PART 1: SCOPE AND CONDITIONS

1. GENERAL SCOPE

This Specification covers construction of 33kV overhead lines, New, Up-rating and rehabilitation of the existing 33kV overhead lines of WESCO.

Up-rating consists mainly of re-conductoring of existing lines, and rehabilitation refers to the replacement of faulty or inadequate poles, hardware, cross arms and other components, and attention to deferred maintenance needs.

The distribution lines shall conform in all respects to highest standards of engineering, design, workmanship, this specification and the latest revisions of relevant standards at the time of offer, and the Purchaser shall have the power to reject any work or material which, in his judgement, is not in full accordance therewith.

1.1. Scope

The scope of work shall include the following:

- The design, testing, supply, and erection of all types 33kV single or double circuit distribution line support structures, including cross-arms, bolts, nuts and washers, D-shackles, support stays and all type of accessories such as phase plate, circuit or support structure identification plate, danger plate, anti-climbing and earthing devices;

- The supply of conductors, insulators, insulator hardware, earth-wire, joints, connectors and all other conductor and earth-wire clamps and accessories;

- Design, selection and installation of foundations for all poles and other structures required for the lines;

- Preliminary route survey, finalisation of route alignment, detailed survey, structure (tower / pole) spotting, optimisation of structure location, geo-technical investigation;

- Design, manufacture, supply, erection and stringing of special multi-span river crossing and terminal structures including design and construction of foundations (both on-bank and mid-stream pile type), if so required.

For river crossings, the Contractor shall prepare the crossing plan and profile and shall carry out soil investigations. Based on this information he shall propose an optimum location for the crossing and dimensions for its sub-spans, which shall be submitted to the Project Head for approval prior to further work being carried out. Major long-span river crossings are NOT covered by this Specification. Where the Purchase shall have the requirement for such a crossing, a separate Specification for the crossing and anchor structures shall be provided.

The slack span connections of conductors (and earth wires where applicable) from the terminal structures to the substation gantry structures are included in the scope of this Contract.

The programme for work and work at all the terminal points are required to be co-ordinated with others at no additional cost to the Purchaser.

All working methods employed and all plant and apparatus supplied under this Contract shall be subject to approval.

The Contractor shall be responsible for any discrepancies, errors or omissions in the particulars and guarantees, whether such particulars and guarantees have been approved by the Project Head or not.
APDRP SCHEME, WESCO

Technical Specification for 33KV lines (New & Up-rating)

Corresponding parts of all material shall be made to gauge and shall be interchangeable. When required by the Project Head the Contractor shall demonstrate this quality by actually interchanging parts.

The Facilities shall be designed to facilitate inspection, cleaning and repairs, and for operation where continuity of supply is the first consideration. All equipment shall also be designed to ensure satisfactory operation under the atmospheric conditions prevailing at the Site, and under such sudden variations of load and voltage as may be met with under working conditions on the system.

2. STANDARDS

Except where modified by this specification, the distribution lines and associated equipment shall be designed, manufactured, tested and erected in accordance with the latest editions of the following standards and associated specifications.

<table>
<thead>
<tr>
<th>IEC / ISO</th>
<th>Indian Standard</th>
<th>Subject</th>
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</thead>
<tbody>
<tr>
<td>IEC: 1284</td>
<td>IS: 2486</td>
<td>Insulator fittings for Overhead Power Lines.</td>
</tr>
<tr>
<td>IEC: 120</td>
<td>IS: 398</td>
<td>Round wire concentric lay overhead electrical stranded conductor</td>
</tr>
<tr>
<td>IEC: 1089</td>
<td>IS: 1498</td>
<td>Classification and Identification of Soil for General Engineering Purposes.</td>
</tr>
<tr>
<td></td>
<td>IS: 1888</td>
<td>Method of load tests in soil</td>
</tr>
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<td></td>
<td>IS: 1892</td>
<td>Code of practice for subsurface investigations for foundations</td>
</tr>
<tr>
<td>IEC: 1089</td>
<td>IS: 2141</td>
<td>Galvanised steel wire</td>
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<td></td>
<td>IS: 9708</td>
<td>Stock Bridge Vibration Damper</td>
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<tr>
<td>ISO: 1460</td>
<td>IS: 2629</td>
<td>Hot dip galvanising of steel and iron</td>
</tr>
<tr>
<td>BS: 729</td>
<td>IS: 2121</td>
<td>Conductor and earthwire accessories</td>
</tr>
<tr>
<td>ISO: 9000</td>
<td>IS: 2633</td>
<td>Quality Management Systems</td>
</tr>
<tr>
<td>ISO: 8501-1</td>
<td>IS: 6005</td>
<td>Shotblasting</td>
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<tr>
<td></td>
<td>IS: 2633</td>
<td>Phosphating of iron and steel</td>
</tr>
<tr>
<td></td>
<td>IS: 3043</td>
<td>Tests on galvanised steel</td>
</tr>
<tr>
<td></td>
<td>IS: 3043</td>
<td>Code of practice - earthing</td>
</tr>
</tbody>
</table>
The Bidder may propose alternative standards, provided it is demonstrated that they give a degree of quality and performance equivalent to or better than the referenced standards. The Project Head shall adjudge whether to accept or reject any alternative standard. The Bidder shall furnish a copy of the alternative standard proposed along with his bid. If the alternative standard is in a language other than English, an English translation shall be submitted with the standard. In the case of conflict the order of precedence shall be 1) IEC or ISO Standards, 2) Indian Standards, 3) other alternative standards.

