

	CHAPTER - E14 : INSTALLATION
1.00.00	<p>EARTHING</p> <p>The earthing shall be done in accordance with requirements given in Annexure-I of this section and drawing enclosed with the specifications. Earthing of panels shall be done in line with the requirements given in respective equipment section of this specification.</p>
2.00.00	<p>CIVIL WORKS</p> <p>The civil works shall be done in accordance with requirements stipulated under Part-II, Section-II of this specification.</p>
3.00.00	<p>STRUCTURAL STEEL WORKS</p> <p>The structural steel works shall be done in accordance with requirements stipulated under Part-II, Section-II of this specification.</p>
4.00.00	BAY EQUIPMENT
4.01.00	The disposition of equipment to be supplied are shown in enclosed single line diagrams and layout drawings.
4.02.00	The Contractor shall prepare layout drawings and submit the same for approval of the Employer. The approval of drg. shall not absolve Contractor from his responsibility regarding designing & engineering of switchyard and Contractor shall be fully responsible for all works covered in the scope of this specification.
5.00.00	LIGHTNING PROTECTION
5.01.00	Direct stroke lightning protection (DSLPP) shall be provided in the switchyard by lightning masts and shield wires.
5.02.00	Lightning protection System down conductors shall not be connected to other conductors above ground level. Also no intermediate earthing connection shall be made to Surge arrester, Voltage Transformer, earthing leads for which shall be directly connected to rod electrode.
5.03.00	Every down conductor shall be provided with a test joint at about 150mm above ground level. The test joint shall be directly connected to the earthing system.
5.04.00	The lightning protection system shall not be in direct contact with underground metallic service ducts and cables.
6.00.00	EQUIPMENT ERECTION NOTES
a)	All support insulators, circuit breaker interrupters and other fragile equipment shall be handled with cranes with suitable booms and handling capacity.

	<p>b) Where, assemblies are supplied in more than one section, Contractor shall make all necessary mechanical and electrical connections between sections including the connection between buses. Contractor shall also do necessary adjustments/alignments necessary for proper operation of circuit breakers, isolators and their operating mechanisms. All components shall be protected against damage during unloading, transportation, storage, installation, testing and commissioning. Any equipment damaged due to negligence or carelessness or otherwise shall be replaced by the Contractor at his own expense. The contractor shall strictly follow manufacturer's recommendations for handling and erection of equipment.</p> <p>c) The slings shall be of sufficient length to avoid any damage to insulator due to excessive swing, scratching by sling ropes etc. Handling equipment, sling ropes etc. should be tested before erection and periodically thereafter for strength.</p> <p>d) Bending of piping should be done by a bending machine and through cold bending only. Bending shall be such that inner diameter of pipe is not reduced. The pipes shall be thoroughly cleaned before installation.</p> <p>e) Cutting of the pipes wherever required shall be such as to avoid flaring of the ends. Hence only a proper pipe cutting tool shall be used. Hack saw shall not be used.</p> <p>f) For cleaning the inside and outside of hollow insulators only Muslin or leather cloth shall be used.</p>
7.00.00	<p>STORAGE OF EQUIPMENT</p> <p>Contractor is responsible for the proper storage and maintenance of all materials/equipment entrusted to him. The Contractor shall provide & construct adequate storage shed for proper storage of equipment. Sensitive equipment shall be stored indoors. All equipment during storage shall be protected against damage due to acts of nature or accidents. Contractor shall take all required steps to carryout subsequent inspection of materials/equipment stored as well as erected until the same is taken over by the Employer. The storage instruction of the equipment manufacturers/Engineer-in-Charge shall be strictly adhered to.</p>
8.00.00	<p>CABLING</p>
8.01.00	<p>Cabling shall be on cable racks, in trenches, vertical shafts, excavated trenches for direct burial, pulled through pipes and conduits run clamped on steel structures etc.</p>
8.02.00	<p>Cables inside the switchyard shall be laid on cable racks mounted on angle supports at 600mm spacing with separate tiers for control and power cables.</p>
8.03.00	<p>Cables shall be generally located adjoining the electrical equipment through the pipe insert embedded in the ground. In the case of equipment located away from cable trench either pipe inserts shall be embedded in the ground connecting the cable trench and the equipment or in case the distance is small, notch/opening shall be provided. In all these cases necessary bending radii as recommended by the cable supplier shall be maintained.</p>

8.04.00	Cabling in the control room shall be done on ladder type cable trays.
8.05.00	All interpole cables (both power & control circuit) for equipments shall be laid in cable trenches/G.I. Conduit Pipe of NB 50/100mm which shall be buried in the ground at a depth of 300mm.
9.00.00	CONDUITS, PIPES AND ACCESSORIES
9.01.00	The conductor shall supply and install all rigid conduits, mild steel pipes, flexible conduits, hume pipes etc. including all necessary sundry materials, such as tees, elbows, check nuts, bushings, reducers, enlargers, wooden plugs, coupling caps, nipples, gland sealing fittings, pull boxes etc. The size of the conduit/pipe shall be selected on the basis of maximum 40% fill criterion. All conduits/pipes shall have their ends closed by caps until cables are pulled. After cables are pulled, the ends of conduits/pipes shall be sealed in an approved manner, to prevent damage to threaded portion and entrance of moisture and foreign material.
9.02.00	Rigid conduits shall be flow-coat metal conduits of Nagarjuna Coated Tubes or equivalent make. The outer surface of the conduits shall be coated with hot-dip zinc and chromate coatings. The inner surface shall have silicone epoxy ester coating for easy cable pulling. Mild steel pipes shall be hot-dip galvanised. All rigid conduits/pipes shall be of a reputed make.
9.03.00	The hume pipes and accessories shall be of reinforced concrete conforming to class NP2 of IS: 458. All tests on hume pipes shall be conducted as per IS: 458.
9.04.00	Flexible conduits shall be of heat-resistant lead coated steel, water-leak, fire and rust proof and be of PLICA make or equivalent.
10.00.00	JUNCTION BOXES
	Contractor shall supply and install junction boxes complete with terminals as required. The brackets, bolts, nuts and screws required for the erection shall be included in the installation price. The junction boxes shall conform to the requirements of sec. AUX.
11.00.00	CABLE TAGS AND MARKER
11.01.00	Each cable and conduit run shall be tagged with numbers that appear in the cable and conduit schedule.
11.02.00	The tag shall be of aluminium with the number punched on it and securely attached to the cable conduit by not less than two turns of 20 SWG GI wire conforming to IS: 280. Cable tags shall be of rectangular shape for power cables and of circular shape for control cables.
11.03.00	Location of cables laid directly underground shall be clearly indicated with cable marker made of galvanised iron plate.
11.04.00	Location of underground cable joints shall be indicated with cable marker with an additional inscription "Cable joint".

11.05.00	The marker shall project 150mm above ground and shall be spaced at an interval 30 meters and at every change in direction. They shall be located on both sides of road and drain crossings.
11.06.00	Cable tags shall be provided on all cables at each end (just before entering the equipment enclosure), on both sides of a wall or floor crossing, on each duct/conduit entry. Cable tags shall be provided inside the switchgear, motor control centres, control and relay panels etc., wherever required for cable identification, such as where a number of cables enter together through a gland plate.
11.07.00	The price of cable tags and markers shall be included in the installation rates for cables /conduits quoted by the Contractor.
11.08.00	Specific requirements for cabling, wiring ferrules as covered in respective equipment section shall also be complied with.
12.00.00	CABLE GLANDS
12.01.00	Double compression type tinned/Nickel plated (coating thickness not less than 20 microns in case of Tin and 10 to 15 Microns in case of Nickel) brass cable glands shall be provided by the Contractor for all power and control cables to provide dust and weather proof terminations. The cable glands shall be tested as per BS : 6121. They shall comprise of heavy duty brass casting, machine finished and tinned to avoid corrosion and oxidation. Rubber components used in cable gland shall be neoprene and of tested quality.
12.02.00	Required number of packing glands to close unused openings in gland plates shall also be provided.
13.00.00	CABLE LUGS
13.01.00	Cable lugs shall be tinned copper solderless crimping type conforming to IS: 8309 and 8394 suitable for aluminium or copper conductor (as applicable). Solderless crimping of terminals shall be done by using corrosion inhibitory compound. The cable lugs shall suit the type of terminals provided.
13.02.00	The cable lugs shall be of Dowell make or equivalent.
13.03.00	Crimping tool used shall be of approved design and make.
14.00.00	STORAGE AND HANDLING OF CABLE DRUMS
	Cable drums shall be unloaded, handled and stored in an approved manner and rolling of drums shall be avoided as far as practicable. For short distances, the drums may be rolled provided they are rolled slowly and in proper direction as marked on the drum. In absence of any indication the drums may be rolled in the same direction it was rolled during taking up the cables.

