MINISTRY OF SCIENCES AND TECHNOLOGY GOVT. OF INDIA) VILLAGE BHANKRI, FARIDABAD, HARYANA.

S-83, PANCHSHILA PARK
NEW DELHI-110017
TEL: (011) 26014466, 26016341
MAIL:n_goel@vsnl.com

Ar.Sandeep Goel
CHIEF ARCHITECT

DRAWING FOR TENDER

CLIENT

N
W E
S

BUILDING TYPE:
MASTER PLAN

DRAWING TITLE:
SITE LAYOUT PLAN

REVISION
R0

DRAWING NUMBER:
08008-(PH2)-MP-S5-AP-001

SCALE : 1:1000	SHEET SIZE : A1	SHEET NO : 001

VillageBhankri,Land Area (Detail)		
	S.NO	AREA(Sqm.)
KHASRA NO	1.	58062.2959Sqm.
	2.	37841.2958Sqm.
	3.	7434.7101Sqm.
	4.	24191.5421Sqm.
	9.	49970.9289Sqm.
	10.	31048.5149Sqm.
	11.	27564.3225Sqm.
	12.	27885.9198Sqm.
	13.	38522.6918Sqm.
	14.	20492.9793Sqm.
	15.	16733.8958Sqm.
	16.	11645.0562Sqm.
	17.	21489.4841Sqm.
Total Area=372843.4480Sqm.		

VillageBarkhal,Land area
345777.3396Sqm.
67.89 ACRES.

TEMPORARY FENCING

BM1
RL=99.739m.

BM2
RL=101.622m.

100.0 m Wide Green Belt

2500 wide pathway

Expansion joint 30 M

VillageBhankri,Land
Area=372843.4480Sqm.
=92.105 Acres

Land Already
6 Alloted(40Acres)

HIGH TENTION LINE

To Gurgaon

To Faridabad

ASSUMED
RL=100.000m.

CLIENT-:

Village Barkhal, Land Area = 67.89 acres
Village Bhankri Land Area = 92.105 acres

160 Acres.

ALL DIM. ARE IN METERS.
CONTOUR INTERVAL=1.00METER.

DRAWING BY SPC

SCALE

LEGEND

BOUNDARY	
ROAD	
CULVERT	
DITCH	
HIGH TENTION LINE	
BM	
WELL	WELL
PROPOSED FENCING	
PROPOSED BOUNDARY WALL	

LEGEND

DESCRIPTION	SYMBOL
TREE	
BOUNDARY WALL	
ROAD	
FENCE	
CULVERT N 10025	
DITCH	

NOTE-1. THIS DRAWING IS FOR REFERENCE ONLY
2.EXPANSION JOINT SHALL BE PROVIDED AT EVERY 30 METRE.

N 10000

DATE	REV.	REV.BY	DESCRIPTION	DATE	NOS	ISSUED TO

ARCHITECT

SURESH GOEL & ASSOCIATES
ARCHITECTS . ENGINEERS . PLANNERS

DWG ISSUED ON: 20-08-2016	AT: NEW DELHI		PROJECT CODE
Sig:	Sig:	Sig:	08008
Name: DHRUV	Name: NIS	Name: MLG	BUILDING CODE
Originated by Architect	Checked by Architect	Validated by Engineer	MP

PROJECT

NCR BIO TECH SCIENCES CLUSTER UNDER THE DEPARTMENT OF BIOTECHNOLOGY (MINISTRY OF SCIENCES AND TECHNOLOGY GOVT. OF INDIA) VILLAGE BHANKRI, FARIDABAD, HARYANA.

S-83, PANCHSHILA PARK
NEW DELHI-110017
TEL: (011) 26014466, 26016341
MAIL:n_goel@vsnl.com

Ar.Sandeep Goel
CHIEF ARCHITECT

DRAWING FOR TENDER

CLIENT

N W E S

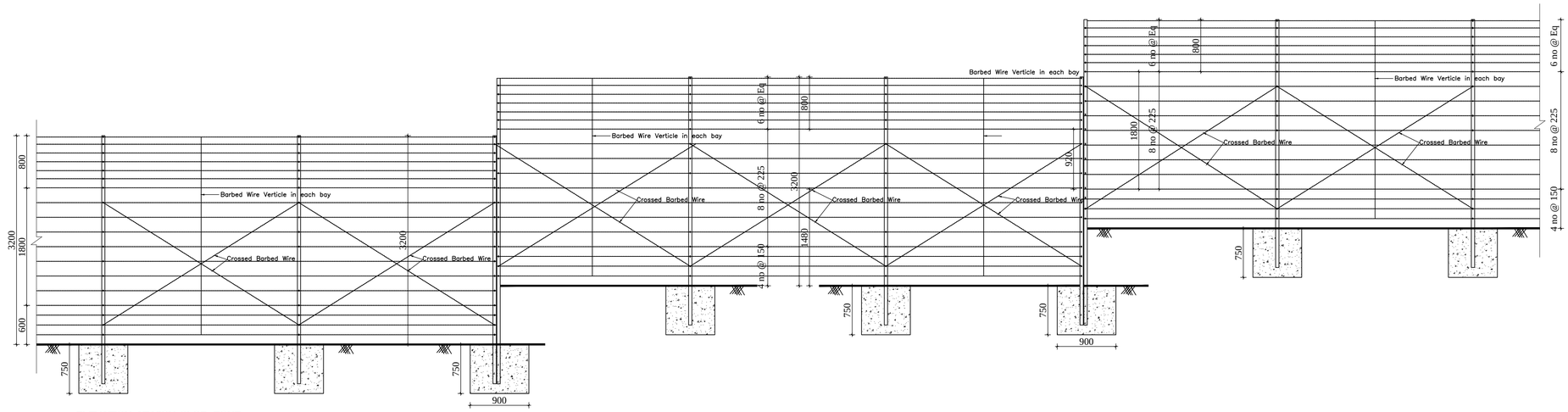
BUILDING TYPE:-
MASTER PLAN(160 ACRE)

DRAWING TITLE:-
SITE LAYOUT PLAN (160 ACRE)

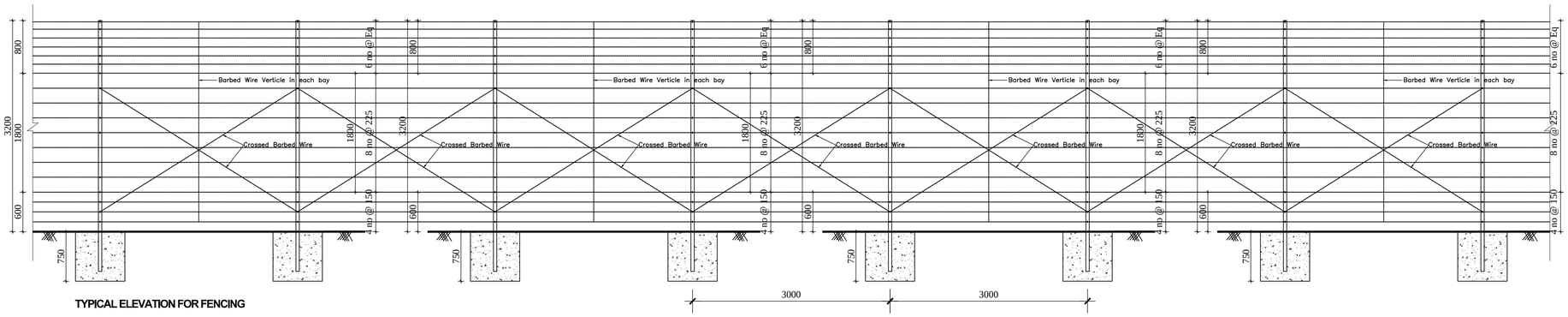
REVISION R1

DRAWING NUMBER:-
08008(PH2)-MP-S5-AP-001

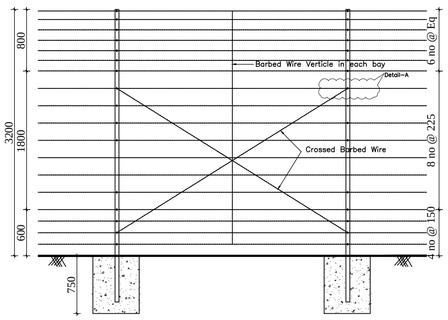
SCALE : 1:1000 | SHEET SIZE : A1 | SHEET NO : 001