3. SYSTEM CONDITIONS

The equipment shall be suitable for installation in supply systems of the following characteristics:

- Frequency 50 Hz

- Nominal system voltages 33kV

- Maximum system voltages: 33kV System 36 kV

- Nominal short circuit levels: 33kV System 25 kA

- Insulation Levels:
  1.2/50 ms impulse withstand
  (positive and negative polarity): 33kV System 170 kV

- Power frequency one minute withstand
  (wet and dry) 33kV System 70 kV

- Neutral earthing arrangements: 33kV System Solidly earthed
4. **SUPPORT STRUCTURES FOR 33KV LINES**

4.1. General

The support structures shall be designed to carry the line conductors with the necessary insulators and all other fittings and equipment under the conditions specified.

Poles may be manufactured from concrete (pre-stressed or spun).

**For conductor sizes of 100/232 mm$^2$ intermediate pole structures shall be of the single pole or double pole type with pin or post insulators. The average span length for 100 Sq.mm shall be 80 to 100 Mtrs & for 232 Sq.mm shall be 45 to 55 Mtrs.**

Pole cross arms are normally constructed of steel and shall be bolted to the pole.

4.2. Stays, Guys and Struts

Except where the structure is designed to perform without stays, stays or guys shall be erected on poles at all positions at which strain occurs, that is, at angles, branches, end and section poles. The angle of stay spread shall normally be between $30^\circ$ and $45^\circ$, which is measured between the perpendicular of the pole and the stay wire.

The number of stays required for each structure, angle of stays and tension in stay wires should be detailed in the design calculations. The basic design shall assume a 45 degree stay angle, and the maximum tension on the structure. For lesser tension the number of stays shall be reduced. Alternatively the Project Head may reduce the stay angle subject to approval.

In the design of the individual lines the number of stays required on any structure shall be kept to the minimum necessary, except by agreement with the Project Head. The Contractor shall provide a schedule of staying requirements for each type of line structure indicating the optimum number of stays for various angles of deviation.

The stay or stays shall be applied along or about the centre line of the direction of the resultant tensions of the conductors. Stay tension shall be adjustable using the stay turnbuckle. WESCO normally mount the turnbuckle above the stay insulator.

Stays shall be attached to the pole by stay brackets bolted through the poles, and held in the ground by a stay block. The stay block shall be installed perpendicular to the line of the stay. The stay block shall be buried to a depth of at least 1.5m, in good ground, with as little disturbance of the surrounding ground as possible. The hole shall be undercut to allow the stay block to bear against undisturbed ground. A slot shall be formed in the ground, to accommodate the stay rod, so that it can be aligned with the angle and direction of the stay.

Stays set in solid rock shall be held by a patented anchoring arrangement of approved type and design. Details of the system to be used shall be submitted with the bid, together with the relevant design calculations, for the Project Head’s approval.

A stay insulator shall be inserted in the stay, 1.8m from the stay bracket. The stay wire shall be made off in a secure, approved manner.

The maximum permissible tension in any one stay wire shall not exceed 40 percent of the ultimate tensile strength of the wire. The complete stay assembly shall be designed to match the strength of the stay wire.

In situations, where stays or guys would be required, but cannot be installed, it shall be permissible to use a strut pole. The Project Head shall approve the use of strut poles.
5. DESIGN CONDITIONS FOR 33KV LINES

5.1. Minimum Clearances

The minimum clearance between the line conductors and ground or other objects shall be as specified in the section referenced 33kV Line Clearances in this specification. These clearances shall be obtained under conditions corresponding to the 75°C still air sag of the AAAC line conductors and with an angle of swing of the conductors from the vertical between 0° and 35°, assuming the aforementioned sag is always applicable.

5.2. Conductor Phase Spacing

Phase to phase spacing at cross-arms shall be determined by reference to sag on the maximum span at maximum conductor temperature (75°C), insulator string deflection and voltage. The calculations to substantiate choice and sizing of the cross-arm to attain design phase to phase clearance will be submitted as per the Submittals clause of this specification. For pin insulator lines the minimum recommended horizontal spacing is 1.5 metres.

5.3. 33kV Line Clearances

<table>
<thead>
<tr>
<th>Situation</th>
<th>Min. Clearances (Metres)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Over Open Country</td>
<td>5.20</td>
</tr>
<tr>
<td>Over a Road</td>
<td>6.10</td>
</tr>
<tr>
<td>Along A Road</td>
<td>5.80</td>
</tr>
<tr>
<td>Over Telecomm Lines</td>
<td>2.44</td>
</tr>
<tr>
<td>Over Rivers</td>
<td>6.10*</td>
</tr>
<tr>
<td>Over Railways</td>
<td>14.10</td>
</tr>
<tr>
<td>Over 11kV or LV Lines</td>
<td>2.44</td>
</tr>
<tr>
<td>Under HV Lines</td>
<td>2.44</td>
</tr>
<tr>
<td>Near Buildings: Vertical</td>
<td>3.70</td>
</tr>
<tr>
<td>Horizontal</td>
<td>2.00</td>
</tr>
</tbody>
</table>
Distance above highest flood level of non-navigable rivers. Refer to the Navigation Authority for clearances over navigable rivers.