15.00.00	CABLE SUPPORTS AND CABLE TRAY MOUNTING ARRANGEMENTS
15.01.00	Cable trays in the control room are normally provided with embedded steel inserts on concrete floors/walls. The Contractor shall secure supports by welding to these inserts or available building steel structures.
15.02.00	However, in cases where no such embedded steel inserts are available, the Contractor shall have to secure the supports on wall or floors by suitable anchoring at no extra cost to the Employer. Details of fixing steel plates by anchor fasteners shall be decided during detailed engineering stage.
15.03.00	The cable supports shall conform to the requirements of Sec. E12 of this Specification.
15.04.00	Insert plates will be provided at an interval of 600mm wherever cables are to be supported without the use of cable trays, while at all other places these will be at an interval of 2000mm.
16.00.00	CABLE TERMINATIONS AND CONNECTIONS
16.01.00	The termination and connection of cables shall be done strictly in accordance with cable and termination kit manufacturer's instructions, drawing and/or as directed by the Employer.
16.02.00	The work shall include all clamping, fittings, fixing, plumbing, soldering, drilling, cutting, taping, heat shrinking, (where applicable), connecting to cable terminal, shorting and grounding as required to complete the job.
16.03.00	Cost of all consumable material shall be included in the erection rates quoted.
16.04.00	The equipment will be generally provided with undrilled gland plates for cables/conduit entry. The Contractor shall be responsible for drilling of gland plates, painting and touching up. Holes shall not be made by gas cutting.
16.05.00	The contractor shall tag/ferrule the control cable cores at all terminations, as instructed by the Employer. In panels where a large number of cables are to be terminated and cable identification may be difficult, each core ferrule may include the complete cable number as well.
16.06.00	Spare cores shall be similarly tagged with cable numbers and coiled up.
16.07.00	Control cables shall have stranded copper conductor. Bare portion of the solid conductors shall be tinned after removing the insulation and shall be terminated directly without using cable lugs.
16.08.00	All cable entry points shall be sealed and made vermin and dust proof. Unused openings shall be effectively closed.
16.09.00	If the cable end box or terminal enclosure provided on the equipment is found unsuitable and requires modification, the same shall be carried out by the Contractor as directed by the Employer.

16.11.07	Selection of cable drums for each run shall be so planned as to avoid using straight through joints. In case joints are necessary the same shall be supplied by the Contractor. Cable splices will not be permitted except where called for by the drawings, unavoidable or where permitted by the Employer.
16.11.08	Control cable terminations inside equipment enclosures shall have sufficient lengths so that switching of termination in terminal blocks can be done without requiring any splicing.
16.11.09	Metal screen and armour of the cable shall be bonded to the earthing system of the station, wherever required.
16.11.10	Rollers shall be used at intervals of about 2.0 metres, while pulling cables.
16.11.11	All due care shall be taken during unreeling, laying and termination of cable to avoid damage due to twist, kink, sharp bends etc.
16.11.12	Cable ends shall be kept sealed to prevent damage.
16.11.13	Inspection on receipt, unloading and handling of cables shall generally be in accordance with IS: 1255 and other Indian Standard Codes of practices.
16.11.14	Wherever cables pass through floor or through wall openings or other partitions, wall sleeves with bushes having a smooth curved internal surface so as not to damage the cables, shall be supplied, installed and properly sealed by the Contractor at no extra charges.
16.11.15	The erection work shall be carried out in a neat workmanlike manner and the areas of work shall be cleaned of all scrap materials, etc. after the completion of work in each area every day. Contractor shall remove the RCC/steel bench covers before taking up the work and shall replace all the trench covers after the erection work in that particular area is completed or when further work is not likely to be taken up for some time.
16.11.16	Contractor shall furnish three copies of the report on work carried out in a particular week, such as cable numbers and a date on which laid, actual length and route, testing carried out, alongwith the marked up copy of the cable schedule and interconnection drawing wherever any modifications are made.
16.11.17	Contractor shall paint the tray identification number on each run of trays at an interval of 10m.
16.11.18	In case the outer sheath of a cable is damaged during handling/installation, the Contractor shall repair it at his own cost, and to the satisfaction of the Engineer-in-Charge. In case any other part of a cable is damaged, the same shall be replaced by a healthy cable, at no extra cost i.e. the Contractor shall not be paid for installation and removal of the damaged cable.
16.11.19	All cable terminations shall be appropriately tightened to ensure secure and reliable connections. The Contractor shall cover the exposed part of all cable lugs whether supplied by him or not with insulating tape, sleeve or paint.

16.12.00	Conduits, Pipes and Duct Installation
16.12.01	Contractor shall supply all conduits, pipes and ducts as specified and to be shown in detailed engineering drg. Flexible conduit should be used between fixed conduit and equipment terminal boxes. Where vibration is anticipated, the flexible conduit shall be as per the relevant IS.
16.12.02	Contractor shall have his own facility for bending, cutting and threading the conduits at site. Cold bending should be used. All cuts & threaded ends shall be made smooth without leaving any sharp edges. Anti corrosive paint shall be applied at all field threaded portions. The Contractor shall supply and apply this protective material.
16.12.03	All conduit/pipes shall be extended on both sides of wall/floor/openings. Exposed conduits/pipes shall be adequately clamped at an interval of about 2m. The fabrication and installation of supports and the clamping shall be included in the scope of work by Contractor.
16.12.04	When two lengths of conduits are joined together through a coupling, running threads equal to twice the length of coupling shall be provided on any length to facilitate easy dismantling of two conduits.
16.12.05	Conduit installation shall be permanently connected to earth by means of special approved type of earthing clamps. G.I. Pull wire of adequate size shall be laid in all conduits before installation.
16.12.06	Each conduit run shall be painted with its designation as indicated on the drawings, such that it can be identified at each end.
16.12.07	Embedded conduits shall have a minimum concrete cover of 50mm. Positioning and ensuring proper alignment during concrete by other agencies shall be the responsibility of the Contractor.
16.12.08	Conduit runs sleeves shall be provided with the bushings at each end.
16.12.09	Metallic conduit runs at termination shall have two locknuts and a bushing for connection. Flexible conduits shall also be suitably clamped at each end. Bushings shall have rounded edges so as not to damage the cables.
16.12.10	Where embedded conduits turn upwards from a slab or fill, the termination dimensions shown on the drawings, if any, shall be taken to represent the position of the straight extension of the conduit external to and immediately following the bend. At least one half the arc length of the bend shall be embedded.
16.12.11	For underground runs, Contractor shall excavate and back fill as necessary.
16.13.00	BASIS OF PAYMENT
16.13.01	The Contractor shall maintain a detailed account of all material received at site, and erected. Full records shall be maintained and updated regularly at least fortnightly regarding the use of the material and these shall be available to the Engineer-in- Charge for inspection.