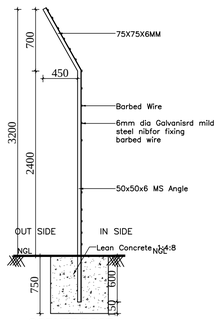
ELEVATION AT HIGH SLOP ZONE



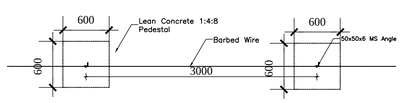
TYPICAL ELEVATION FOR FENCING



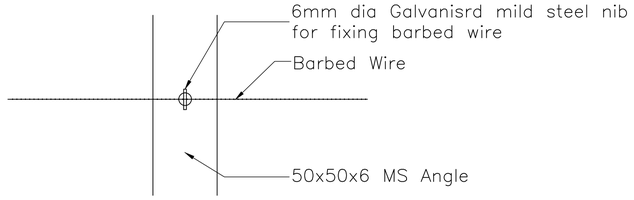
ELEVATION - TYPICAL MODULES



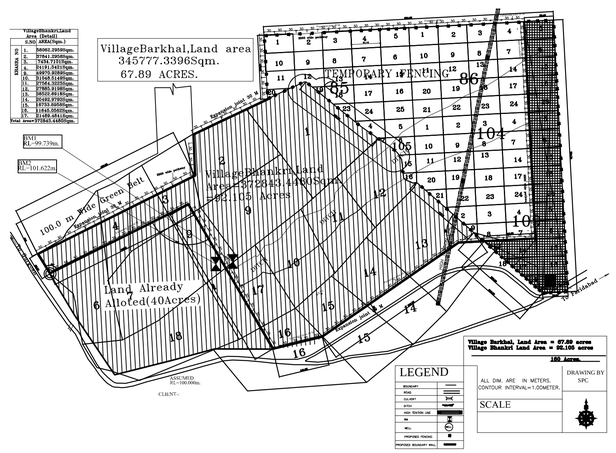
CORNER POST



PLAN



DETAIL A



KEY PLAN

NOTE-THIS DRAWING IS FOR REFERENCE ONLY

DATE	REV.	REV.BY	DESCRIPTION	DATE	NOS	ISSUED TO

ARCHITECT

SURESH GOEL & ASSOCIATES
ARCHITECTS . ENGINEERS . PLANNERS

DWG ISSUED ON: 20-08-2016	AT: NEW DELHI		PROJECT CODE
Sig:	Sig:	Sig:	08008
Name: DHRUV	Name: NIS	Name: MLG	BUILDING CODE
Originated by Architect	Checked by Architect	Validated by Engineer	MP

PROJECT

NCR BIO TECH SCIENCES CLUSTER UNDER THE DEPARTMENT OF BIOTECHNOLOGY (MINISTRY OF SCIENCES AND TECHNOLOGY GOVT. OF INDIA) VILLAGE BHANKRI, FARIDABAD, HARYANA.

S-83, PANCHSHILA PARK
NEW DELHI-110017
TEL: (011) 26014466, 26016341
MAIL:n_goel@vsnl.com

Ar.Sandeep Goel
CHIEF ARCHITECT

DRAWING FOR TENDER

CLIENT

N W E S

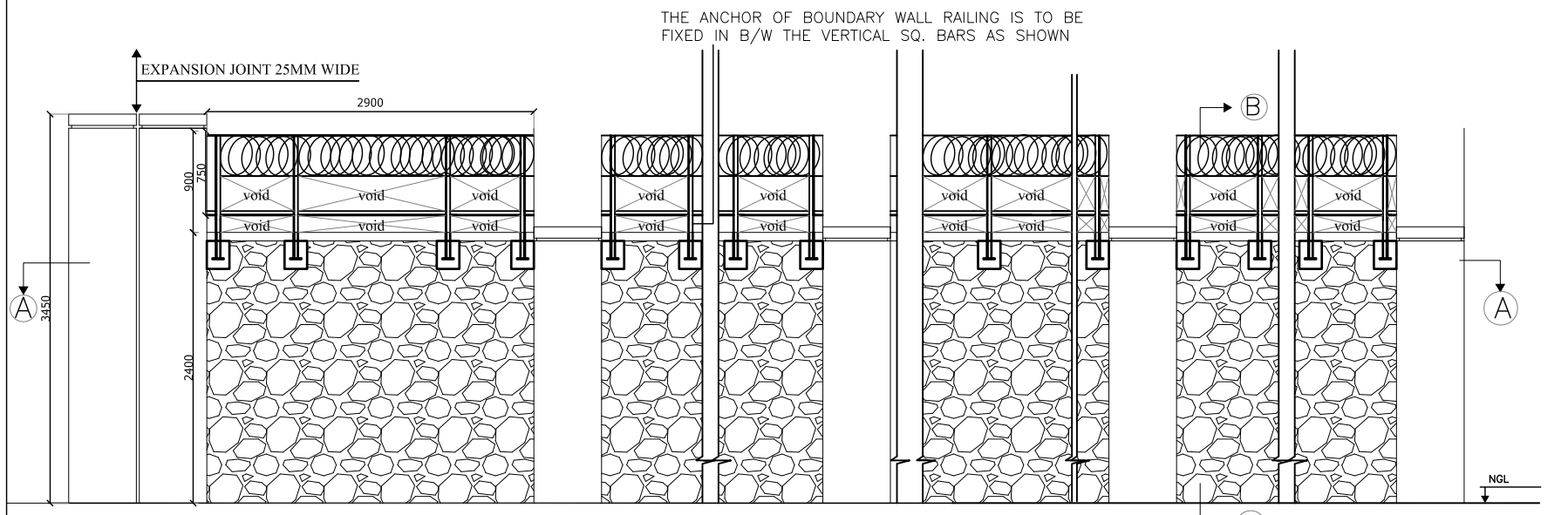
BUILDING TYPE: MASTER PLAN

DRAWING TITLE: **TYPICAL FENCING DETAIL**

REVISION R1

DRAWING NUMBER: 08008(PH2)-MP-S5-AD-905

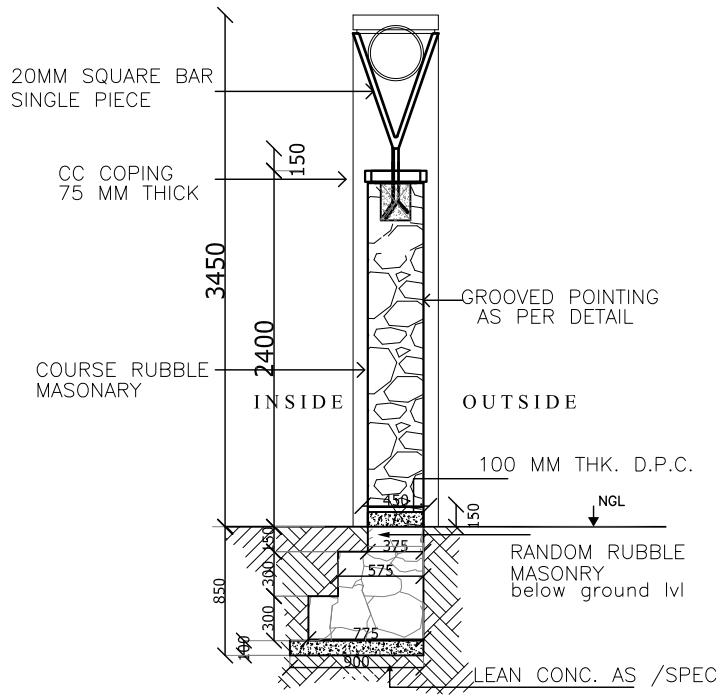
SCALE : 1:1000 | SHEET SIZE : A1 | SHEET NO : 001