5.3.1. Adjacent or Over Buildings

Where bare 33kV overhead lines passes above or adjacent to any building or part of a building it shall have on the basis of maximum sag a vertical clearance above the highest part of the building as specified in the section referenced 33kV Line Clearances in this specification.

The 33 kV overhead lines crossing over buildings or close enough in the horizontal plane to buildings such that the nearest conductor is within falling distance then ‘H’ or other approved structures shall be used with reinforced insulator strings. The crossing span shall be, where possible, limited to 64% of maximum span length and no mid-span joints shall be allowed in it.

In every case worst design conditions shall be obtained from every point in the building including television aerials. Worst design conditions are considered to be 75°C conductor temperature in still air for vertical sag and 75°C conductor temperature with maximum zone wind pressure for horizontal swing out.

5.3.2. Road Crossings

At all road crossings the conductor to ground clearances, at maximum conductor temperature, stipulated in the section referenced 33kV Line Clearances must be achieved. The crossing angle shall be as near as possible to 90° but in any case shall not be less than 60°. At all major road crossings double pin or double string suspension or tension insulator sets shall be used at both sides of the road to support the conductor. On national highways double tension strings shall be mandatory. In all instances the method of crossing national highways shall be agreed between WESCO and the Roads Authority. Where the use of double insulator sets is not mandatory and the use of a guard or cradle is an option then the method to be adopted shall be at the discretion of the Project Head.

5.3.3. Railway Crossings

Where an overhead line must be constructed across a railway line then the method of crossing shall be agreed between WESCO and the Railways Authority. In general all crossings up to and including 11kV shall be by underground cables (IS 5613 part 1, sect, 3). Where the crossing is by overhead line then the clearances stipulated in the section referenced 33kV Line Clearances in this specification must be observed. The crossing angle shall be as near as possible to 90°.

At the time of detailed survey the details of the crossings of railways shall be finalised to comply with Regulations of the Railway Authorities. These include the requirements that tension towers shall be used on either side of the crossing and that twin string tension sets shall be used at each end of the crossing span, which is to be at right angles to the rail track. The minimum distance of the towers at either side of the crossing from the centre line of the railway track nearest to the tower shall not be less than the height of the tower plus six metres. Details of the crossing shall be prepared by the Contractor including profile, plan, tower and foundation designs and drawings. Six copies of the details shall be provided by the Contractor to the Project Head in order that approval of the crossing proposals can be obtained by the Employer from the Railway Authority.

The span shall be kept to a minimum and the use of ‘H’ Poles or other approved tension structure shall be used. In general the crossing span shall be restricted to 64% of maximum span length and midspan joints shall not be permitted in it.

5.3.4. Telecommunication Line Crossings

Where it is necessary for a line to cross over an overhead telecommunications line the construction shall be such that a failure of a line conductor (s) does not create a danger to the telecommunications system. The following minimum precautions shall be taken:
• Minimum clearance as specified in the section referenced 33kV Line Clearances in this specification must be observed

• Span length shall be, where possible, no longer than 64% of normal span

• Crossing angle shall be as near to 90° as possible but in any case not less than 60°

• Separate guard should be erected over the telecommunications line as detailed in IS: 5613

On request from the Contractor, the Employer may obtain the permission of the telecommunication authority. Also, in the crossing span, power line support will be as near the telecommunication line as possible, to obtain increased vertical clearance between the wires.

5.3.5. River Crossings

For crossings over major navigable rivers the clearance to be provided shall be that required by the Navigation Authority. For non-navigable rivers the clearances shall be measured over highest flood level as stipulated in the section referenced 33kV Line Clearances in this specification. The crossing angle shall be as near as possible to 90° but in any case shall not be less than 60°. The Bidder shall include in the standard designs a structure for long spans up to 250 metres. These shall be used on river crossing up to that length. For longer spans special crossing structures shall be required. The Contractor shall propose an appropriate solution for each situation as it arises.

No mid-span joints shall be permitted in the crossing span.

5.3.6. Power Line Crossings

Where the line crosses over other power lines the span shall be kept to a minimum and the use of ‘H’ Poles or other approved tension structure shall be used. In general the crossing span shall be restricted to 64% of maximum span length and mid-span joints shall not be permitted in it. Provisions to prevent the possibility of one line coming in contact with the other overhead line shall be made in accordance with the Indian Electricity Rules, 1956 or the latest revisions/amendments thereof.

When crossing under another power line similar precautions shall be required. The Contractor shall refer his proposals for such crossings to the Project Head for reference to the appropriate authority. In general such crossings should be made as close as possible to the higher voltage line structure to maximise clearance.

5.3.7. Working In Proximity to Services

The Contractor shall at all times comply with the restrictions and conditions stipulated by the responsible authorities. Before any work is undertaken, the Contractor shall give due notice to all utilities where services may be in conflict with the proposed route, for example, telecommunications, roads, railways, rivers and other electricity authorities.

Special safety procedures and precautions apply to pole erection and stringing activities in the vicinity of live existing electricity networks especially where conductor is being strung under or over networks, which are alive or are capable of being made alive. In such circumstances the Contractor shall be responsible for strict adherence to, and compliance with any safety procedures, practices and requirements, which shall be laid down by the Project Head.

The Contractor shall provide and erect approved work signs; bollards, lighting, safety barriers and such like where necessary or required to ensure the safety of the public and workers.

