TECHNICAL SPECIFICATION

1. **Name of Work: -**

Civil & associated work for the 6.5 MWp (DC) Solar Power Plant at **"Nalanda University – Rajgir, Bihar"**.

2. **Scope of Work: -**

Scope of contractor for the Civil works to fulfill the general requirements of this tender includes: -

- Clearing and cutting of trees/ Plantation to remove the shadow.
- Earthwork (including excavation, back filling, compacting, grading & dressing) for the proper levelling of yard.
- Embedment(piling/foundation) of structure including providing & installation of metal fabrication required in piling.
- Construction of internal roads of 4 Metre width with cement concrete surface and 1.5m wide pathway/ footstep in different section of yard.
- Construction of cable trenches & drainage system.
- Supplying and fixing of Chain link fencing along with gates (one 6.5 mtr wide & 3 Nos. 1.5 mtr wide) including structural & foundation work.
- Providing cleaning system for PV Modules.
- Arrangement of Street lighting including supply of 6.5 – 9 mtr G.I. poles, LED lights, cable & other accessories as per specification.
- Supply & Fixing of FRP security post along with all electrical fittings.

Note: - For the piling work, cold rolled steel G.I. sections (in cut length) shall be provided by BHEL.

3. **Technical Specification: -**

Abbreviations:

In the technical specifications, as well as in the bill of quantities(BOQ), the following abbreviations have been used:

BOQ	Bill of quantity
Cu. M.	Cubic Metre
Sq. M.	Square Metre
R. M.	Running Metre
Q. R.	Quoted Rate
NO.	Numbers

3.1 Specification for material: -

All materials shall be best of their kind and shall confirm to the relevant latest Indian standard. All materials shall be of approved quality as per samples and from origins approved by the Engineer in Charge.

A set of specimen samples of all approved materials shall be kept in sealed container or otherwise at site, cost of which is to be borne by the contractor.

(a) Cement: -

Ordinary Portland cement shall be used after due approval of the Engineer-in-charge. All cement shall be fresh when delivered. Cements of different types are not to be mixed with one another. Consignments shall be used in the order of delivery. Admixture if any shall be used only after approvals of Engineer in charge.

Cement shall be kept, at all times, in covered storage in an approved manner. No cement shall be kept on the site longer than three months before use. Any cement, which is stored onsite in excess of 28 days, shall be tested in accordance with relevant Standard prior to use.

Cement to be used in the Works shall conform to the following standards:

- 33 Grade Ordinary Portland Cement IS: 269
- 43 Grade Ordinary Portland Cement IS: 8112
- 53 Grade Ordinary Portland Cement IS: 12269

Make: - ACC, ULTRATECH, JP, Ambuja (fly ash based)

(b) Aggregate, Sand & Bricks: -

Coarse Aggregate

Aggregates for use in concrete (other than light-weight concrete) shall comply with the requirements of IS 383. As far as possible preference shall be given to natural aggregates. Coarse aggregate shall have a specific gravity as per mix design report. Aggregate below this specific gravity shall not be used without the special permission of the Engineer.

Coarse aggregate shall consist of natural or crushed stone, angular in shape with granular or crystalline surfaces or approved river shingle or gravel, rounded in shape. All aggregate shall be clean and free from elongated, friable, flaky or laminated pieces, adherent coatings, clay lumps, mica, organic matter and any other deleterious matter that may cause corrosion of reinforcement or impair the strength and / or durability of concrete. It shall be chemically inert, hard, strong, dense, and durable against weathering.

The maximum quantities of deleterious materials in the coarse aggregate shall not exceed the limits indicated in the IS 383 when tested as per IS 2386 Part-I & Part-II "Method of Tests for Aggregate for Concrete".

Coarse aggregate, which is not clean, shall be washed with clear fresh water before use in the job. Screening should be done, if considered necessary by the Engineer, without extra cost.

Fine Aggregate

Fine aggregate for different end uses (other than light-weight concrete) shall conform to the following standards:

- For structural concrete — IS: 383 (between Grading Zones I & II)
- For mortar & grout — IS: 2116
- For plastering — IS: 1542 (Class A Grading)

Fine aggregate shall consist of natural sands or machine crushed rock/gravel. It shall be clean, sharp, hard, strong and durable and free from dust, vegetable substances, adherent coating, clay, loam, alkali, organic matter, mica, soluble sulphate, gypsum or any other deleterious substances which can be injurious to the setting qualities / strength / durability of concrete.
The use of sea sand is prohibited.