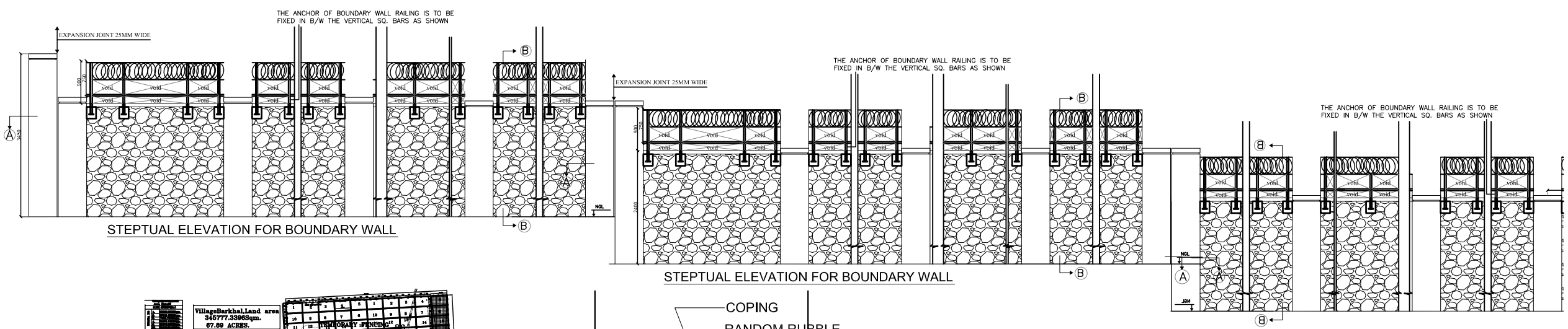
ELEVATION

COURSE RUBBLE PILLARS

(PLAN)- TYPICAL RANDOM RUBBLE MASONRY BOUNDARY WALL

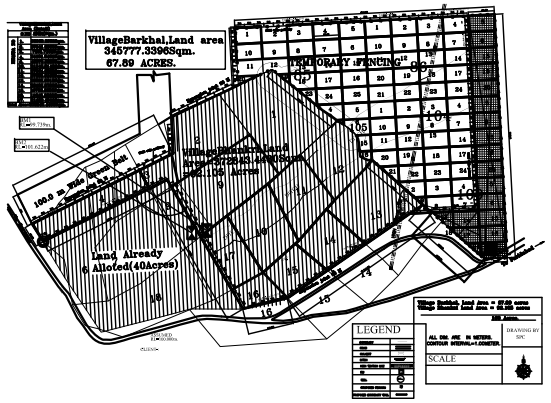


SECTION BB

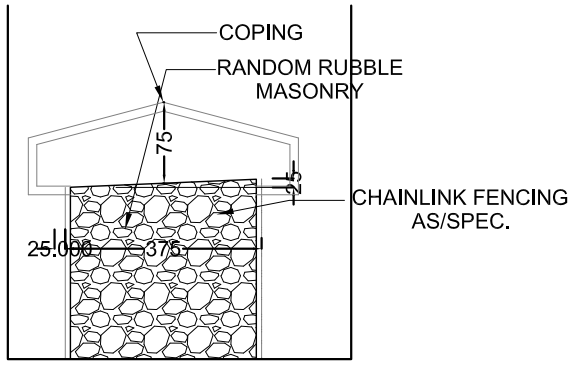


STEPTUAL ELEVATION FOR BOUNDARY WALL

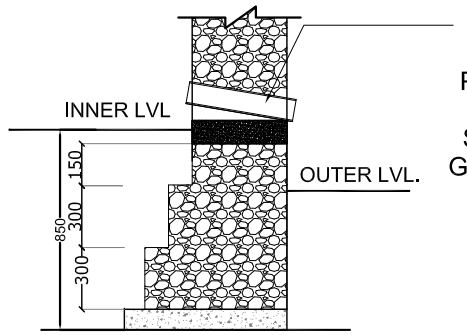
STEPTUAL ELEVATION FOR BOUNDARY WALL



KEY PLAN



DETAIL-C



250 Ø RCC PIPES TO BE PLACED IN MASONARY@15M c/c AT GROUND LVL. AS SHOWN IN SKETCH IF INNER GROUND LVL. IS HIGHER THAN THE OUTER GROUND LVL.

TYP DETAIL OF DRAINAGE

NOTE : THIS DRAWING IS FOR REFERENCE

N 10000

DATE	REV.	REV.BY	DESCRIPTION	DATE	NOS	ISSUED TO

ARCHITECT

SURESH GOEL & ASSOCIATES
ARCHITECTS . ENGINEERS . PLANNERS

DWG ISSUED ON: 20-08-16	AT: NEW DELHI		PROJECT CODE
Sig:	Sig:	Sig:	08008
Name: DHRUV	Name: NIS	Name: MLG	BUILDING CODE
Originated by Architect	Checked by Architect	Validated by Engineer	MP

PROJECT

NCR BIO TECH SCIENCES CLUSTER UNDER THE DEPARTMENT OF BIOTECHNOLOGY (MINISTRY OF SCIENCES AND TECHNOLOGY GOVT. OF INDIA) VILLAGE BHANKRI, FARIDABAD, HARYANA.

S-83, PANCHSHILA PARK
NEW DELHI-110017
TEL: (011) 26014466, 26016341
MAIL:n_goel@vsnl.com