All care shall be taken to minimise damage to property in the execution of these works, by means of route design, planning and prior consultation with owners, occupiers and responsible authorities. It shall be the Contractors responsibility to make good any damage which is caused to lands, crops, trees, walls, fences, gates, drains, pipelines buildings, roads, or any other property, caused directly or indirectly by the execution of the works.
5.3.8. Cradles and Guards:
Where approved by the Project Head, guards or cradles shall be erected where overhead lines cross over roads, railways, telecommunications lines and other overhead power lines. Approved devices, as defined in the Indian Electricity Rules, shall be used.

6. RIGHT OF WAY FOR 33KV LINES
The proposed Line will be constructed along the existing 33 KV line. If any kind of right of way problem arises out of reorientation of line or any deviation of route of the existing line, this should be brought to the notice of the Purchaser.

7. CONFLICTS FOR 33KV LINES
Lines shall be located so as to minimise conflicts along the route. Support structures located in or at sites accessible to large trucks and mobile mechanical equipment shall be strategically situated so as to avoid vehicular contact and ensure adequate conductor to ground safety clearances. There are special precautions necessary for lines crossing roads, telecommunication circuits, rivers, roads, railways or near to buildings. Such lines shall be built to the specially stipulated security standards covered in this specification.

8. SUPPORT STRUCTURE DESIGN AND FABRICATION FOR 33KV LINES
The support structures shall comply with the Technical Specification for Line Support Structures and Cross-arms.

For 33kV lines the wind pressures to be applied to the conductors, insulators and support structures are specified in IS: 5613(Part 1/Sect. 1): (1985) and as stipulated in the Service Conditions in this specification. The Bidder shall take account of the wind loading regimes necessary for the projects for which he is bidding and shall propose the design of structures, which will prove most effective for the project and for the system.

The working load on the structures should correspond to those that are likely to come onto the structure during their service life.

8.1. Factors of Safety
The factor of Safety of these support structures varies depending on the type of structure and are as follows:

- For metal supports 2.0
- For mechanically processed concrete supports 2.5

The minimum factors of safety shall be based on such a load as would cause failure of the support to perform its function (assuming that the foundation and other components of the structure are intact). This load shall be:

- Equivalent to the yield point stress or the modulus of rupture, as the case may be, for supports subject to bending and vertical loads;
- The crippling load for supports used as struts

The Ultimate Moment capacity in the longitudinal direction should be at least one quarter of that in the transverse direction.

Provided that in the case of latticed steel or other compound structures, factors of safety shall not be less than 1.5 under broken wire conditions.
The minimum factor of safety for stay wires, guard wires or bearer wires shall be 2.5 based on the ultimate tensile strength of the wire.

The minimum factor of safety for conductors shall be 2.0 based on their ultimate tensile strength.

For the purpose of calculating the factors of safety the following guidelines shall be adopted:

- The maximum wind pressure shall be as specified for the location in IS: 5613 (1985) or the latest revision thereof.

- For compound structures, such as ‘H’ frame the wind pressure on the lee - side members shall be taken as one - half of the wind pressure on the wind - ward side members and the factors of safety shall be calculated on the crippling load of the struts and upon the elastic limit of the tension members.

- Maximum conductor tension under full wind load and minimum temperature.

- The maximum and minimum temperatures shall be as stated in the Service Conditions of this specification.

9. EARTHING PRACTICE AND CONDUCTORS FOR 33KV LINES

9.1. Earthing of Poles.

All steel and concrete support poles inclusive of metal fittings shall be permanently and efficiently earthed. The earth shall be of the pipe or coil type and shall be constructed and installed in accordance with IS: 3043: 1966. The cross-sectional area of the galvanised steel earth conductor connecting the pole structure to the earthing device shall not be less than 25 mm² and in accordance with IS: 5613.

10. INSULATORS FOR 33KV LINES

Suspension and tension insulator sets of the cap and pin, pin or post type insulators, shackle insulators and stay insulators shall comply in all respects with the requirements of the Technical Specification for Insulators referenced.

All insulators and insulator fittings shall be handled carefully during transportation, assembly and installation on the support structures to avoid chipping or damage and shall be cleaned when installed. Proper precautions shall also be taken to ensure that they are not strained or damaged during erection or during the pulling in of the conductors. Any damaged insulator shall not be installed on the Employer's system.

10.1. Binding - In

On 33kV pin insulators or post type, the conductor shall be bound in on the top groove, using two suitable stirrups in each case. The bind shall be formed of a single layer of closely wound wire, extending at least 25 mm beyond the stirrups. The bind shall be wound in opposite directions, on each side of the insulator.

With all aluminium alloy conductor the bind shall be formed of two stirrups, with 3.53 mm diameter aluminium binding wire. In addition, aluminium armour tape shall be used, wrapped in a direction opposite to that of the conductor lay. The armour tape shall cover the portion of the conductor, which is in contact with the insulator, and extend at least 40 mm beyond the bind, on each side.

At 33kV angle, section and end pole positions where disc type strain insulators are used, the conductor shall be terminated using compression joints of a material suitable for the conductor. Wrapped joints or terminations shall not be permitted. All connections to suspension disc type insulators shall be via an approved conductor clamp and armour rods.
11. FOUNDATIONS FOR 33KV LINES

11.1. Ground Types

Foundations for structures shall be designed to cater for the following types of ground:

- Normal dry soil
  
  Cohesive or non-cohesive soils which are present without encountering sub-soil water table within the first 1.50 metres of depth of the foundation.