16.13.02	For all items to be supplied and erected, payment shall be on unit supply rate basis for the quantities actually erected at site. (The unit rates shall be inclusive of all accessories, hardwares, tray couplers, bends, joints as applicable). The responsibility of supplying the required quantity of cables lies with the Contractor, the payment for supplies of all the cables shall be made only after the erection/at site.
16.13.03	For handling and laying of power and control cables-payment shall be on unit laying rate basis for cable length actually laid as measured between the farthest terminal at one end and the farthest terminal on the other end. (The unit rates shall be inclusive of all associated work and accessories e.g. cable tags, clamps).
16.13.04	For termination of cables-payment shall be unit termination rate basis, for the actual number of terminations. (The unit rates shall include drilling of gland plates, fixing of glands and lugs, core ferrules etc.).
16.13.05	Wherever specifically required by the Engineer-in-Charge, the Contractor shall disconnect all cores of a cable from the equipment terminals (for equipment or cable testing), and reconnect subsequently. The Contractor shall be paid for this work on the basis of unit rates quoted for cable termination for different cable sizes.
16.13.06	<p>The successful Contractor shall be required to carry out the following :</p> <p>a) Estimating the requirements of all items of supply including</p> <p>the requirement of conduits, fittings, supports, materials for earthing and lighting protection, etc. for various work areas.</p> <p>the requirement of Hume pipes for crossing of roads, drains, etc.</p> <p>b) Preparing detailed drawings for cable jointing and terminations supports, etc. (Wherever required.)</p> <p>c) Preparing cable drum length, cutting schedule etc.</p>
16.13.07	All scrap produced by the Contractor shall be removed by him daily from the plant area to waste dump and the work site shall be kept reasonably clean. The cut lengths of cables, trays etc., which are proposed to be supplied as spares shall be removed to Contractor's stores and kept properly preserved, wound on drums etc.

EARTHING NOTES

1.00.00

GENERAL

1.00.01

Approximate quantity of Earthing conductor is given Section-G0. Exact location of earthing connections shall be designed to suit the site conditions.

1.00.02

Neutral points of systems of different voltages, metallic enclosures and frame works associated with all current carrying equipments and extraneous metal works associated with electric system shall be connected to a single earthing systems unless stipulated otherwise.

1.00.03

Earthing system installation shall be in strict accordance with the latest editions of Indian Electricity Rules, relevant Indian Standards and Codes of practice and Regulations existing in the locality where the system is installed.

1.00.04

Bolts and nuts required for earthing all main equipment structures and for connecting with earthing system as explained in Cl. 1.00.02 above shall be in the scope of the Contractor.

2.00.00

DETAILS OF EARTHING SYSTEM

Item	Size	Material
Main Earthing conductor	40mm dia rod	Mild steel
Conductor above ground & earthing leads (for equipment)	75 x 12/ G.S. Flat 50 x 6	Galvanized steel
Rod Electrode	40mm dia, 3000mm	Mild steel
G.I. Earthwire	7/8 SWG	GI

3.00.00

EARTHING CONDUCTOR LAYOUT

3.00.01

Earthing conductors in outdoor areas shall be buried atleast 600mm below finished grade level unless stated otherwise.

3.00.02

Minimum 6000mm spacing between rod electrodes shall be provided unless stipulated otherwise.

3.00.03

Wherever earthing conductors cross cable trenches, underground service ducts, pipes, tunnels, railway tracks etc., it shall be laid atleast 300mm below them and shall be re-routed in case it fouls with equipment/structure foundations.

3.00.04	Tap connections from the earthing grid to the equipment/structure to be earthed, shall be terminated on the earthing terminals of the equipment/structure, if the equipment is available at the time of laying the grid. Otherwise, “earth insert” with temporary wooden cover or “earth riser” shall be provided near the equipment foundation/pedestal for future connections to the equipment earthing terminals.
3.00.05	Earthing conductor along their run on cable trench ladder columns, beams, walls, etc. shall be supported by suitable welding/cleating at intervals of 750mm. Earthing conductors along cable trenches shall be on the wall nearer to the equipment. Wherever it passes through walls, floors etc. galvanized iron sleeves shall be provided for the passage of the conductor. Both ends of the sleeves shall be sealed to prevent the passage of water through the sleeves.
3.00.06	Earthing conductor around the building shall be buried in earth at a minimum distance of 1500mm from the outer boundary of the building. In case high temperature is encountered at some location, the earthing conductor shall be laid minimum 1500mm away from such location.
3.00.07	In outdoor areas, tap connections shall be brought 300mm above ground level for making connections in future, in case equipment is not available at the time of grid installations.
3.00.08	Earthing conductors crossing the road shall be either installed in hume pipes or laid at greater depth to suit the site conditions.
3.00.09	Earthing conductors embedded in the concrete fibre shall have approximately 50mm concrete cover.
4.00.00	EQUIPMENT AND STRUCTURE EARTHING
4.00.01	The connection between earthing pads and the earthing grid shall be made by short and direct earthing leads free from kinks and splices. In case earthing pads are not provided on the item to be earthed, same shall be provided in consultation with engineer.
4.00.02	Metallic pipes, conduits and cable tray sections for cable installation shall be bonded to ensure electrical continuity and connected to earthing conductors at regular interval. Apart from intermediate connections, beginning points shall also be connected to earthing system.
4.00.03	Metallic conduits shall not be used as earth continuity conductor.
4.00.04	A separate earthing conductor shall be provided for earthing lighting fixtures, lighting poles, receptacles, switches, junction boxes, lighting conduits, etc.

CHAPTER – E14
ANNEXURE-I

Page 3 of 4

4.00.05	Wherever earthing conductor crosses or runs along metallic structures such as gas, water, steam, conduits, etc. and steel reinforcement in concrete it shall be bonded to the same.
4.00.06	Cable and cable boxes/glands, lockout switches etc. shall be connected to the earthing conductor running alongwith the supply cable which, in turn, shall be connected to earthing grid conductor at minimum two points, whether specifically shown or not.
4.00.07	Railway tracks within switchyard area shall be bonded across fish plates and connected to earthing grid at several locations.
4.00.08	Earthing conductor shall be buried 2000mm outside the switchyard fence. Every post of the fence and gates shall be connected to earthing loop by one lead.
4.00.09	Flexible earthing connectors shall be provided where flexible conduits are connected to rigid conduits to ensure continuity.
4.00.10	Equipment earthing (Riser & welding of two conductors) shall be done as per enclosed sketch. Drg. No. 9518-500-POE-A-11
5.00.00	JOINTING
5.00.01	Earthing connections with equipment earthing pads shall be of bolted type. Contact surfaces shall be free from scales, paint, enamel, grease, rust or dirt. Two bolts shall be provided for making each connection. Equipment bolted connections, after being checked and tested, shall be painted with anti-corrosive paint/compound.
5.00.02	Connection between equipment earthing lead and between main earthing conductors shall be welded/brazed type. For rust protections, the welds should be treated with red lead and afterwards thickly coated with bitumen compound to prevent corrosion.
5.00.03	Steel to copper connections shall be brazed type and shall be treated to prevent moisture ingress.
5.00.04	Resistance of the joint shall not be more than the resistance of the equivalent length of the conductor.
5.00.05	All ground connections shall be made by electric arc welding. All welded joints shall be allowed to cool down gradually to atmospheric temperature before putting any load on it. Artificial cooling shall not be allowed.
5.00.06	Bending of large diameter rod/thick conductor shall be done preferably by gas heating.
5.00.07	All arc welding with large diameter conductors shall be done with low hydrogen content electrodes.

6.00.00	<p>POWER CABLE EARTHING</p> <p>Metallic sheaths and armour of all multi core power cables shall be earthed at both equipment and switchgear end. Sheath and armour of single core power cables shall be earthed at switchgear end only.</p>
7.00.00	<p>SPECIFIC REQUIREMENT FOR EARTHING SYSTEMS</p>
7.00.01	<p>Earthing terminal of each surge arrester, capacitor voltage transformer and lightning down conductors shall be directly connected to rod electrode which in turn, shall be connected to station earthing grid.</p>
7.00.02	<p>Earthing mat comprising of closely spaced (300mm x 300mm) conductors shall be provided below the operating handles of the isolators.</p>
7.00.03	<p>For specific requirements for earthing at panel refer to Section-Control and Relay Panel of this specification.</p>
8.00.00	<p>SPECIFIC REQUIREMENTS FOR LIGHTNING PROTECTION SYSTEM</p>
8.00.01	<p>Conductors of the lightning protection system shall not be connected with the conductors of the safety earthing system above ground level.</p>
8.00.02	<p>Down conductors shall be cleated on the structures at 2000mm interval.</p>
8.00.03	<p>Connection between each down conductor and rod electrodes shall be made via test joint located approximately 150mm above ground level.</p>
8.00.04	<p>Lightning conductors shall not pass through or run inside G.I. conduits.</p>
8.00.05	<p>Lightning protection system installation shall be in strict accordance with the latest editions of Indian Electricity Rules, Indian Standards and Codes of practice and Regulations existing in the locality where the system is installed.</p>