Ar.Sandeep Goel
CHIEF ARCHITECT

DRAWING FOR TENDER

CLIENT

N W E S

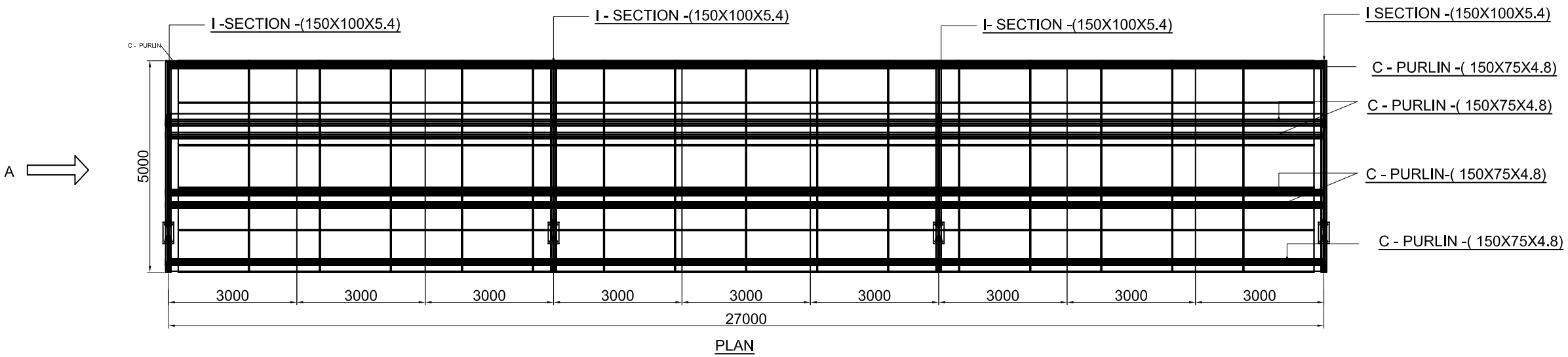
BUILDING TYPE: MASTER PLAN

DRAWING TITLE: **TYPICAL BOUNDARY WALL DETAIL**

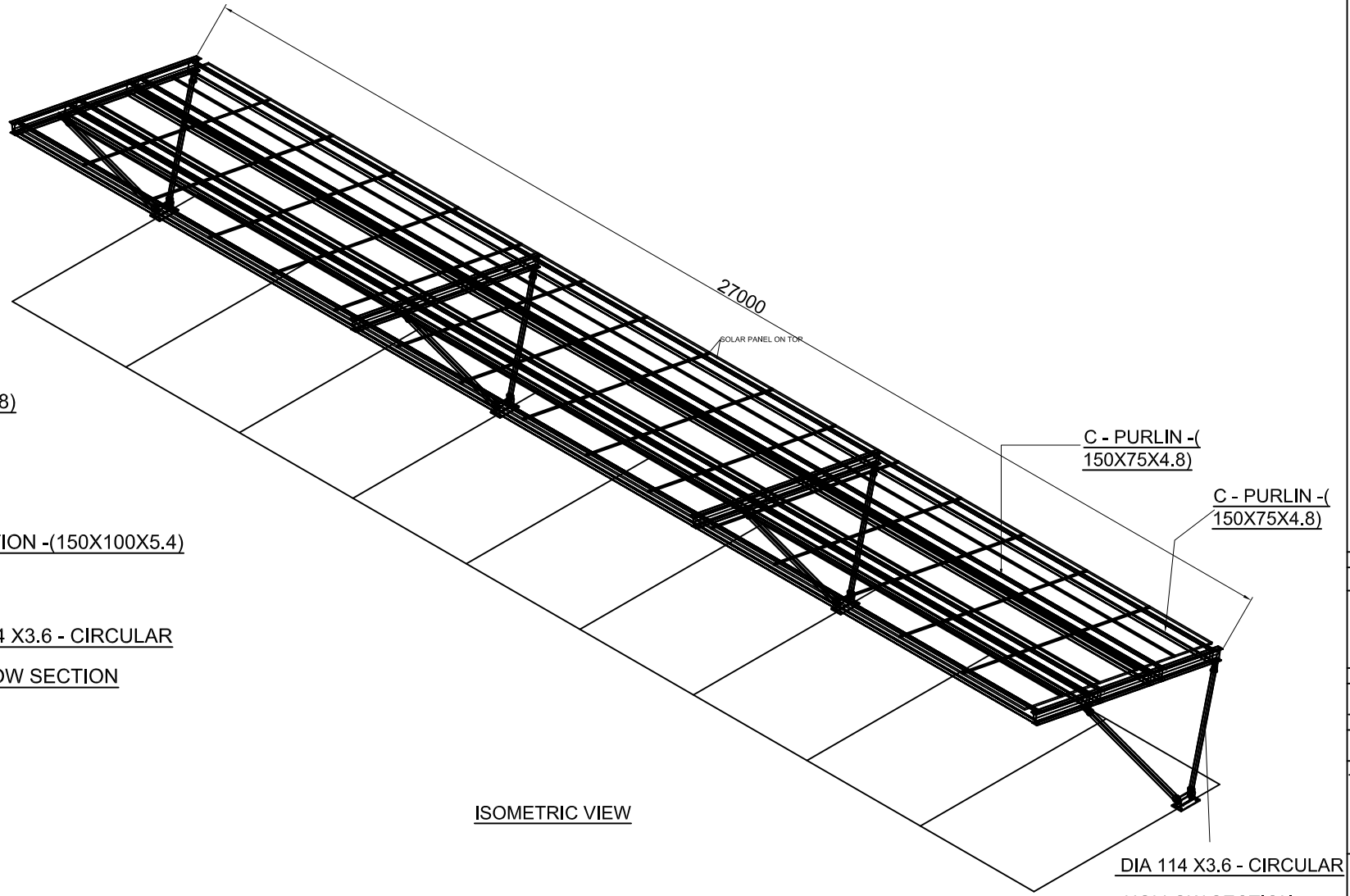
REVISION R1

DRAWING NUMBER: 08008-PH2-MP-S5-AD-906

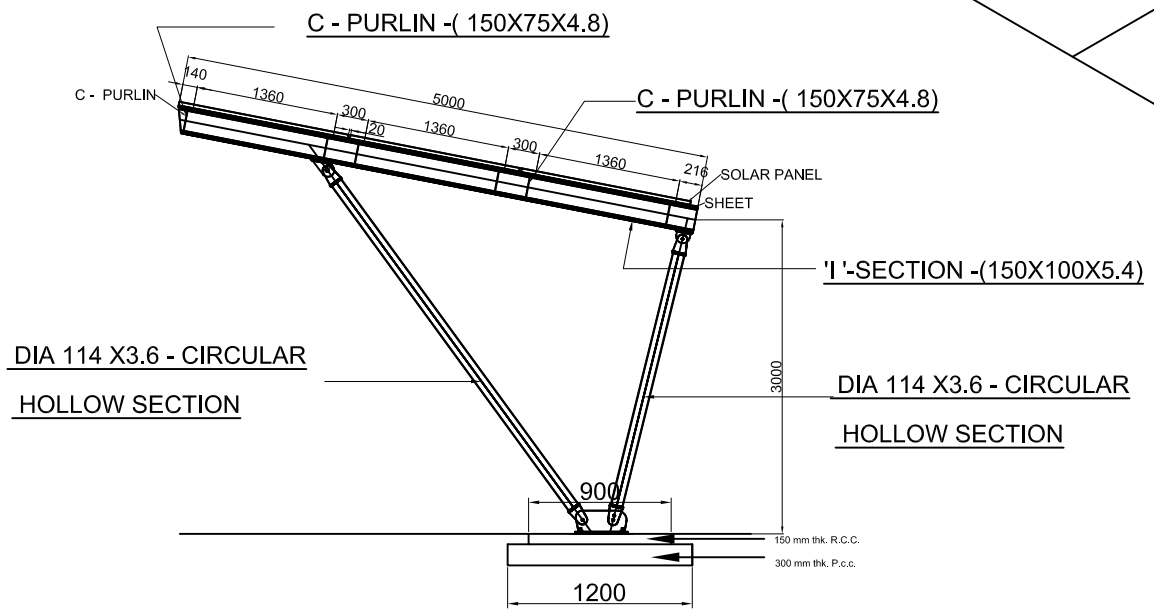
SCALE : 1:1000 | SHEET SIZE : A1 | SHEET NO : 001



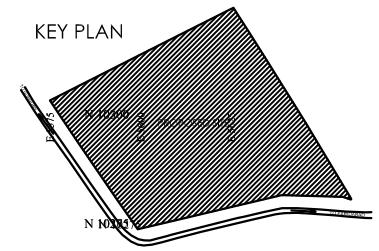
PLAN



ISOMETRIC VIEW



VIEW-A



Note:-
This drawing for reference

DATE	REV.	REV.BY	DESCRIPTION	DATE	NOS	ISSUED TO

ARCHITECT

SURESH GOEL & ASSOCIATES
ARCHITECTS . ENGINEERS . PLANNERS

DWG ISSUED ON: 20-08-2016	AT: NEW DELHI		PROJECT CODE
Sig:	Sig:	Sig:	08008
Name: DHRUV	Name: NIS	Name: MLG	BUILDING CODE
Originated by Architect	Checked by Architect	Validated by Engineer	MP

PROJECT

NCR BIO TECH SCIENCES CLUSTER UNDER THE DEPARTMENT OF BIOTECHNOLOGY (MINISTRY OF SCIENCES AND TECHNOLOGY GOVT. OF INDIA) VILLAGE BHANKRI, FARIDABAD, HARYANA.

S-83, PANCHSHILA PARK
NEW DELHI-110017
TEL: (011) 26014466, 26016341
MAIL:n_goel@vsnl.com

Ar.Sandeep Goel
CHIEF ARCHITECT

DRAWING FOR TENDER

CLIENT

N W E S

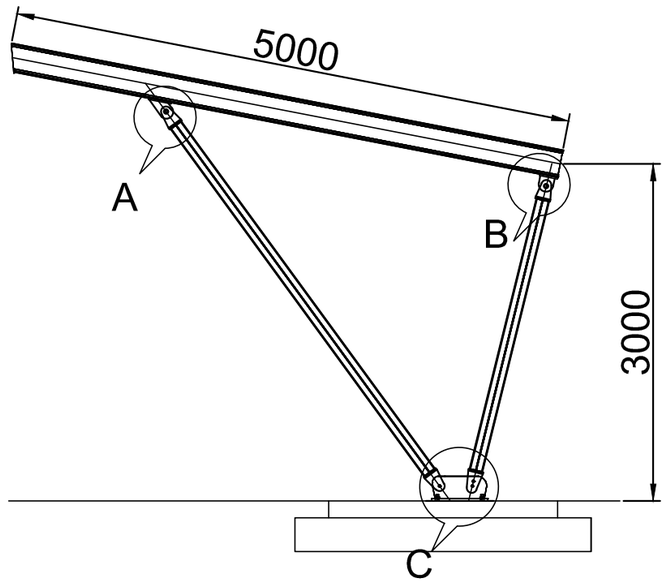
BUILDING TYPE:
MASTER PLAN

DRAWING TITLE:
TYPICAL CAR SHADE DETAIL

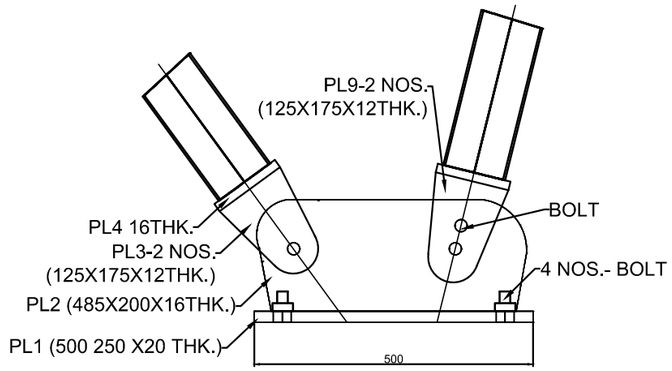
REVISION
R0

DRAWING NUMBER:
08008-(PH2)-MP-S5-AD-901

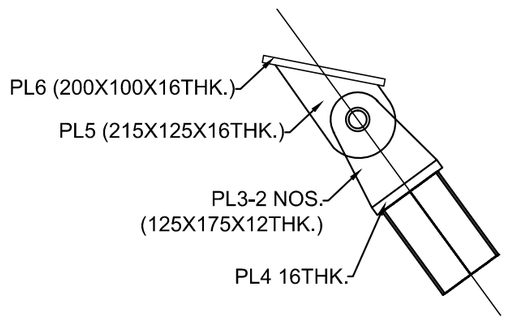
SCALE : 1:1000	SHEET SIZE : A1	SHEET NO : 001