- Wet soil (Ground Type 'A')
  
  Wet earth due to sub-soil water table met at less than 1.50 metres below the ground level and in locations where surface water is prevalent for long periods of time, for instance, paddy fields.

- Black cotton soil (Ground Type 'B')
  
  Soil of a clayey type, not necessarily black in colour, which shrinks when dry and swells when wet, resulting in differential movement. For designing the foundation at such locations, the soils are to be considered as wet soil.

- Fissured rock (Ground Type 'C')
  
  Decomposed or fissured rock, hard gravel, kankar, lime stone, laterite or any other soil of a similar nature.

- Hard rock (Ground Type "D")
  
  Rock, which requires chiselling, drilling or blasting for excavation. Rock anchoring techniques are required to prevent uplift forces.

11.2. Pole structure foundations

The foundation design criteria shall be determined from the classification of the ground into which the structure is to be erected and in accordance with IS: 2720 and the Ground Types definitions in this specification.

The allowable bearing pressure of the soil where the poles are to be erected shall be based on adequate subsoil exploration and tests carried out in accordance with IS 1888 and IS 1892.

The pole foundation holes in normal soil shall not be so large as to affect adversely the bearing strength of the ground in the immediate vicinity. The butt end of the pole structure shall be supported with the installation of a 100 mm thick concrete pad, six mm thick galvanised steel plate or cast iron plate, set in the bottom of the foundation hole. The structure shall be mounted on this pad.

Where the bearing area of the support structure is insufficient to resist the overturning moment acting on the foundation, then the bearing area shall be increased by casting a concrete collar around the structure. The Contractor shall demonstrate by calculation which option is required.

The collar of concrete cover to be provided shall be of not less than 100 mm thick and shall be cast around the pole from the base pad to a point approximately 250 mm below ground level. A further collar of concrete of the same thickness shall be applied from this point to 300 mm above ground level.

Each section of the concrete being allowed to dry prior to the application/installation of the next section. The concrete shall be to a minimum nominal mix of 1:3:6 with the size of aggregates for the pad and top collar being 18 mm and for the intermediate section 13 mm.

Where a foundation hole has been excavated directly into the ground and the pole erected without any concrete support then the soil shall be thoroughly tamped, as the foundation hole is backfilled, at intervals of not more than 300 mm. When backfilling, the subsoil shall be filled first, and so on.
progressively until the topsoil is replaced in its proper position in order to achieve maximum strength for the pole foundations and to restore the site to its original condition.

In poor ground precautions shall be taken to increase the bearing area in order to ensure the bearing strength of the foundation is adequate to sustain the overturning moment due to the wind loads on the conductors and structures. Where necessary, side stays or baulks shall be used in addition to assist stability. Baulks, if used shall be buried at least 450 mm below surface level, they shall be securely fastened to the structure with galvanised bolts and hardware. Baulks shall be constructed from reinforced concrete or galvanised steel, and shall be of adequate cross section to withstand the worst design loads to be applied during their life. Baulks shall be designed with the factors of safety specified in the Section on Factor of Safety in this specification.

In general the planting depth of the pole shall not be less than one sixth of the total length of the pole above ground level, and shall not be less than 1.5 metres.

Where soil is of a composite nature, classification of the foundation shall be according to the type of soil predominant in the excavation and payment shall be accordingly.

The type of foundation to be used at each position shall be to the approval of the Project Head and shall normally be decided on the most economic solution.

Guidelines for the design and construction of foundations are detailed in IS 4091 - 1979.

12. SURVEY OF 33KV LINES

12.1. Preliminary Survey.

Based on the initial route alignment drawings to be provided by the Purchase, the Contractor shall carry out the survey to finalise the route alignment.

The route alignment shall be plotted on Survey of India topographical maps to the scale of 1 cm = 0.25 Km. (1:25,000) where these are available, or 1 cm = 0.5 km (1:50,000). All topographical details including all Railway lines, rivers, canals, roads upto 2 km on either side of the route of lines shall be drawn to the scale. The name of railway stations shall be written in capital letters only. Alignment shall be plotted on the map with North being clearly indicated on each drawing. Latitude and longitude shall also be properly marked. In large urban areas maps shall be to the scale of 1:10,000.

For convenience in handling, each drawing shall be restricted to the standard ‘Survey Of India’ Toposheet size with 30 mm. overlaps between the sheets. The match line shall be clearly shown on each sheet.

The Bidder should note that Purchase will not furnish the topographical maps prepared by Survey of India but will make available any assistance that may be required in obtaining the topographical maps.

Some portions of the line may require clearance from various authorities. The Contractor shall indicate the portion of the line so affected, the nature of clearance required and the name of concerned organisation such as local bodies, municipalities, DoT (name of circle), Inland Navigation, Irrigation Department and Zonal Railways, Divisional Forest Authorities etc.

Three copies of the route alignment drawings and all other the information shall be furnished in a report form, to the Project Head for approval. After approval, the Contractor shall submit three more sets of the approved survey report along with one set of reproducible of final route alignment drawings to the Project Head.

The preliminary shall include details of all obligatory points on the route. These obligatory points shall include all the rivers crossing, railway crossings, power line crossings, telecommunication line crossings, forest areas or any other important crossings encountered in the line route.
12.2. Final Survey

Immediately after the Employer has approved the line routes as determined by the preliminary survey, the Contractor will arrange for clearing to commence to allow the ground profile survey to proceed with the minimum of delay.