Sand

The source from which sand is to be obtained shall be subject to the approval of Engineer-in charge. The sand shall be clean, sharp and gritty to touch and be freed from soil and other impurities by washing. The sand shall be washed to such a degree that when a handful is mixed with clean water in a glass and allowed to stand for an hour the precipitate of mud over the sand shall not exceed 5%. The sand should conform to IS 382-1982 for fine and coarse aggregates from natural sources.

Brick

Common burnt clay F.P.S. (non modular) bricks of class designation 7.5 shall be used for relevant schedule items or work. They must be free from cracks, chips, flaws, stones or lumps of any kind. The bricks shall show no sign of efflorescence either dry or subsequent to soaking in water.

(c) Steel Structure & Fencing: -

Steel work shall be carried out as per CPWD & IS code norms. For the piling cold rolled steel G.I. sections shall be supplied by BHEL. For the fixing of chain link fencing with iron post & Gate work 50x50x6mm M.S. angle shall be used.

G.I. Chain link fabric shall be supplied with the mesh size 50x50x3.15mm and should have height of 2.1 meter. Chain Link Fencing shall confirm to the following standards: -

- For Material — : IS 280 - 1978
  : IS 1608 - 1995
- For Testing — : IS 1717 - 1985
  : IS 1755 - 1983

- For Galvanizing : IS 4826 -1979

3.2 Cement Concrete work: -

(a) All work shall be carried out under the guidance of Engineer- In charge. Concrete work: -

- For Piling : M20 (1 cement : 1.5 coarse sand: 3 Aggregate)
- For Road : M15 (1 cement : 2 coarse sand: 4 Aggregate)
- For Foundation of Structural : M10 (1 cement : 3 coarse sand: 6 Aggregate)

(b) Concrete work shall be carried out as per I.S. 456, – 2000 (Or latest), CPWD & other relevant IS code. Grade of concrete shall be as per BOQ. The concrete shall consist of an aggregate of the proportion by volume defined in relevant schedule item or work. Only measured quantity shall be used. The aggregate shall consist of stone ballast of quality approved by Engineer-in-charge and shall consist of graded size 20 mm and down wards as per PWD specification or the size mentioned in the item description.

(c) **Water**: - The water to be used in making and curing of concrete, mortar etc. shall be free from objectionable quantities of silts, organic matter, injurious amount of oils, acids, salts and other impurities etc. as per IS-456-2000.

(d) **Laying:** - The cement, sand and stone chips shall be mixed properly in mechanical mixer in such a manner as to avoid loss of water. The concrete shall be mixed for minimum period of 2 minutes or until it is of even color and uniform consistency throughout. As soon as the concrete is mixed it should be removed to the work in iron vessels as rapidly as practicable. The concrete laid will be vibrated for compaction by the vibrators. Slum test will be carried at site during execution of work.

(e) **Curing: -** The concrete laid shall not be disturbed and shall be kept thoroughly damped by means of wet matting and sand until it shall have become thoroughly set and hard enough to prevent its drying and cracking.

(f) **Forms:** - Contractor shall furnish on the site of work sufficient number of centering & shuttering, moulds or templates for its expeditious execution. The forms shall be made in such a way and of such materials as will ensure a smooth surface on the finished concrete. Forms and centering shall be left in place until the concrete has set sufficiently to permit the removal without danger to the structure.

(g) **Testing:** - Cube test for CC work in piling/foundation shall be done in lab and its compressive strength should be within the allowable limit.

3.3 Brick Masonry Work: -

(a) Brick work to be carried out in the construction of trenches & drainage system. bricks shall be used of specified type as per relevant schedule item or work.
(b) **Curing of bricks:** All bricks work shall be keep well-watered for the sufficient period before and after laying.
(c) **Cement Mortar: -** The mortar for brick work shall consist of cement and sand mixed in proportion defined in relevant schedule item for various item of work. Only measured quantity shall be used. The color and consistency shall at this stage be quite uniform, if not, further turning shall be done. Water shall be added by measured quantities.
(d) **Plaster: -** All brick work unless otherwise specified will be plastered internally with 12mm cement plaster (1:6) proportion.