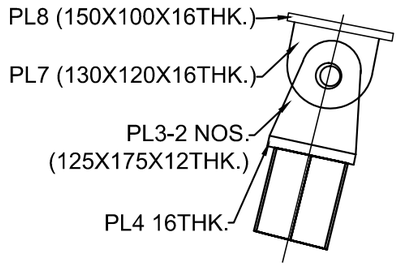
ELEVATION



DETAIL -C



DETAIL -A



DETAIL -B

N 10275

NOTE-THIS DRAWING IS FOR REFERENCE ONLY

DATE	REV.	REV.BY	DESCRIPTION	DATE	NOS	ISSUED TO

ARCHITECT

SURESH GOEL & ASSOCIATES
ARCHITECTS . ENGINEERS . PLANNERS

DWG ISSUED ON: 20-08-2016	AT: NEW DELHI		PROJECT CODE
Sig:	Sig:	Sig:	08008
Name: NIS	Name: NIS	Name: MLG	BUILDING CODE
Originated by Architect	Checked by Architect	Validated by Engineer	MP

PROJECT

NCR BIO TECH SCIENCES CLUSTER UNDER THE DEPARTMENT OF BIOTECHNOLOGY (MINISTRY OF SCIENCES AND TECHNOLOGY GOVT. OF INDIA) VILLAGE BHANKRI, FARIDABAD, HARYANA.

S-83, PANCHSHILA PARK
NEW DELHI-110017
TEL: (011) 26014466, 26016341
MAIL:n_goel@vsnl.com

Ar.Sandeep Goel
CHIEF ARCHITECT

DRAWING FOR TENDER

CLIENT

N W E S

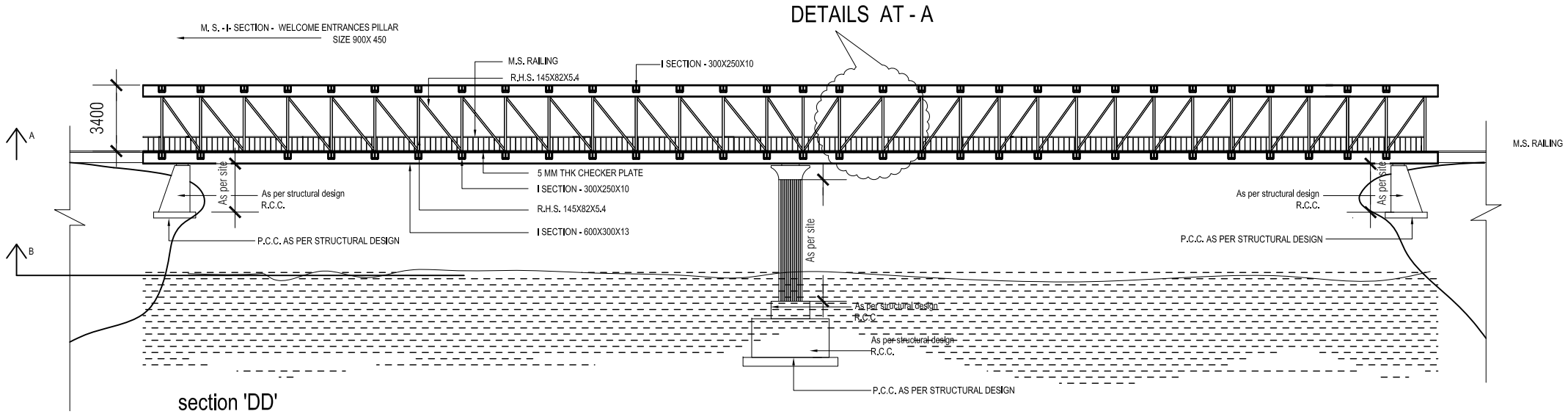
BUILDING TYPE:-
MASTER PLAN

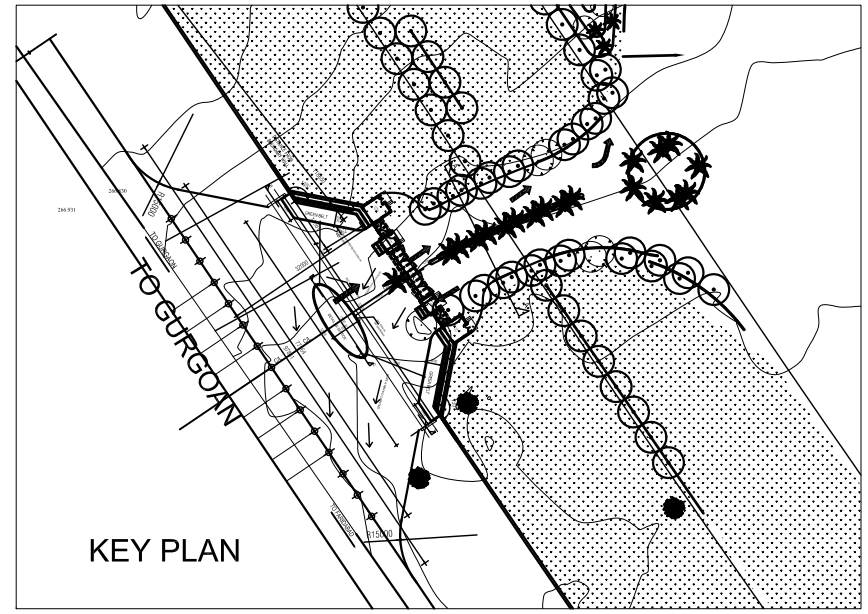
DRAWING TITLE:-
CAR SHADE DETAILS

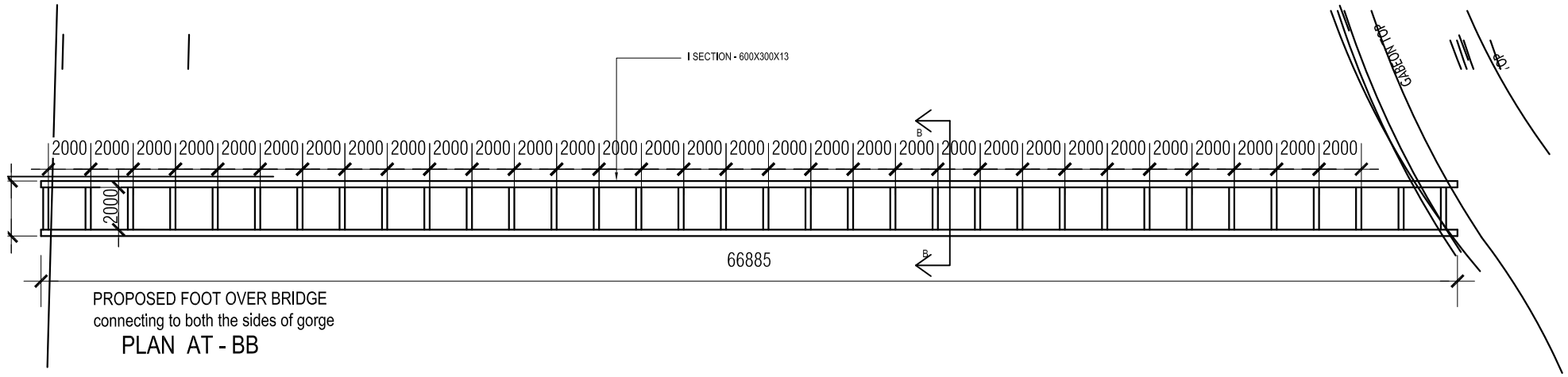
REVISION
R1

DRAWING NUMBER:-
08008-(PH2)-MP-S5-AD-902

SCALE : 1:1000	SHEET SIZE : A1	SHEET NO : 001







section 'DD'