	<p>PROCEDURE FOR NON DESTRUCTIVE TESTING</p> <p>A. LIQUID PENETRANT EXAMINATION OF WELDED JOINTS</p> <p>a) Evaluation of indications:</p> <p>Relevant indications are those which result from mechanical discontinuities. Rounded indications or indications which are circular or elliptical with the length less than three times the width.</p> <p>Linear indications are those indications in which the length is more than three times the width.</p> <p>Any questionable or doubtful indications, shall be retested to verify whether or not actual defects are present.</p> <p>Localised surface imperfections, such as may occur from machining marks, surface conditions, may procedure similar indications which are not relevant to the detection of unacceptable discontinuities.</p> <p>b) Acceptance standards</p> <p>All surfaces to be examined shall be free of</p> <p>linear indications;</p> <p>four or more rounded defects with any dimensions more than 1.6mm in a line separated by 1.16 inch (1.6mm) or less (edge to edge).</p> <p>c) Defect removal and repair:</p> <p>Unacceptable imperfections shall be removed and re-examination made to assure the complete removal. Whenever a defect is removed and subsequent repair by welding is not required, the excavated area shall be blended into the surrounding surface so as to avoid sharp notches, crevices or corners. Where welding is required after removal of a defect, the area shall be cleaned and welding performed in accordance with a qualified welding procedure. Completed repairs shall be re-examined by the method originally used for detection of the defect.</p> <p>d) Treatment of imperfections believed non-relevant:</p> <p>Any indication of an imperfection which is believed to be non-relevant shall be regarded as a defect unless, on re-evaluation, it is shown by re-examination by the same method or by the use of other non-destructive methods and/or by surface conditioning that no unacceptable defect is present.</p> <p>e) Examination of areas from which defects have been removed:</p> <p>After a defect is thought to have been removed and prior to making weld repairs, the area shall be examined by suitable methods to ensure the defect has been eliminated.</p>
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B.	<p>f) Re-examination of repaired area:</p> <p>After repairs are made, the repaired areas shall be blended.</p> <p>RADIOGRAPHIC EXAMINATION OF WELDED JOINTS</p> <p>Radiographic examination shall cover minimum 10% of weld seam and acceptance standard for visual examination and Radiography shall be as follows:</p> <p>Any of the following imperfections shall not be acceptable:</p> <p>i) Cracks</p> <p>ii) Zone of incomplete fusion or penetration, which exceed 10% of the weld length of the joint. In longitudinal or transverse butt weld, where full penetration is intended by the weld procedure, some lack of penetration is acceptable. The total length of weld with lack of penetration shall not exceed 10% of the overall weld length. At no place, shall weld penetration be less than 90% of the thickness of the material. Continuous occurrence of lack of penetration is permitted, but shall not exceed 50mm in any 500mm length of weld.</p> <p>iii) Inadequate weld dimensions, Root Cavity (shrinkage) and incompletely filled groove greater than 10% effective throat thickness.</p> <p>iv) Excess penetration shall be permitted provided it does not exceed 25% of the wall thickness or 4mm whichever is smaller.</p> <p>v) Weld reinforcement:</p> <p>Build up in excess of 25% of the effective throat thickness shall be dressed. Any reinforcement shall be substantially symmetrical about the centreline of the weld and shall be of smooth contour blending smoothly at the toes with the parent material.</p> <p>vi) Undercutting and overlapping greater than 10% effective throat thickness.</p> <p>vii) Elongated cavities and/or worm holes exceeding 3mm dia or equivalent area in length provided the limitations on porosity are met with.</p> <p>viii) Copper, tungsten or oxide inclusions greater than t/4 or 3mm dia or its equivalent area, whichever is smaller.</p> <p>ix) Crater pipes exceeding 25% effective throat thickness or 3mm whichever is smaller.</p> <p>x) Porosity:</p> <p>Scattered porosity not exceeding 0.5% by volume is acceptable. In general, the size of the pores shall not exceed 0.8mm dia, but occasional 1.6mm dia pores may be acceptable, provided the following limits are not exceeded:</p> <p>Where pore size is 0.4mm or less, upto 150t pores may be permitted in 1000mm sq. area or radiograph.</p>
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	<p>Where pore size is 0.8 mm dia or less, upto 19t pores may be permitted in 1000mm sq. area or radiograph.</p> <p>Where pore sizes are generally 0.8mm dia or less, but occasional 1.6mm dia pores are present, upto 9t of 0.8mm dia may be permitted in 1000mm sq. area of radiograph, provided the number of pores upto 1.6mm in dia does not exceed it.</p> <p>However, visible surface porosity > 1mm dia is not acceptable.</p> <p>Note:</p> <p>In all cases, t = thickness of the thinnest section of the weld under examination.</p> <p>Unacceptable weld defects shall be repaired in accordance with the original welding procedure. All repairs shall be 100% inspected in accordance with original testing procedure.</p>
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	Erection Drawings to be submitted by the Contractor
1.	Single line diagram
2.	Switchyard layout (Plan & Section)
3.	Equipment & Foundation Cable trench layout
4.	Structural Arrangement Drawing
5.	Earthmat Layout
6.	Composite G.A. Drawing
7.	Clearance Diagram
8.	Cable Trench Section
9.	Equipment Earthing details
10.	Welding Details
11.	All Design Calculations
12.	G.A. of Clamps and Connectors Drawings
13.	G.A. and Part Drawing of Insulator String and Hardware
14.	G.A. and Schematics of all Marshalling Kiosks and cabinets
15.	Data Sheets and Drawings of all Other Miscellaneous Items

	<p style="text-align: center;">CHAPTER – E15 : SITE TESTING AND COMMISSIONING</p>
1.00.00	<p>INTRODUCTION</p> <p>An indicative list of tests is given below. Contractor shall perform any additional test based on specialties of the items as per the field QP/ instructions of the equipment supplier or Employer without any extra cost to the Employer. The Contractor shall arrange all instruments required for conducting these tests alongwith calibration certificates and shall furnish the list of instruments to the Employer for approval.</p>
2.00.00	<p>GENERAL CHECKS</p> <ol style="list-style-type: none"> a) Check for physical damage. b) Visual examination of zinc coating/ plating c) Check from name plate that all items are as per older/ specification. d) Check tightness of all bolts, clamps and connecting terminals using toque wrenches. e) For oil filled equipment check for oil leakage, if any. Also check oil level and top up. f) Check ground connections for quality of weld and application of zinc rich paint over weld joint of galvanized surfaces. g) Check cleanliness of insulator and bushings. h) All checks and tests specified by the manufactures in their drawings and manuals as well as all tests specified in the relevant code of erection. i) Check for surface finish of grading rings (corona control ring.) j) Pressure test on all pneumatic lines at 1.5 times the rated pressure shall be conducted.
3.00.00	<p>CIRCUIT BREAKERS</p> <ol style="list-style-type: none"> a) Insulation resistance of each pole. b) Check adjustments, if any, suggested by manufacturer. c) Breaker closing and tripping time. d) Slow and power closing operation and opening e) Trip free and anti pumping operation. f) Minimum pick up volts of coils g) Contact resistance h) Functional checking of compressed air plant and all accessories i) Functional checking of control circuits, interlocks, tripping through protective relays and auto-reclose operation. j) Insulation resistance of control circuits, motor etc. k) Resistance of closing and tripping coils.
4.00.00	<p>ISOLATORS</p> <ol style="list-style-type: none"> a) Insulation resistance of each pole b) Manual and electrical operation on interlocks c) Insulation resistance of control circuits and motors. d) Ground connections e) Contact resistance f) Proper alignment to minimise the vibration to the extreme possible during operation.

	g)	Measurement of operating torque for isolator and Earth switch
	h)	Resistance of operating and interlocking coils.
5.00.00		CURRENT TRANSFORMERS
	a)	Insulation Resistance Test
	b)	Polarity test.
	c)	Ratio identification test-checking of all ratios on all cores by primary injection of current.
	d)	Dielectric test of oil (wherever applicable)
	e)	Magnetizing characteristics test.
6.00.00		VOLTAGE TRANSFORMERS
	a)	Insulation resistance test
	b)	Polarity test
	c)	Ratio test
	d)	Dielectric test of oil (if applicable)
7.00.00		SURGE ARRESTER
	a)	Grading leakage current
	b)	Resistance of ground connection.
8.00.00		PHASING OUT
		The phasing out of all supplies in the station system shall be carried out.
9.00.00		STATION EARTHING
	a)	Check soil resistivity
	b)	Check continuity of grid wires
	c)	Check earth resistance of the entire grid as well as various sections of the same.
	d)	Check for weld joint and application of zinc rich paint on galvanised surface.
	e)	Dip test on earth conductor prior to use.
10.00.00		CONDUCTOR STRINGING AND POWER CONNECTORS
	a)	Physical check for finish
	b)	Electrical clearance check
	c)	Testing of torque by torque by torque wrenches on all bus power connectors and other accessories.
	d)	Milli volt drop test on all power connectors.
	e)	Sag and tension check on conductors.
11.00.00		INSULATORS
		Visual examination for finish damage, creepage distance, etc.