At the starting point of the commencement of route survey, an angle iron spike of 65x65x6mm section and 1000 mm long shall be driven firmly into the ground to project only 150 mm above the ground level. A punch mark on the top section of the angle iron shall be made to indicate location of the survey instrument. Teak wood peg 50 x 50 x650 mm size shall be driven at prominent position at intervals of not more than 750 metre along the line to be surveyed upto the next angle point. Nails of 100 mm wire should be fixed on the top of these pegs to show the location of instrument. The pegs shall be driven firmly into the ground to project 100 mm only above ground level. At angle position stone/concrete pillar with WESCO marked on them shall be put firmly on the ground for easy identification.

The ground profiles (longitudinal sections) with strip route plans are to be prepared by the Contractor for the complete route length, generally in accordance with the requirements of IS: 5613 and this Specification. The scale shall be 1:2000 horizontal and 1:200 vertical. In addition to showing the line route ground line and tower (centre point) location, the following features, where applicable, shall be shown:

- Continuous longitudinal chain-age
- Ground line
- Indication of side slopes where these affect clearances (account being taken of conductor under wind loaded conditions)
- All the numbered pegs identifying the survey points and the towers locations. For each peg the plan will show partial and progressive distances and elevation
- Buildings, rivers, roads, power and telecommunication lines, railways and other obstacles to be crossed, including where necessary details to confirm the required electrical clearances are obtained
- Sections unsuitable for structure locations
- Vegetation and nature of ground
- Distances from centre line of route to forest land/groves/orchards
- Land scheduling for forest stretches
- Structure locations, type of structure with height (standard, standard plus 1 m etc.) if necessary and structure number
- Angles of deviation, spans, ruling spans.
- Line of lowest conductor at maximum still air sag (75°C)
- Clearance curve

The Contractor shall be responsible for ensuring that at crossings of public services he has complied with all relevant Regulations and Rules.

All topographical details, permanent features, such as trees, building etc. within 7.5 m of the lines on either side of the alignment shall be detailed on the profile plan.

Clearance from ground, buildings, trees and telephone lines shall be provided in conformity with the Indian Electricity Rules, 1956 as amended upto date.
12.3. Line schedule.

As soon as the final tower locations are agreed and approved by the Purchase, the Contractor shall submit a line schedule. The line schedule shall include all the item schedule items to be included in the construction of the line. The line schedule shall indicate route designation, voltage, conductor type number and size, structure numbers, structure types, structure heights, angles of deviation, insulator types, insulators string types, spans, equivalent spans, section lengths, accumulated chain-age, and a "remarks" column in which details of crossings, etc. can be entered.

After the completion of various parts of the works further data, for instance the foundation types for each structure, locations of conductor mid-span joints and repair sleeves, shall be added to the line schedule.

For rehabilitation work, completed detailed inspection sheets showing work to be done on a structure by structure / span-by-span basis. In addition, maps, to a 1:25000* scale in rural areas and a minimum of 1:10000 in urban areas, showing the location of individual poles / tower, shall be required where inter-poling takes place.

A comprehensive detailed plan, on a circuit-by-circuit basis, showing proposed isolation and commissioning detail, to effectively manage the shutdowns to achieve minimum disruption to consumers shall be included with each line schedule.

13. INSTALLATION OF 33KV LINES

Installation of 33kV overhead lines shall be done in compliance with the requirements of this and other associated WESCO specifications and of IS: 5613.

13.1. Conductor Installation

The new or up-rated line conductors shall consist of All Aluminium Alloy Conductor, (hereinafter referred to as AAAC) of the specified cross section and complying in all respects with the requirements.

13.1.1. Phase Rotation

As far as is possible lines shall comply with the conventional phase rotation used in the Employer’s overhead network. The three phases are designated R, Y and B, which stand respectively for red, yellow and blue.

On "V" and horizontal cross-arms, the convention is that, with one’s back to the sending station, the phases are arranged R, Y and B from left to right. This same arrangement is maintained from top to bottom on any pole in which a vertical construction is used.

All connections to transformers, and to cable end boxes, must be arranged so that LV networks may be paralleled.

13.1.2. Conductor Stringing

Running out blocks or stringing pulleys shall be used to run out the conductors and care shall be taken to ensure that the conductors are run out from the top of the drums and do not touch or rub on the ground or against any object that may cause damage or scratching of the conductors. Pulling of conductors over and against cross-arms is prohibited. All damage to conductors shall be reported to the Project Head and at his discretion the use of an approved repair sleeve may be permitted. The fullest possible use shall be made of the maximum lengths of line conductor to reduce to a minimum the number of mid-span joints. All mid-span joints used shall be of the compression type and to the approval of the Project Head.

The Contractor shall include in his submittal a method statement for stringing.
13.1.3. Tensioning and Sagging of Conductors

For each type and size of conductor, suitable sag and tension charts shall be provided by the Contractor, for both design and erection conditions. The Contractor shall also state in his proposal the method to be employed for the erection, sagging and tensioning of the conductors.

Tensioning to achieve the design sag shall preferably be completed using a dynamometer, but where this is not available then other methods such as "sighting" will be considered for approval by the Project Head.

Sags shall be checked before handing over of the completed network in the presence of the Project Head.