3.4 Steel Structural & Fencing Work: -

(a) All steel structural & fencing work shall be carried out in the guidance of Engineer- In charge.
(b) Height of Chain link fencing shall be 2.1 mtr from the ground level. For the fixing of fencing iron post made of 50x50x6mm M.S. angle, shall be placed at every 3 mtr. Apart, 30 cm in ground embedded in cement concrete 1:3:6 (30x30x45 cm cement concrete bed). Corners & every 10^{th} post to be strutted with 50x50x6mm M.S. angle, fixed and fitted with the post.
(c) Gates shall be made of M.S. Rectangular/circular hollow pipe as per site requirement. Contractors shall submit drawing & design of gate to BHEL for approval. Fabrication & Erection work shall be started after getting approval only.
(d) **Painting: -** One Coat of primer shall be applied on all steel section of fencing & gates.

2.5 Cleaning System:

(a) **Pump Set: -** Pump set(s) of suitable rating shall be provided as per requirement of site to maintain sufficient pressure required for cleaning of Modules.
(b) **Piping including fittings: -** G.I. pipe of suitable size(s) shall be used for the piping work. Minimum size of pipe shall be 15 mm. Related trench excavation & back filling shall be included in the work. No Extra cost shall be payable.
(c) **Outlets/Tapping points: -** Sufficient no. of outlet/ tapping points shall be provided to cover the entire yard for module cleaning. This also includes supply of PVC hose pipe as per site requirement.

2.7 Street Lighting: -

(a) **Lighting Pole: -** Galvanized tubular steel pole of minimum coating 360 gm/sqm shall be provided of 6 – 9 mtr height for the street lighting. Pipe shall be used made of Class B pipe with integral junction box & sufficient protection per pole. Maximum span between two poles shall be 30 mtr. Pole to be embedded

(30*30*45 cm) with cement concrete of specified grade under the guidance of Engineer in charge.

(b) **LED Lighting: -** LED lights of sufficient rating to maintain Average 30 Lux through solar yard shall be provided. Fixture shall be minimum IP 66 rated along with minimum IP 65 rated control gear, luminance efficacy of the fixture shall be more than 70%, colour temperature shall be 3000~4000 K to match the peripheral area lighting of the campus.

(c) **Cable, Protection & other accessories: -** Cable shall be used of suitable rating after getting approval of Engineer in-charge. Sufficient protection per pole shall be used. Other accessories shall be provided as per site requirements.

2.8 Security Post: -

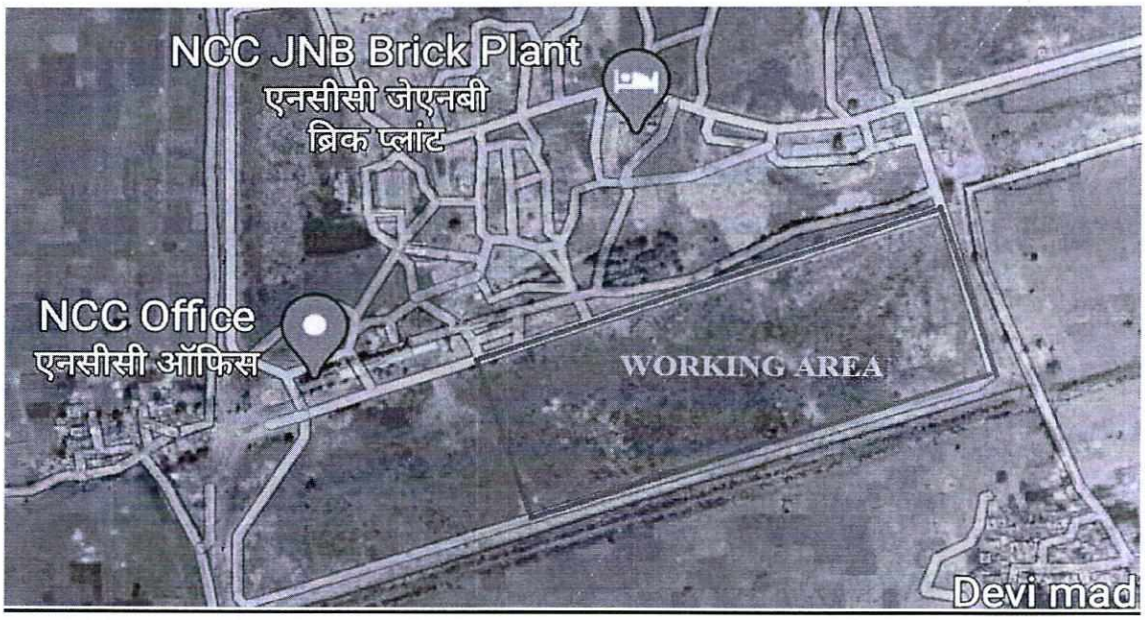
FRP security cabin with two window having size of 4ft x 4ft x7ft shall be provided after getting approval of Engineer in-charge. Minimum thickness of FRP used shall be 3mm. Frame shall be made of M.S. Angle in order to provide sufficient strength. Gap between inner & outer wall shall be filled by using 25mm thick polyurethane foam having density 32/cum. Door shall be made of powder coated aluminum frame with partly paneled & partly glazed with 5 mm thickness glass. Windows shall also be made of powder coated aluminum frame with sliding arrangement and glazed with glass of 4mm thickness. Provision for the lighting arrangement for one fan, one 2ft tube light and one led light shall also be made in security post.