	<p style="text-align: center;">Chapter-G2</p> <p style="text-align: center;">ADDITIONAL CONSTRUCTION WORK</p> <p style="text-align: center;">SPLIT RESPONSIBILITIES</p>
1.00.00	GENERAL
1.01.00	The following shall supplement the conditions already contained in the other parts of these specifications and documents and shall govern that portion of the work or this contract to be performed at site.
1.02.00	The Contractor upon signing of the contract shall, in addition to a Project Co-ordinator, nominate another responsible officer as his representative at site suitably designated for the purpose of overall responsibility and co-ordination of the works to be performed at site. Such person shall function from the site office of the Contractor during the pendency of contract.
2.00.00	REGULATION OF LOCAL AUTHORITIES AND STATUTES
2.01.00	The Contractor shall comply with all the rules and regulations of local authorities during the performance of his field activities. He shall also comply with the Minimum Wages Act, 1948 and the Payment of Wages Act (both of the Government of India) and the rules made thereunder in respect of any employee or workman employed or engaged by him or his sub-Contractor.
2.02.00	All registration and statutory inspection fees, if any, in respect of his work pursuant to this contract shall be to the account of the Contractor. However, any registration, statutory inspection fees lawfully payable under the provisions of the any statutory laws and its amendments from time to time during erection in respect of the plant equipment ultimately to be owned by the Employer, shall be to the account of the Employer. Should any such inspection or registration need to be re-arranged due to the fault of the Contractor or his Sub-contractor, the additional fees to such inspection and/or registration shall be borne by the Contractor.
3.00.00	EMPLOYER'S LIEN ON EQUIPMENT
3.01.00	The Employer shall have lien on all equipment including those of the Contractor brought to the site for the purpose of erection, testing and commissioning of the plant. The Employer shall continue to hold the lien on all such equipment throughout the period of contract. No material brought to the site shall be removed from the site by the Contractor and/or his Sub-contractors without the prior written approval of the Project Manager.
4.00.00	INSPECTION, TESTING AND INSPECTION CERTIFICATES
4.01.00	The provisions of the clause entitled Inspection, Testing and Inspection Certificates under General Technical Requirements in Chapter-G1 shall also be applicable to the erection portion of the works. The Project Manager shall have the right to re-inspect any equipment though previously inspected and approved by him at the Contractor's

	works, before and after the same are erected at site. If by the above inspection, the Project Manager rejects any equipment, the Contractor shall make good for such rejections either by replacement or modification/ repairs as may be necessary to the satisfaction of the Project Manager. Such replacements will also include the replacements or re-execution of such of those works of other Contractors and/or agencies, which might have got damaged or affected by the replacements or re-work done to the Contractor's work.
5.00.00	ACCESS TO SITE AND WORKS ON SITE
5.01.00	Suitable access to and possession of the Site shall be afforded to the Contractor by the Employer in reasonable time.
5.02.00	The works so far as it is carried out on the Employer's premises, shall be carried out at such time as the Employer may approve and the Employer shall give the Contractor reasonable facilities for carrying out the works.
5.03.00	In the execution of the works, no person other than the Contractor or his duly appointed representative, Sub-contractor and workmen, shall be allowed to do work on the site, except by the special permission, in writing of the Project Manager or his representative.
6.00.00	CONTRACTOR'S SITE OFFICE ESTABLISHMENT
6.01.00	The Contractor shall establish a site office at the site and keep posted an authorised representative for the purpose of the Contract. Any written order or instruction of the Project Manager or his duly authorised representative, shall be communicated to the said authorised resident representative of the Contractor and the same shall be deemed to have been communicated to the Contractor at his legal address.
7.00.00	DISCIPLINE OF WORKMEN
7.01.00	The Contractor shall adhere to the disciplinary procedure set by the Project Manager in respect of his employees and workmen at site. The Project Manager shall be at liberty to object to the presence of any representative of employee of the Contractor at the site, if in the opinion of the Project Manager such employee has mis-conducted himself or is incompetent or negligent or otherwise undesirable and then the Contractor shall remove such a person objected to and provide in his place a competent replacement.
8.00.00	CONTRACTOR'S FIELD OPERATION
8.01.00	The Contractor shall keep the Project Manager informed in advance regarding his field activity plans and schedules for carrying out each part of the works. Any review of such plan or schedule or method of work by the Project Manager shall not relieve the Contractor of any of responsibilities towards the field activities. Such reviews shall also not be considered as an assumption of any risk or liability by the Project Manager or the Employer or any of his representatives and no claim of the Contractor will be entertained because of the failure or inefficiency of any such plan or schedule or method of work reviewed. The Contractor shall be solely responsible for the safe ty, adequacy and efficiency of plant and equipment and his erection methods.

8.02.00	The Contractor shall have the complete responsibility for the conditions of the work-site including the safety of all person employed by him or his Sub-contractor and all the properties under his custody during the performance of the work. This requirement shall apply continuously till the completion of the Contract and shall not be limited to normal working hours. The construction review by the Project Manager is not intended to include review of Contractor's safety measures in, or of near the work-site, and their adequacy or otherwise.
9.00.00	PHOTOGRAPHS AND PROGRESS REPORT
9.01.00	The Contractor shall furnish three (3) prints each to the Project Manager of progress photographs of the work done at site. Photographs shall be taken as and when indicated by the Project Manager or his representative. Photographs shall be adequate in size and number to indicate various stages of erection. Each photograph shall contain the date, the name of the Contractor and the title of the photograph.
9.02.00	The above photographs shall accompany the monthly progress report detailing out the progress achieved on all erection activities as compared to the schedules. The report shall also indicate the reasons for the variance between the scheduled and actual progress and the action proposed for corrective measures, wherever necessary.
10.00.00	MAN-POWER REPORT
10.01.00	The Contractor shall submit to the Project Manager, on the first day of every month, a man hour schedule for the month, detailing the man hours scheduled for the month, skill-wise and area-wise.
10.02.00	The Contractor shall also submit to the Project Manager on the first day of every month, a man power report of the previous month detailing the number of persons scheduled to have been employed and actually employed, skill-wise and the areas of employment of such labour.
11.00.00	PROTECTION OF WORK
11.01.00	The Contractor shall have total responsibility for protecting his works till it is finally taken over by the Project Manager. No claim will be entertained by the Employer or the Project Manager for any damage or loss to the Contractor's works and the Contractor shall be responsible for complete restoration of the damaged works to original conditions to comply with the specification and drawings. Should any such damage to the Contractor's Works occur because or other party not being under his supervision or control, the Contractor shall make his claim directly with the party concerned. If disagreement or conflict or dispute develops between the Contractor and the other party or parties concerned regarding the responsibility for damage to the Contractor's Works the same shall be resolved as per the provisions of the Clause 7.0 above entitled "Co-operation with other Contractors." The Contractor shall not cause any delay in the repair of such damaged Works because of any delay in the resolution of such disputes. The Contractor shall proceed to repair the Work immediately and no cause thereof will be assigned pending resolution of such disputes.
12.00.00	EMPLOYMENT OF LABOUR