The minimum factor of safety for conductors shall be 2 based on the Ultimate Tensile Strength (UTS). The conductor tension at 32°C without external loading, shall not exceed the following percentages of the UTS of the conductor:

- Initial unloaded tension .........................35%
- Final unloaded tension...........................22%

Conductor creep shall be compensated for by slight over tensioning at the time of sagging. To achieve the correct over tensioning value the conductor is sagged to a temperature on the sag - tension charts which is 15°C below the actual stringing temperature.

In calculating the sags and tensions allowance shall be made for the elasticity and co-efficient of expansion of the conductor materials. The "ruling span" method shall be used, in which the tension in any section length is that which would apply to a single span equal to the square root of the figure arrived at by dividing the sum of the cubes of the individual span lengths, in the section considered, by their sum. Unless otherwise approved, the sag of any one conductor should not differ from the correct sag by more than +/- 4 percent as specified in IS: 5613 (part 2 sect 2) Appendix B, and, in any one span, the maximum permissible difference in sag between conductors of different phases shall not exceed 150 mm.

The Contractor shall take into account a sag tolerance of + 150 mm when determining structure height.

13.1.4. Joints and Jumpers

The fullest possible use shall be made of maximum conductor lengths and therefore tension joints shall be minimised but where they are unavoidable they shall preferably be of the compression type and in accordance with the requirements of IEC - 1284, IS - 2121 and IS - 2486. Other tension joints, such as "preformed" and "self locking", may be proposed, but final approval for use shall be at the Project Head's discretion.

The electrical conductivity and current carrying capacity of each joint shall be such that the resistance of the joint is not greater than 75% of the resistance of an equivalent length of the line conductor. At the Project Heads request the Contractor shall measure the electrical resistance of joints after completion and before erection. The resistance of the joint shall be in accordance with the requirements of the Specification and shall in no case be greater than 75 percent of the resistance of the equivalent length of conductor. Any faulty joint shall be cut out and replaced at the Contractor’s expense. This operation may be required on all joints or as a random exercise. Contractor shall supply not less than one suitable resistance measuring machine complete with calibration test certificate.

Tension joints shall not permit slipping of, or cause damage to, or failure of, the complete line conductor or any part thereof at a load less than 95% of the ultimate tensile strength of the line conductor.

Mid-span joints shall not be less than 15m from the nearest conductor tension / suspension clamp or bind connection, and there shall not be more than one joint per conductor in any one span. Mid-span
joints shall not be used in railway crossings, where lines cross other lines of different voltages, cross
over communications lines or pass over or in close proximity to buildings. Two mid-span joints shall
not be made less than four spans apart in any one conductor.

Jumpers shall be formed in smooth curves, without sharp bends. They shall be as short as possible, and
where necessary, shall be supported on pilot insulators to which they shall be clamped or bound.

13.2.  Temporary Stays.
Where it is necessary to install conductors on one side of a structure or otherwise apply loads in excess
of the structure design loads the Contractor shall install temporary stays, anchors or other approved
restraints to ensure that the structure is not over stressed. All temporary stays or anchors shall be
installed into the ground and proof loading tests carried out prior to use.

13.3.  Pole Numbering System
Each feeder support structure shall be uniquely identified along the route. The Employer shall, through
the Project Head, inform the Contractor of the particular numbering system used. The details shall be
painted onto the concrete and steel pole structures using stencils or via approved circuit identification
plates in the case of steel latticed towers.

The painted numbers shall be applied at a height of 1.6 metres from ground level directly onto the pole
in a position approved by the Project Head. The numerals shall be of approved dimensions and painted
in black on a yellow background. The paint shall be of a permanent outdoor type and free from UV
degradation and fading.

13.4.  Steelwork
All steelworks stored at site shall be kept clear of the ground. Contact with brackish water or other
substances likely to attack galvanising shall be avoided and all tower members shall be kept in a clean
and tidy condition. Steelwork being erected on site should be kept off the ground by using timber
blocks.

If any shop errors in the steel are discovered, the Contractor shall notify the Project Head who will
decide whether the error shall be corrected on site or the members shall be replaced.

After erection all steelworks within 150 mm of the upper surface of the concrete together with the upper
surface of the concrete within 150 mm of the projecting steel shall be painted with two coats of
bituminous or other approved paint. In swamp areas the painting shall extend 500 mm above the
concrete. Steelwork and concrete to be thoroughly cleaned prior to application.

The Contractor shall at his own expense make suitable arrangements for temporary guying of towers,
where necessary. The additional loads imposed on specific towers during erection by the use of
temporary guys shall be calculated and approved. Attachment of the guys to the tower shall be
accomplished so as not to damage the steelworks or its galvanised coating. This can be achieved by
Hessian bagging of the steelwork, timbering or with the use of hosing placed around the slings.
PART 3: GENERAL PARTICULARS AND GUARANTEES

14. COMPLIANCE WITH SPECIFICATION

The overhead lines shall comply in all respects with the requirements of this specification. However, any minor departure from the provisions of the specification shall be disclosed at the time of tendering in the Non Compliance Schedule of this document.

The mass and dimensions of any item of equipment shall not exceed the figures stated in the Schedules.

15. COMPLIANCE WITH REGULATIONS

All the equipment and work carried out shall comply in all respects with the Indian Statutory Regulations and Acts in force.

The equipment and connections shall be designed and arranged to minimise the risk of fire and any damage, which might be caused in the event of fire.