KEY PLAN

PROPOSED FOOT OVER BRIDGE
connecting to both the sides of gorge
PLAN AT - BB

section 'BB'

PLAN At - AA

DETAILS AT - A

NOTE-THIS DRAWING IS FOR REFERENCE ONLY

DATE	REV	REV.BY	DESCRIPTION	DATE	NOS	ISSUED TO

ARCHITECT
SURESH GOEL & ASSOCIATES
ARCHITECTS . ENGINEERS . PLANNERS

DWG ISSUED ON: 20-08-16	AT: NEW DELHI		PROJECT CODE
Sig:	Sig:	Sig:	08008
Name: DHRUV	Name: NIS	Name: MLG	BUILDING CODE
Originated by Architect	Checked by Architect	Validated by Engineer	MP

PROJECT
NCR BIO TECH SCIENCES CLUSTER -PHASE -2 UNDER THE DEPARTMENT OF BIOTECHNOLOGY (MINISTRY OF SCIENCES AND TECHNOLOGY GOVT. OF INDIA) VILLAGE BHANKRI, FARIDABAD, HARYANA

S-83, PANCHSHILA PARK
NEW DELHI-110017
TEL: (011) 26014466, 26016341
MAIL:n_goel@vsnl.com

Ar.Suresh Goel
CHIEF ARCHITECT

DRAWING FOR TENDER

CLIENT

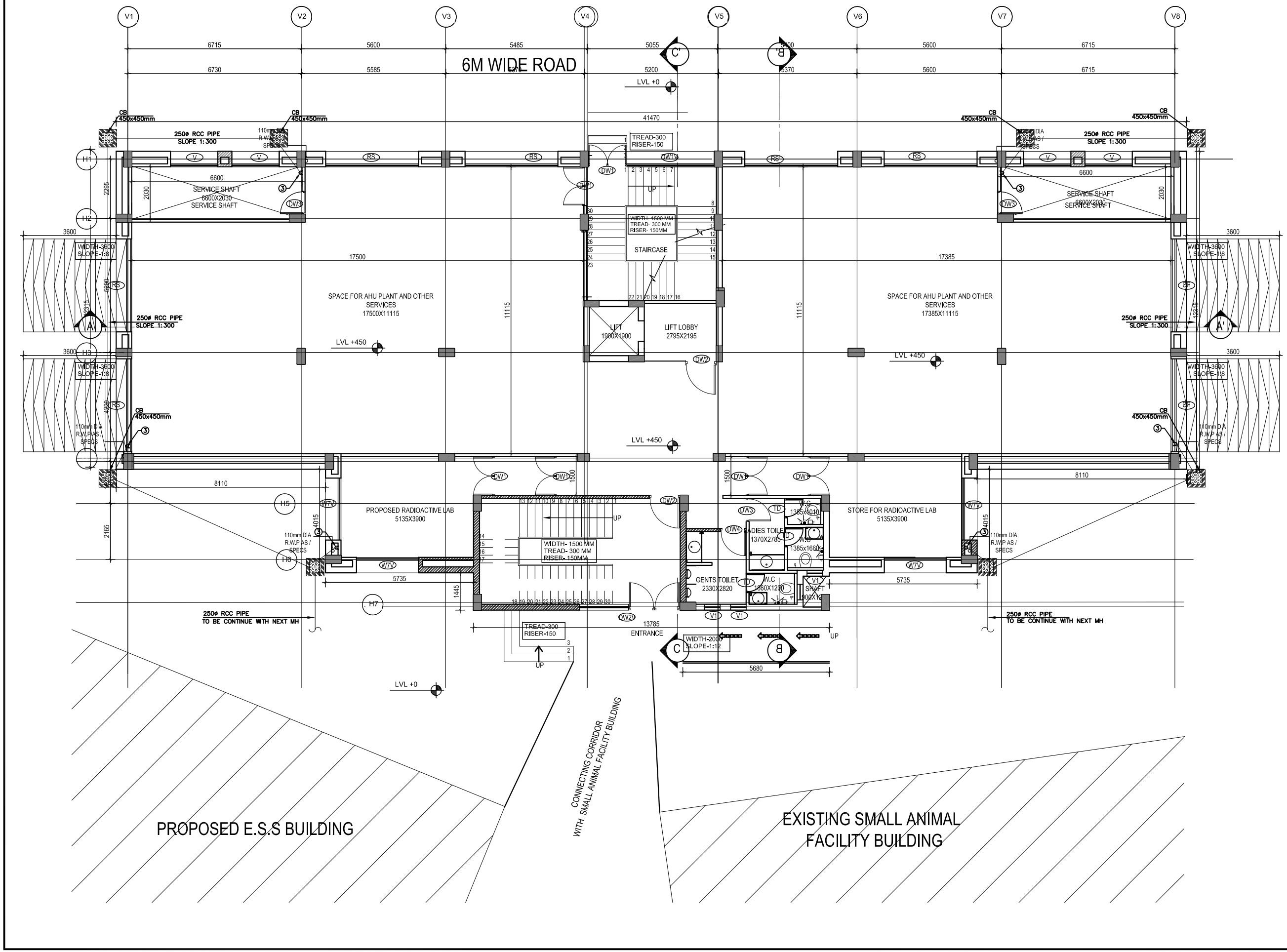
N
W E
S

BUILDING TYPE:
FOOT OVER BRIDGE

DRAWING TITLE:
FOOT OVER BRIDGE

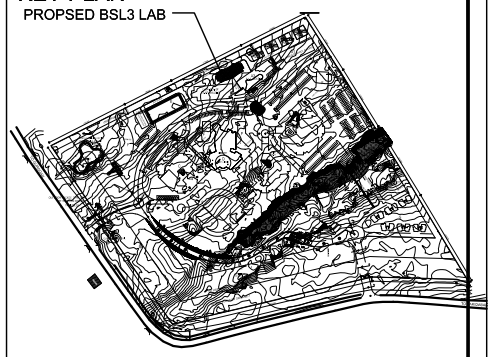
DRAWING NUMBER:
08008-PH2-MP-S5-AD-903

SCALE : 1:1000
SHEET SIZE : A1
SHEET NO : 001



KEY PLAN

PROPSED BSL3 LAB



GENERAL NOTES

1. ALL DIMENSIONS ARE IN MM.
2. ONLY WRITTEN DIMENSIONS ARE TO BE FOLLOWED.
3. FOR STAIRCASE / TOILET / RAMP DETAIL, REFER DETAIL DRAWINGS.
4. ANY DISCREPANCY FOUND IN THE DRAWING SHOULD BE BROUGHT TO THE NOTICE OF ARCHITECT / STRUCTURAL CONSULTANT BEFORE TAKING ANY DECISION.
5. THIS DRAWING IS TO BE READ IN CONJUCTION WITH STRUCTURAL AND OTHER RELEVANT SERVICES DRAWINGS.
6. PLASTER AT ALL CORNERS TO BE CHAMFERED WITH 15 MM RADIUS.

DOOR SCHEDULE				
TYPE	WIDTH	HEIGHT	SILL LEVEL	TOP LEVEL
DW	2000	2700	-	2700
DW1	1500	2700	-	2700
DW2	1200	2700	-	2700
DW3	900	2400	-	2400
DW4	1000	2400	-	2400
DW5	1200	2700	-	2700
TD	750	2100	-	2100
RS	3600	3000	-	3000

WINDOW SCHEDULE				
TYPE	WIDTH	HEIGHT	SILL LEVEL	TOP LEVEL
W3V	1900	1200	1200	2700
W4V	1500	1200	1200	2700
W5V	3600	1200	1200	2700
W6V	3640	1200	1200	2700
W7V	2400	1200	1200	2700
W8V	4500	1200	1200	2700
DW1V	4900	1500	1200	2700
DW2V	3900	1500	1200	2700
V	1800	1500	1200	2700
V1	600	700	2000	2700

NOTE-THIS DRAWING IS FOR REFERENCE ONLY

DATE	REV.	REV.BY	DESCRIPTION	DATE	NOS	ISSUED TO

ARCHITECT

SURESH GOEL & ASSOCIATES

ARCHITECTS . ENGINEERS . PLANNERS

DWG ISSUED ON: 20-08-16	AT: NEW DELHI	PROJECT CODE
Sig:	Sig:	Sig: 08008
Name: DHRUV	Name: NIS	Name: MLG BUILDING CODE
Originated by Architect	Checked by Architect	Validated by Engineer A4

PROJECT

PROPOSED BUILDING PLAN FOR CONSTRUCTION OF NCR BIOTECH SCIENCE CLUSTER PHASE- II UNDER THE DEPARTMENT OF BIOTECHNOLOGY (MINISTRY OF SCIENCES AND TECHNOLOGY GOVT. OF INDIA) VILLAGE BHANKRI FARIDABAD, HARYANA.