12.01.00	The Contractor will be expected to employ on the work only his regular skilled employees with experience of his particular work. No female labour shall be employed after darkness. No person below the age of eighteen years shall be employed.
12.02.00	All travelling expenses including provisions of all necessary transport to and from site, lodging allowances and other payments to the Contractor's employees shall be the sole responsibility of the Contractor.
12.03.00	The hours of work on the Site shall be decided by the Employer and the Contractor shall adhere to it. Working hours will normally be eight (8) hours per day - Monday through Saturday.
12.04.00	Contractor's employees shall wear identification badges while on work at Site.
12.05.00	In case the Employer becomes liable to pay any wages or dues to the labour or any Government agency under any of the provisions of the Minimum Wages Act, Workmen Compensation Act, Contract Labour Regulation Abolition Act or any other law due to act of omission of the Contractor, the Employer may make such payments and shall recover the same from the Contractor's bills.
13.00.00	FACILITIES TO BE PROVIDED BY THE CONTRACTOR
13.01.00	Tools, tackles and scaffoldings The Contractor shall provide all the construction equipments, tools, tackles and scaffoldings required for pre-assembly, erection, testing and commissioning of the equipments covered under the contract. He shall submit a list of all such materials to the Project Manager before the commencement of pre-assembly at site. These tools and tackles shall not be removed from the site without the written permission of the Project Manager.
13.02.00	First-aid The Contractor shall provide necessary first-aid facilities for all his employees, representatives and workmen working at the site. Enough number of Contractor's personnel shall be trained in administering first-aid.
13.03.00	Cleanliness
13.03.01	The Contractor shall be responsible for keeping the entire area allotted to him clean and free from rubbish, debris etc. during the period of contract. The Contractor shall employ enough number of special personnel to thoroughly clean his work-area at least once in a day. All such rubbish and scrap material shall be stacked or disposed in a place to be identified by the Project Manager. Materials and stores shall be so arranged to permit easy cleaning of the area. In areas where equipment might drip oil and cause damage to the floor surface, a suitable protective cover of a flame resistant, oil proof sheet shall be provided to protect the floor from such damage.
13.03.02	Similarly the labour colony, the offices and the residential areas of the Contractor's employees and workmen shall be kept clean and neat to the entire satisfaction of the

	Project Manager. Proper sanitary arrangements shall be provided by the Contractor, in the work-areas, office and residential areas of the Contractor.
14.00.00	<p>LINES AND GRADES</p> <p>All the works shall be performed to the lines, grades and elevations indicated on the drawings. The Contractor shall be responsible to locate and lay-out the Works. Basic horizontal and vertical control points will be established and marked by the Project Manager at site at suitable points. These points shall be used as datum for the works under the contract. The Contractor shall inform the Project Manager well in advance of the times and places at which he wishes to do work in the area allotted to him so that suitable datum points may be established and checked by the Project Manager to enable the Contractor to proceed with his works. Any work done without being properly located may be removed and/or dismantled by the Project Manager at Contractor's expense.</p>
15.00.00	FIRE PROTECTION
15.01.00	The work procedures that are to be used during the erection shall be those which minimise fire hazards to the extent practicable. Combustible materials, combustible waste and rubbish shall be collected and removed from the Site at least once each day. Fuels, oils and volatile or flammable materials shall be stored away from the construction and equipment and materials storage areas in safe containers. Untreated canvas, paper, plastic or other flammable flexible materials shall not at all be used at Site for any other purpose unless otherwise specified. If any such materials are received with the equipment at the site, the same shall be removed and replaced with acceptable material before moving into the construction or storage area.
15.02.00	Similarly corrugated paper fabricated cartons etc. will not be permitted in the construction area either for storage or for handling of materials. All such materials used shall be of water-proof and flame resistant type. All the other materials such as working drawings, plans, etc. which are combustible but are essential for the works to be executed shall be protected against combustion resulting from welding sparks, cutting flames and other similar fire sources.
15.03.00	All the Contractor's supervisory personnel and sufficient number of workers shall be trained for fire-fighting and shall be assigned specific fire protection duties. Enough of such trained personnel must be available at the site during the entire period of the contract.
15.04.00	The Contractor shall provide enough fire protection equipment of the types and number for the warehouses, office, temporary structures, labour colony area, etc. Access to such fire protection equipment, shall be easy and kept open at all time.
16.00.00	<p>SECURITY</p> <p>The Contractor shall have total responsibility for all equipment and materials in his custody stores, loose, semi-assembled and/or erected by him at site. The Contractor shall make suitable security arrangements including employment of security personnel to ensure the protection of all materials, equipment and works from theft, fire, pilferage and any other damages and loss. All materials of the Contractor shall enter</p>

	and leave the project site only with the written permission of the Project Manager in the prescribed manner.
17.00.00	<p>CONTRACTOR'S AREA LIMITS</p> <p>The Project Manager will mark-out the boundary limits of access roads, parking spaces, storage and construction areas for the Contractor and the Contractor shall not trespass the areas not so marked out for him. The Contractor shall be responsible to ensure that none of his personnel move out of the areas marked out for his operations. In case of such a need for the Contractor's personnel to work out of the areas marked out for him the same shall be done only with the written permission of the Project Manager.</p>
18.00.00	<p>CONTRACTOR'S CO-OPERATION WITH THE EMPLOYER</p> <p>In case where the performance of the erection work by the Contractor affects the operation of the system facilities of the Employer, such erection work of the Contractor shall be scheduled to be performed only in the manner stipulated by the Project Manager and the same shall be acceptable at all times to the Contractor. The Project Manager may impose such restrictions on the facilities provided to the Contractor such as electricity, water, etc. as he may think fit in the interest of the Employer and the Contractor shall strictly adhere to such restrictions and co-operate with the Project Manager. It will be the responsibility of the Contractor to provide all necessary temporary instrumentation and other measuring devices required during start-up and operation of the equipment systems which are erected by him. The Contractor shall also be responsible for flushing and initial filling of all the oil and lubricants required for the equipment furnished and erected by him, so as to make such equipment ready for operation. The Contractor shall be responsible for supplying such flushing oil and other lubricants unless otherwise specified elsewhere in documents and specifications.</p>
19.00.00	<p>PRE-COMMISSIONING TRIALS AND INITIAL OPERATIONS</p> <p>The pre-commissioning trials and initial operations of the equipment furnished and erected by the Contractor shall be the responsibility of the Contractor as detailed in relevant clauses in Technical Specification. The Contractor shall provide, in addition, test instruments, calibrating devices, etc. and labour required for successful performance of these trials. If it is anticipated that the above test may prolong for a long time, the Contractor's workmen required for the above test shall always be present at Site during such trials.</p>
20.00.00	MATERIALS HANDLING AND STORAGE
20.01.00	All the equipment furnished under the Contract and arriving at site shall be promptly received, unloaded and transported and stored in the storage spaces by the Contractor.
20.02.00	Contractor shall be responsible for examining all the shipment and notify the Project Manager immediately of any damage, shortage, discrepancy etc. for the purpose of Project Manager's information only. The Contractor shall submit to the Project Manager every week a report detailing all the receipts during the week. However, the Contractor shall be solely responsible for any shortages or damage in transit, handling

	and/or in storage and erection of the equipment at site. Any demurrage, wharfage and other such charges claimed by the transporters, railways etc. shall be to the account of the Contractor.
20.03.00	The Contractor shall maintain an accurate and exhaustive record detailing out the list of all equipment received by him for the purpose of erection and keep such record open for the inspection of the Project Manager.
20.04.00	All equipment shall be handled very carefully to prevent any damage or loss. No bare wire ropes, slings, etc. shall be used for unloading and/or handling of the equipment without the specific written permission of the Project Manager. The equipment stored shall be properly protected to prevent damage either to the equipment or to the floor where they are stored. The equipment from the store shall be moved to the actual location at the appropriate time so as to avoid damage of such equipment at site.
20.05.00	All electrical panels, controls gear, motors and such other devices shall be properly dried by heating before they are installed and energised. Motor bearings, slip rings, commutators and other exposed parts shall be protected against moisture ingress and corrosion during storage and periodically inspected. Heavy rotating parts in assembled conditions shall be periodically rotated to prevent corrosion due to prolonged storage.
20.06.00	All the electrical equipment such as motors, generators, etc. shall be tested for insulation resistance at least once in three months from the date of receipt till the date of commissioning and a record of such measured insulation values maintained by the Contractor. Such records shall be open for inspection by the Project Manager.
20.07.00	The Contractor shall ensure that all the packing materials and protection devices used for the various equipments during transit and storage are removed before the equipment are installed.
20.08.00	The consumables and other supplies likely to deteriorate due to storage must be thoroughly protected and stored in a suitable manner to prevent damage or deterioration in quality by storage.
20.09.00	All the materials stored in the open or dusty location must be covered with suitable weather-proof and flameproof covering material wherever applicable.
20.10.00	If the materials belonging to the Contractor are stored in areas other than those earmarked for him, the Project Manager will have the right to get it moved to the area earmarked for the Contractor at the Contractor's cost.
20.11.00	The Contractor shall be responsible for making suitable indoor storage facilities to store all equipment which require indoor storage. Normally, all the electrical equipments such as motors, control gear, generators, exciters and consumables like electrodes, lubricants etc. shall be stored in the closed storage space . The Project Manager, in addition, may direct the Contractor to move certain other materials, which in his opinion will require indoor storage, to indoor storage areas which the Contractor shall strictly comply with.
21.00.00	CONSTRUCTION MANAGEMENT