15.1. Inspection and Testing

The Project Head shall have free entry at all times, while work on the contract is being performed, to all parts of the manufacturer’s works which concern the manufacture, testing, processing, installation or erection of the equipment ordered. The manufacturer shall afford the Project Head without charge, all reasonable facilities to assure that the equipment being furnished is in accordance with this specification.

The equipment shall successfully pass all the type tests and routine tests referred to in relevant equipment technical specification and those listed in the most recent edition of the standards given in Clause 2 of this specification.

The Project Head reserves the right to reject an item of equipment if the test results do not comply with the values specified or with the data given in the technical data schedule.

Type tests shall be carried out at an independent testing laboratory or be witnessed by a representative of such laboratory or some other representative acceptable to the Project Head. The Contractor at no extra charge at the manufacturer’s works shall carry out routine tests.

Type Test certificates shall be submitted with the bid for evaluation. The Project Head will decide the requirement for additional type tests.

The Project Head may witness routine and type tests. In order to facilitate this, the Contractor shall give the Project Head a minimum of four weeks notice that the material is ready for testing. If the Project Head does not indicate his intention to participate in the testing, the manufacturer may proceed with the tests and shall furnish the results thereof to the Project Head.

Full details of the proposed methods of testing, including connection diagrams, shall be submitted to the Project Head by the Contractor for approval, at least one month before testing.

All costs in connection with the testing, including any necessary retesting, shall be borne by the Contractor who shall provide the Project Head with all the test facilities which the latter may require, free of charge. The Project Head shall have the right to select the samples for test and shall also have the right to assure that the testing apparatus is correct. Measuring apparatus for routine tests shall be calibrated at the expense of the Contractor at an approved laboratory and shall be approved by the Project Head.

The Contractor shall be responsible for the proper testing of the work completed and plant and materials supplied by sub-suppliers to the same extent as if the work, plant or materials were completed or supplied by the Contractor.

Any cost incurred by the Project Head in connection with inspection and re-testing as a result of failure of the equipment under test or damage during transport or offloading shall be to the account of the Contractor.
The Contractor shall submit to the Project Head five signed copies of the test certificates, giving the results of the tests as required. No materials shall be dispatched until the Project Head has received the test certificates and the Contractor has been informed that they are acceptable.

The test certificates must show the actual values obtained from the tests, in the units used in the relevant specification, and not merely confirm that the requirements have been met.

In the case of components for which specific type tests or routine tests are not given in the Tests section of the relevant specification, or in the quoted standards in Clause 2, of this specification, the Contractor shall include a list of the tests normally required for these components. All materials used in the Contract shall withstand and shall be certified to have satisfactorily passed such tests.

No inspection or lack of inspection or passing by the Project Head’s Representative of work, equipment and materials whether carried out or supplied by the Contractor or sub-contractor, shall relieve the Contractor from his liability to complete the contract works in accordance with the contract or exonerate him from any of his guarantees.

15.2. Supervision, Checking and Operational Acceptance of the Facilities

The completion of all work, at the sites included in the scope of work of this specification, shall be supervised throughout by the Contractor or by a sufficient number of his representatives who have had thorough experience of the erection, repair and commissioning of similar Facilities.

If at any time it appears to the Project Head that the Contractor will be unable to complete any part of the Facilities in the time stipulated in the programme, then the Contractor shall, if required by the Project Head, carry on such work outside normal working hours and shall not make any claims for any extra expense thereby incurred unless, in the opinion of the Project Head, the delay is due to causes for which the Contractor would be entitled to an extension of time under the conditions of the contract.

The Contractor shall be responsible for any remedial work that may emanate from defects on the Facilities during the “Defects Liability Period” and as such shall make available locally to the equipment skilled personnel who can respond without delay to the Employer’s needs.

Each section or subsection of Facilities completed and ready for service shall be “Handed Over” to the Employer. The certificate of Hand Over shall state which section or subsection of the Facilities is clear of all personnel, tools, temporary earths and equipment and is ready for service and can be energised. Handing over does not constitute taking over.

Until each part of the Facilities has been given Operational Acceptance or deemed to have been given Operational Acceptance under the Conditions of the Contract, and an Operational Acceptance Certificate issued, the Contractor shall be entirely responsible for each such section of the Facilities, whether under construction, during tests or returned to the Employer’s service.

Any work to be completed by the Contractor in compliance with his Contract shall be done with the minimum of disturbance to the consumer and within the shortest time span possible. To this end the Contractor shall propose methodologies as how he will approach the projects to achieve these goals and include these proposals with his Bid documents. If he is successful with his bid, then he shall, in agreement with the Employer, submit a comprehensively detailed document before he commences work.

15.3. Guarantee

The Contractor shall guarantee the following:

- Quality and strength of materials used.

- Satisfactory operation during the guarantee period of twelve (12) months from the date of Operational Acceptance, or 18 months from the Date of Completion of the Facilities or any part thereof, whichever is the earlier.
Performance figures as supplied by the Bidder in the schedule of guaranteed particulars.

15.4. Submittals

The following must be prepared by bidders and accompany each bid:

- Completed technical data schedules;
- Descriptive literature giving technical details of equipment offered;
- General arrangement of each type of intermediate support and heavy angle support and cross-arms;
- Type test certificates, where available, and sample routine test reports;
- Detailed reference list of customers already using equipment offered during the last 5 years with particular emphasis on units of similar design and rating;
- Deviations from this specification. Only deviations approved in writing before award of contract shall be accepted;