S-83, PANCHSHILA PARK
NEW DELHI-110017
TEL: (011) 26014466, 26016341
MAIL:n_goel@vsnl.com

Ar.Sandeep Goel
CHIEF ARCHITECT

DRAWING FOR TENDER

CLIENT

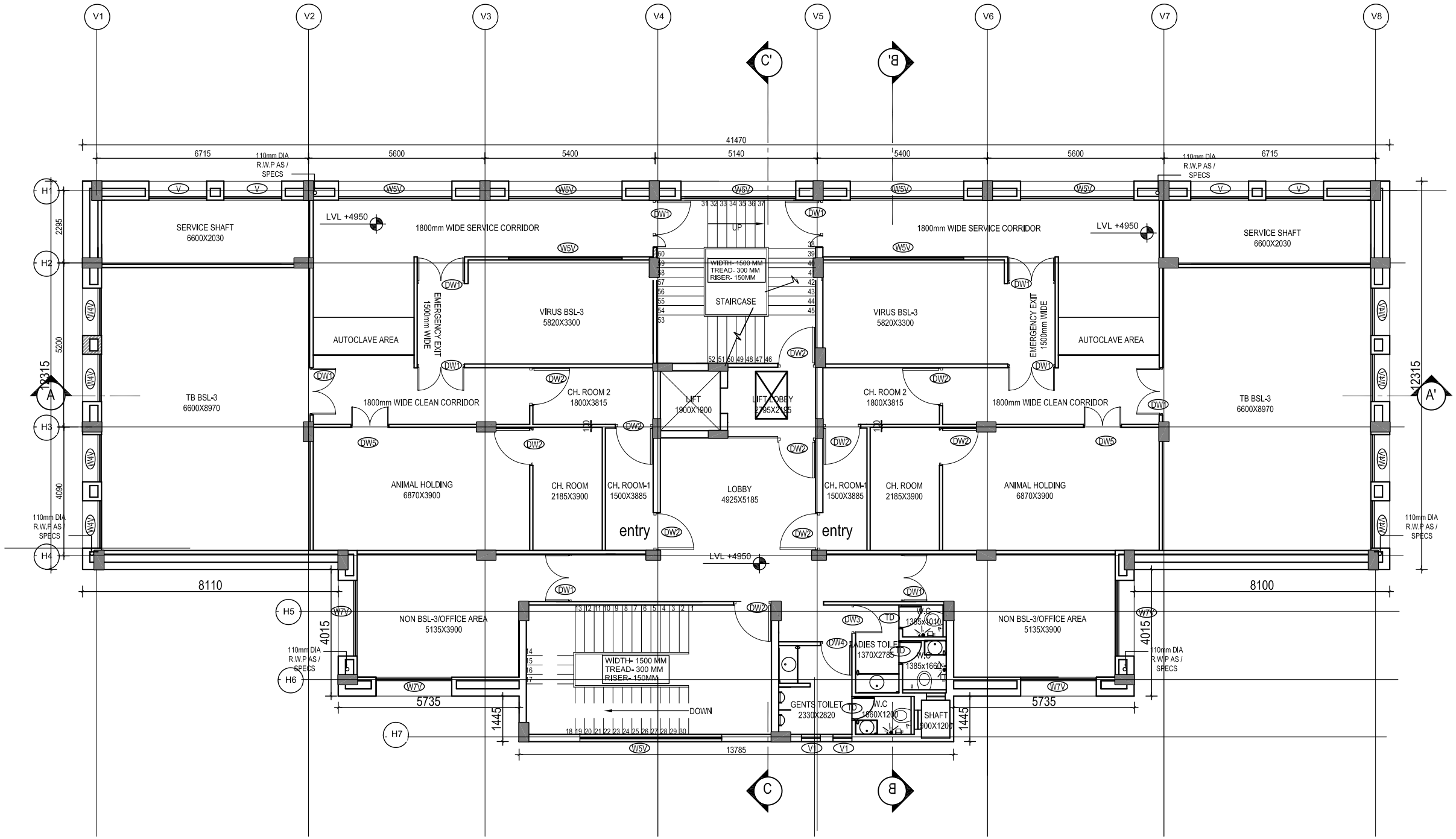
BUILDING TYPE: BSL3 LAB

DRAWING TITLE: GROUND FLOOR PLAN

REVISION

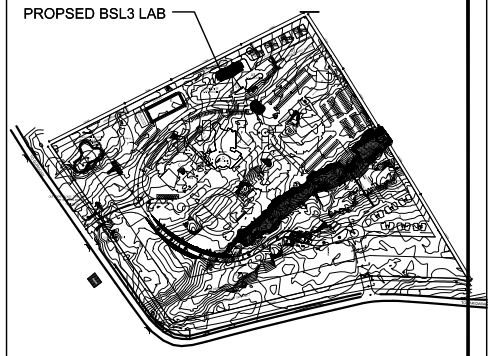
DRAWING NUMBER: 08008(PH2)-A4-S5-AP-001

SCALE : NTS | SHEET SIZE : A3 | SHEET NO : 001



KEY PLAN

PROPSED BSL3 LAB



GENERAL NOTES

1. ALL DIMENSIONS ARE IN MM.
2. ONLY WRITTEN DIMENSIONS ARE TO BE FOLLOWED.
3. FOR STAIRCASE / TOILET / RAMP DETAIL, REFER DETAIL DRAWINGS.
4. ANY DISCREPANCY FOUND IN THE DRAWING SHOULD BE BROUGHT TO THE NOTICE OF ARCHITECT / STRUCTURAL CONSULTANT BEFORE TAKING ANY DECISION.
5. THIS DRAWING IS TO BE READ IN CONJUCTION WITH STRUCTURAL AND OTHER RELEVANT SERVICES DRAWINGS.
6. PLASTER AT ALL CORNERS TO BE CHAMFERED WITH 15 MM RADIUS.

DOOR SCHEDULE				
TYPE	WIDTH	HEIGHT	SILL LEVEL	TOP LEVEL
DW	2000	2700	-	2700
DW1	1500	2700	-	2700
DW2	1200	2700	-	2700
DW3	900	2400	-	2400
DW4	1000	2400	-	2400
DW5	1200	2700	-	2700
TD	750	2100	-	2100
RS	3600	3000	-	3000

WINDOW SCHEDULE				
TYPE	WIDTH	HEIGHT	SILL LEVEL	TOP LEVEL
W3V	1900	1200	1200	2700
W4V	1500	1200	1200	2700
W5V	3600	1200	1200	2700
W6V	3640	1200	1200	2700
W7V	2400	1200	1200	2700
W8V	4500	1200	1200	2700
DW1V	4900	1500	1200	2700
DW2V	3900	1500	1200	2700
V	1800	1500	1200	2700
V1	600	700	2000	2700

NOTE-THIS DRAWING IS FOR REFERENCE ONLY

DATE	REV.	REV.BY	DESCRIPTION	DATE	NOS	ISSUED TO

ARCHITECT

SURESH GOEL & ASSOCIATES

ARCHITECTS . ENGINEERS . PLANNERS

DWG ISSUED ON: 20-08-16	AT: NEW DELHI	PROJECT CODE
Sig:	Sig:	Sig: 08008
Name: DHRUV	Name: NIS	Name: MLG BUILDING CODE
Originated by Architect	Checked by Architect	Validated by Engineer A4

PROJECT

PROPOSED BUILDING PLAN FOR CONSTRUCTION OF NCR BIOTECH SCIENCE CLUSTER PHASE- II UNDER THE DEPARTMENT OF BIOTECHNOLOGY (MINISTRY OF SCIENCES AND TECHNOLOGY GOVT. OF INDIA) VILLAGE BHANKRI FARIDABAD, HARYANA.