21.01.00	The field activities of the various contractors executing different contracts for the project, will be coordinated by the Project Manager and the Project Manager's decision shall be final in resolving any disputes or conflicts between the Contractor and other Contractors and tradesmen of the Employer regarding scheduling and co-ordination of work. Such decision by the Project Manager shall not be a cause for extra compensation or extension of time for the Contractor.
21.02.00	The Project Manager shall hold weekly meetings of all the Contractors working at Site, at a time and place to be designated by the Project Manager. The Contractor shall attend such meetings and take notes of discussions during the meeting and the decisions of the Project Manager and shall strictly adhere to those decisions in performing his Works. In addition to the above weekly meeting, the Project Manager may call for other meeting either with individual contractors or with selected number of contractors and in such a case the Contractor if called, will also attend such meetings.
21.03.00	Time is the essence of the Contract and the Contractor shall be responsible for performance of his works in accordance with the specified construction schedule. If at any time, the Contractor is falling behind the schedule, he shall take necessary action to make good for such delays by increasing his work force or by working overtime or otherwise accelerate the progress of the work to comply with the schedule and shall communicate such actions in writing to the Project Manager, satisfying that his action will compensate for the delay. The Contractor shall not be allowed any extra compensation for such action.
21.04.00	The Project Manager shall however not be responsible for provision of additional labour and/or materials or supply or any other services to the Contractor except for the co-ordination work between various Contractors as set out earlier.
22.00.00	<p>FIELD OFFICE RECORDS</p> <p>The Contractor shall maintain at his site office up-to-date copies of all drawings, specifications and other contract documents and any other supplementary data complete with all the latest revisions thereto. The Contractor shall also maintain the continuous record of all changes to the above contract documents, drawings, specifications, supplementary data, etc. effected at the field. On completion of his total assignment under the contract, the Contractor shall incorporate all such changes on the drawings and other project engineering data to indicate 'as installed' conditions of the equipment furnished and erected under the contract. Such drawings and project engineering data shall be submitted to the Project Manager in required number of copies.</p>
23.00.00	CONTRACTOR'S MATERIALS BROUGHT ON TO SITE
23.01.00	The Contractor shall bring to site all equipment, components, parts, materials, including construction equipment, tools and tackles for the purpose of the works under intimation to the Project Manager. All such goods shall, from the time of their being brought vest in the Employer, but may be used for the purpose of the works only and shall not on any account be removed or taken away by the Contractor without the written permission of the Project Manager. The Contractor shall nevertheless be solely liable and responsible for any loss or destruction thereof and damage thereto.

23.02.00	The Employer shall have a lien on such goods for any sum or sums which may at any time be due or owing to him by the Contractor, under, in respect of or by reasons of the contract. After giving a fifteen (15) days notice in writing of his intention to do so, the Employer shall be at liberty to sell and dispose off any such goods, in such manner as he shall think fit including public auction or private treaty and to apply the proceeds in or towards the satisfaction of such sum or sums due as aforesaid.
23.03.00	After the completion of the works, the Contractor shall remove from the site under the direction of the Project Manager the materials such as construction equipment, erection tools and tackles, scaffolding etc. with the written permission of the Project Manager. If the Contractor fails to remove such materials, within fifteen (15) days of issue of a notice by the Project Manager to do so then the Project Manager shall have the liberty to dispose off such materials as detailed under clause 23.02.00 above and credit the proceeds thereto to the account of the Contractor.
24.00.00	PROTECTION OF PROPERTY AND CONTRACTOR'S LIABILITY
24.01.00	The Contractor shall be responsible for any damage resulting from his operations. He shall also be responsible for protection of all persons including members of public and employees of the Employer and the employees of other Contractors and Sub-Contractors and all public and private property including structures, building, other plants and equipments and utilities either above or below the ground.
24.02.00	The Contractor will ensure provision of necessary safety equipment such as barriers, sign-boards, warning lights and alarms, etc. to provide adequate protection to persons and property. The Contractor shall be responsible to give reasonable notice to the Project Manager and the Employers of public or private property and utilities when such property and utilities are likely to get damaged or injured during the performance or his Works and shall make all necessary arrangements with such Employers, related to removal and/or replacement or protection of such property and utilities.
25.00.00	PAINTING All exposed metal parts of the equipment including pipings, structures railings etc. wherever applicable, after installation unless otherwise surface protected, shall be first painted with at least one coat of suitable primer which matches the shop primer paint used, after thoroughly cleaning all such parts of all dirt, rust, scales, greases, oils and other foreign materials by wire brushing, scraping or sand blasting and the same being inspected and approved by the Project Manager for painting . Afterwards, the above parts shall be finished painted with two coats of allowed resin machinery enamel paints. The quality of the finish paint shall be as per the standards of ISI or equivalent and to be of the colour as approved by the Project Manager.
26.00.00	INSURANCE In addition to the conditions covered under the Clause entitled "Insurance" in Section GCC, Conditions of Contract, the following provisions will also apply to the portion of work to be done beyond the Contractor's own or his subcontractor's manufacturing works.

26.01.00	Workmen’s Compensation Insurance This insurance shall protect the Contractor against all claims applicable under the workmen’s Compensation Act, 1948 (Government of India). This policy shall also cover the Contractor against claims for injury, disability disease or death of his or his Sub-Contractor’s employees, which for any reason are not covered under the Workmen’s Compensation Act 1948. The liabilities shall not be less than: <table><tr><td>Workmen’s Compensation</td><td>As per Statutory Provisions</td></tr><tr><td>Employee’s liability</td><td>As per Statutory Provisions</td></tr></table>	Workmen’s Compensation	As per Statutory Provisions	Employee’s liability	As per Statutory Provisions					
Workmen’s Compensation	As per Statutory Provisions									
Employee’s liability	As per Statutory Provisions									
26.02.00	Comprehensive Automobile Insurance This insurance shall be in such a form to project the Contractor against all claims for injuries, disability, disease and death to members of public including the Employer’s men and damage to the property of other arising from the use of motor vehicles during on or off the Site operations, irrespective of the Employership of such vehicles the liability covered shall be as herein indicated <table><tr><td>Fatal Injury</td><td>:</td><td>Rs. 100,000/- each person</td></tr><tr><td></td><td>:</td><td>Rs. 200,000/- each occurrence</td></tr><tr><td>Property Damage</td><td>:</td><td>Rs. 100,000/- each occurrence</td></tr></table>	Fatal Injury	:	Rs. 100,000/- each person		:	Rs. 200,000/- each occurrence	Property Damage	:	Rs. 100,000/- each occurrence
Fatal Injury	:	Rs. 100,000/- each person								
	:	Rs. 200,000/- each occurrence								
Property Damage	:	Rs. 100,000/- each occurrence								
26.03.00	Comprehensive General Liability Insurance									
26.03.01	The insurance shall protect the Contractor against all claims arising from injuries, disabilities, disease or death of members of public or damage to property of others, due to any act or omission on the part of the Contractor, his agents, his employees, his representatives and Sub-Contractor, his agents, his employees, his representatives and Sub-Contractors or from riots, strikes and civil commotion. This insurance shall also cover all the liabilities of the Contractor arising out of the Clause entitled “Defence of Suits” in Section GCC, Conditions of Contract.									
26.03.02	The hazards to be covered will pertain to all the works and areas where the Contractor, his sub-contractors , his agents and his employees have to perform work pursuant to the Contract.									
26.03.03	The above are only illustrative list of Insurance covers normally required and it will be the responsibility of the Contractor to maintain all necessary insurance coverage to the extent both in time and amount to take care of all his liabilities either direct or indirect, in pursuance of the Contract.									
27.00.00	UNFAVOURABLE WORKING CONDITIONS The Contractor shall confine all his field operations to those works which can be performed without subjecting the equipment and materials to adverse effects during inclement weather conditions, like monsoon, storms, etc. and during other unfavourable construction conditions. No field activities shall be performed by the Contractor under conditions which might adversely affect the quality and efficiency									