2.9 Earth Work: -

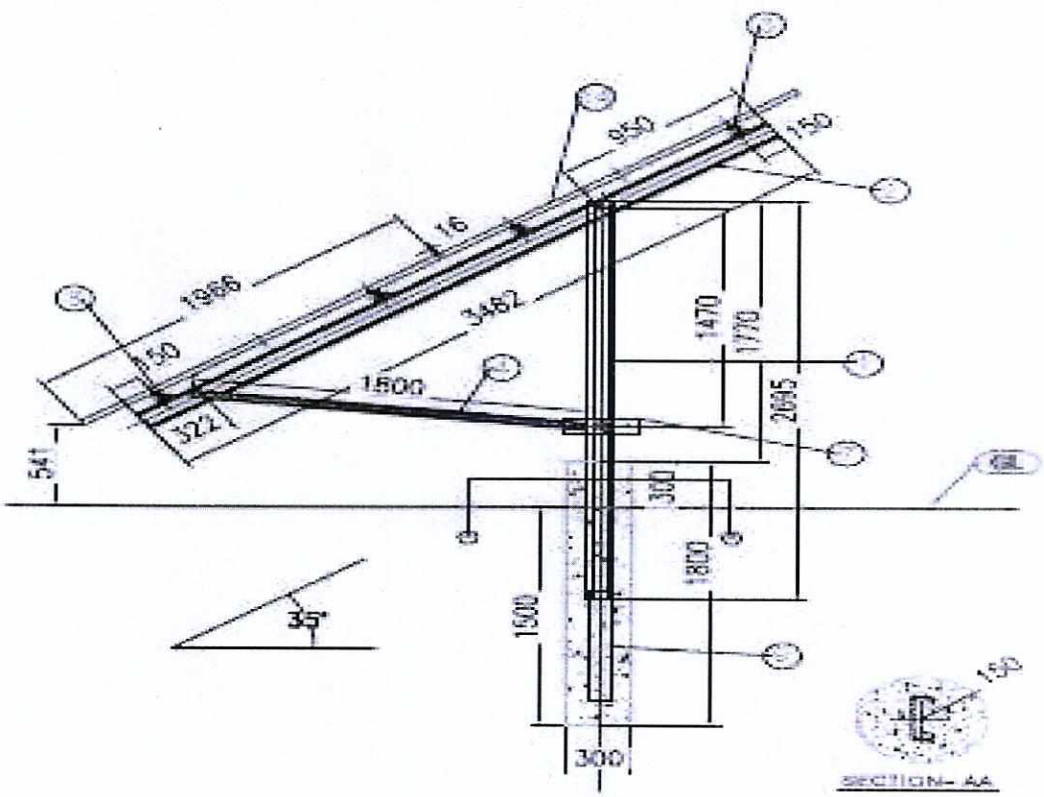
Scope of earth work includes: -

(a) **Auguring: -** For the piling/ foundation work boring of 1.5 mtr depth and 300mm dia to be carried out by mechanical means.
(b) Excavation for the foundation of Fencing iron post, gate etc., to be carried out as per site requirement.
(c) **Drain & Trenches**: - Earth excavation for trenches and drainage system to be carried out as per site requirement.
(d) **Levelling, Grading & compacting**: - Levelling & compacting including removal of plantation (if any) in the provided yard to be carried out by mechanical means. Hydraulic excavator & Road roller/compactor shall be used for such work.

LOCATION OF SITE



DETAIL OF PILING (TENTATIVE)



SIDE VIEW FOR 35° TILT PV MODULE