S-83, PANCHSHILA PARK
NEW DELHI-110017
TEL: (011) 26014466, 26016341
MAIL:n_goel@vsnl.com

Ar.Sandeep Goel
CHIEF ARCHITECT

DRAWING FOR TENDER

CLIENT

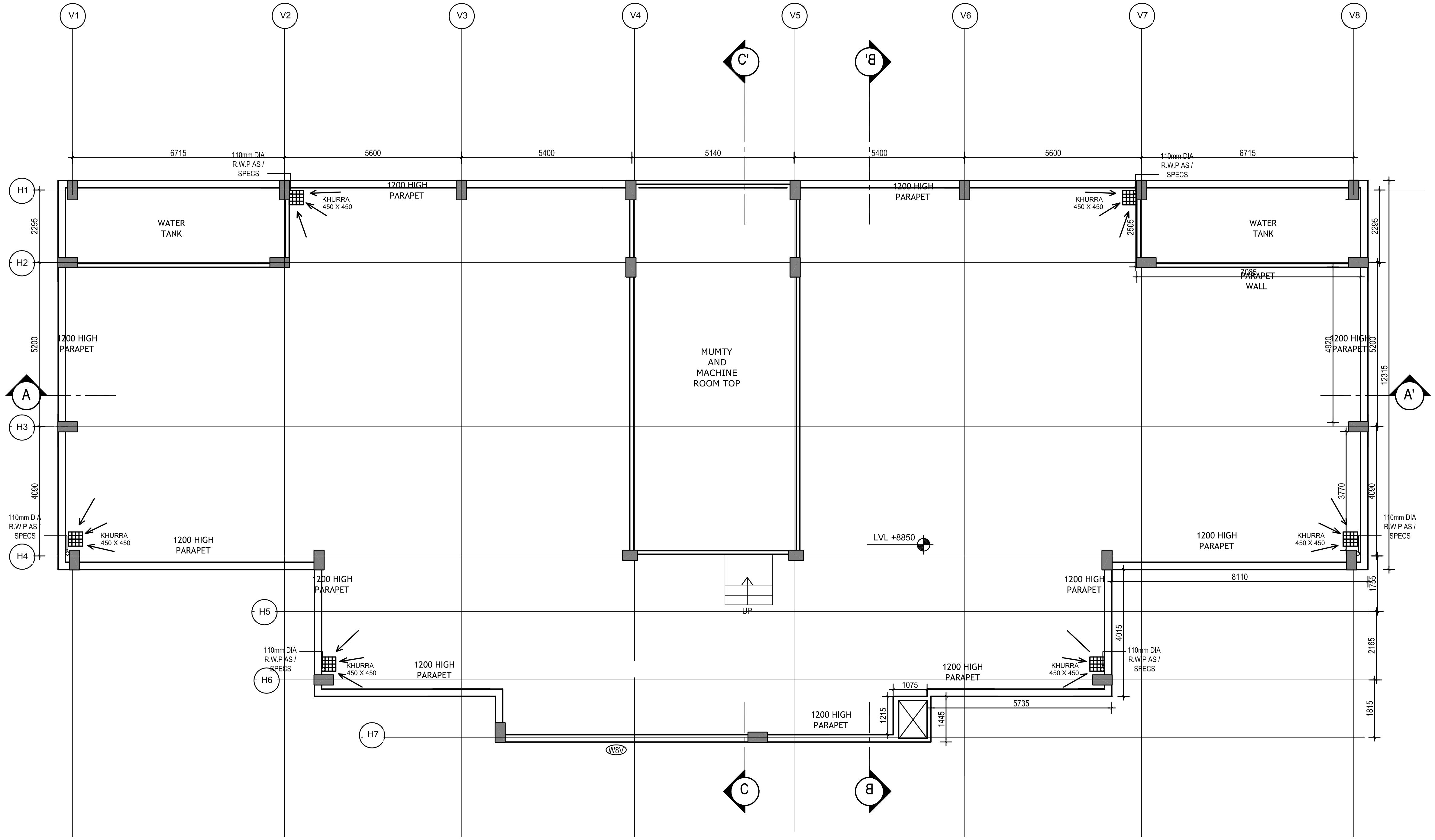
BUILDING TYPE: BSL3 LAB

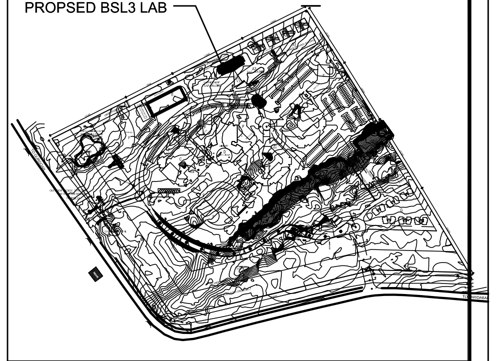
DRAWING TITLE: FIRST FLOOR PLAN

REVISION

DRAWING NUMBER: 08008(PH2)-A4-S5-AP-002

SCALE : NTS | SHEET SIZE : A3 | SHEET NO : 002





KEY PLAN

GENERAL NOTES

1. ALL DIMENSIONS ARE IN MM.
2. ONLY WRITTEN DIMENSIONS ARE TO BE FOLLOWED.
3. FOR STAIRCASE / TOILET / RAMP DETAIL, REFER DETAIL DRAWINGS.
4. ANY DISCREPANCY FOUND IN THE DRAWING SHOULD BE BROUGHT TO THE NOTICE OF ARCHITECT / STRUCTURAL CONSULTANT BEFORE TAKING ANY DECISION.
5. THIS DRAWING IS TO BE READ IN CONJUCTION WITH STRUCTURAL AND OTHER RELEVANT SERVICES DRAWINGS.
6. PLASTER AT ALL CORNERS TO BE CHAMFERED WITH 15 MM RADIUS.

DOOR SCHEDULE				
TYPE	WIDTH	HEIGHT	SILL LEVEL	TOP LEVEL
DW	2000	2700	-	2700
DW1	1500	2700	-	2700
DW2	1200	2700	-	2700
DW3	900	2400	-	2400
DW4	1000	2400	-	2400
DW5	1200	2700	-	2700
TD	750	2100	-	2100
RS	3600	3000	-	3000

WINDOW SCHEDULE				
TYPE	WIDTH	HEIGHT	SILL LEVEL	TOP LEVEL
W3V	1900	1200	1200	2700
W4V	1500	1200	1200	2700
W5V	3600	1200	1200	2700
W6V	3640	1200	1200	2700
W7V	2400	1200	1200	2000
W8V	4500	1200	1200	2700
DW1V	4900	1500	1200	2700
DW2V	3900	1500	1200	2700
V	1800	1500	1200	2700
V1	600	700	2000	2700

NOTE-THIS DRAWING IS FOR REFERENCE ONLY

DATE	REV.	REV.BY	DESCRIPTION	DATE	NOS	ISSUED TO

ARCHITECT

SURESH GOEL & ASSOCIATES
ARCHITECTS . ENGINEERS . PLANNERS

DWG ISSUED ON: 20-08-16	AT: NEW DELHI		PROJECT CODE
Sig:	Sig:	Sig:	08008
Name: DHRUV	Name: NIS	Name: MLG	BUILDING CODE
Originated by Architect	Checked by Architect	Validated by Engineer	A4

PROJECT

PROPOSED BUILDING PLAN FOR CONSTRUCTION OF NCR BIOTECH SCIENCE CLUSTER PHASE- II UNDER THE DEPARTMENT OF BIOTECHNOLOGY (MINISTRY OF SCIENCES AND TECHNOLOGY GOVT. OF INDIA) VILLAGE BHANKRI FARIDABAD, HARYANA.

S-83, PANCHSHILA PARK
NEW DELHI-110017
TEL: (011) 26014466, 26016341
MAIL:n_goel@vsnl.com

Ar.Sandeep Goel
CHIEF ARCHITECT

DRAWING FOR TENDER

CLIENT

N S E W

BUILDING TYPE:
BSL3 LAB

DRAWING TITLE:
TERRACE PLAN

REVISION

DRAWING NUMBER:
08008(PH2)-A4-S5-AP-003

SCALE : NTS | SHEET SIZE : A3 | SHEET NO : 003