	thereof, unless special precautions or measures are taken by the Contractor in a proper and satisfactory manner in the performance of such Works and with the concurrence of the Project Manager. Such unfavourable construction conditions will in no way relieve the Contractor of his responsibility to perform the Works as per the schedule.
28.00.00	<p>PROTECTION OF MONUMENTS AND REFERENCE POINTS</p> <p>The Contractor shall ensure that any finds such as relic, antiquity, coins, fossils, etc. which he may come across during the course of performance of his works either during excavation or elsewhere, are properly protected and handed over to the Project Manager. Similarly the Contractor shall ensure that the bench marks, reference points, etc., which are marked either with the help of Project Manager or by the Project Manager shall not be disturbed in any way during the performance of his works. If, any work is to be performed which disturb such reference, the same shall be done only after these are transferred to other suitable locations under the direction of the Project Manager. The Contractor shall provide all necessary materials and assistance for such relocation of reference points etc.</p>
29.00.00	<p>WORK & SAFETY REGULATIONS</p>
29.01.00	The Contractor shall ensure proper safety of all the workmen, materials plant and equipments belonging to him or to NTPC or to others, working at the Site. The Contractor shall also be responsible for provision of all safety notices and safety equipment required both by the relevant legislations and the Project Manager as he may deem necessary.
29.02.00	<p>The Contractor will notify well in advance to the Employer of his intention to bring to the Site any container filled with liquid or gaseous fuel or explosive or petroleum substance or such chemicals which may involve hazards. The Project Manager shall have the right to prescribe the conditions, under which such container is to be stored, handled and used during the performance of the works and the Contractor shall strictly adhere to and comply with such instructions. The Employer shall have the right at his sole discretion to inspect any such container or such construction plant/equipment for which material in the container is required to be used and if in his opinion, its use is not safe, he may forbid its use. No claim due to such prohibition shall be entertained by the Employer and the Employer shall not entertain any claim of the Contractor towards additional safety provisions/conditions to be provided for/constructed as per the Employer's instructions.</p> <p>Further, any such decision of the Employer shall not, in any way, absolve the Contractor of his responsibilities and in case, use of such a container or entry thereof into the Site area is forbidden by the Employer, the Contractor shall use alternative methods with the approval of the Employer without any cost implication to NTPC or extension of work schedule.</p>
29.03.00	Where it is necessary to provide and/or store petroleum products or petroleum mixtures and explosives, the Contractor shall be responsible for carrying-out such provision and/or storage in accordance with the rules and regulations laid down in Petroleum Act 1934, Explosives Act, 1948, and Petroleum and Carbide of Calcium Manual published by the Chief Inspector of Explosives of India. All such storage shall

	have prior approval of the Project Manager. In case, any approvals are necessary from the Chief Inspector (Explosives) or any statutory authorities, the Contractor shall be responsible for obtaining the same.
29.04.00	All equipment used in construction and erection by Contractor shall meet Indian/International Standards and where such standards do not exist, the Contractor shall ensure these to be absolutely safe. All equipments shall be strictly operated and maintained by the Contractor in accordance with manufacturer's operation Manual and safety instructions and as per Guidelines/Rules of NTPC in this regard.
29.05.00	Periodical Examinations and all tests for all lifting/ hoisting equipment & tackles shall be carried-out in accordance with the relevant provisions of Factories Act 1948, Indian Electricity Act 1910 and associated Laws/Rules in force from time to time. A register of such examinations and tests shall be properly maintained by the Contractor and will be promptly produced as and when desired by Project Manager or by the person authorised by him.
29.06.00	The Contractor shall be fully responsible for the safe storage of his and his Sub-Contractor's radioactive sources in accordance with BARC/DAE Rules and other applicable provisions. All precautionary measures stipulated by BARC/DAE in connection with use, storage and handling of such material will be taken by Contractor.
29.07.00	The Contractor shall provide suitable safety equipment of prescribed standard to all employees and workmen according to the need, as may be directed by Project Manager who will also have right to examine these safety equipments to determine their suitability, reliability, acceptability and adaptability.
29.08.00	Where explosives are to be used, the same shall be used under the direct control and supervision of an expert, experienced, qualified and competent person strictly in accordance with the Code of Practices/Rules framed under Indian Explosives Act pertaining to handling, storage and use of explosives.
29.09.00	The Contractor shall provide safe working conditions to all workmen and employees at the Site including safe means of access, railings, stairs, ladders, scaffoldings etc. The scaffoldings shall be erected under the control and supervision of an experienced and competent person. For erection, good and standard quality of material only shall be used by the Contractor.
29.10.00	The Contractor shall not interfere or disturb electric fuses, wiring and other electrical equipment belonging to the Employer or other contractors under any circumstances, whatsoever, unless expressly permitted in writing by NTPC to handle such fuses, wiring or electrical equipment.
29.11.00	Before the Contractor connects any electrical appliances to any plug or socket belonging to the other Contractor or Employer, he shall: <ul style="list-style-type: none"> a) satisfy the Employer that the appliance is in good working condition: b) inform the Employer of the maximum current rating, voltage and phases of the appliances;

	c)	obtain permission of the Employer detailing the sockets to which the appliances may be connected.
29.12.00		The Project Manager will not grant permission to connect until he is satisfied that;
	a)	The appliance is in good condition and is fitted with suitable plug;
	b)	The appliance is fitted with a suitable cable having two earth conductors, one of which shall be an earthed metal sheath surrounding the cores.
29.13.00		No electric cable in use by the Contractor/Employer will be disturbed without prior permission. No weight of any description will be imposed on any cable and no ladder or similar equipment will rest against or attached to it.
29.14.00		No repair work shall be carried out on any live equipment. The equipment must be declared safe by the Employer and a permit to work shall be issued by the Employer before any repair work is carried out by the Contractor. While working on electric lines/equipments whether live or dead, suitable type and sufficient quantity of tools will have to be provided by Contractor to electricians/workmen/ officers.
29.15.00		The Contractors shall employ necessary number of qualified, full time Electricians/ Electrical Supervisors to maintain his temporary electrical installations.
29.16.00		<p>The Contractor employing more than 250 workmen whether temporary, casual, probationer, regular or permanent or on contract, shall employ atleast one full time officer exclusively as Safety Officer to supervise safety aspects of the equipments and workmen, who will co- ordinate with the Project Safety Officer. In case of work being carried out through sub-contractors, the Sub- contractor's workmen/employees will also be considered as the Contractor's employees/workmen for the above purpose.</p> <p>The name and address of such Safety Officer of Contractor will be promptly informed in writing to Employer with a copy to Safety Officer-Incharge before he starts work or immediately after any change of the incumbent is made during currency of the contract.</p>
29.17.00		The contractor shall comply with all the requirements of " <i>The Building and Other Construction Workers (Regulation of Employment & Conditions of Service) Act,</i> " 1996 and its Central Rule 1998 / State Rules and any other statutory requirements as applicable.
29.18.00		<p>The contractor shall ensure that any area exposed to risk of falling materials, articles or objects is roped off or cordoned off or otherwise suitably guarded from inadvertent entry of any person .</p> <p>Wherever there is a possibility of falling of any material, equipment or construction workers while working at heights, a suitable and adequate safety net should be provided. The safety net should be in accordance with BIS Standards.</p>
29.19.00		Every opening at elevation from ground level through which a building worker, vehicle, material equipment etc. may fall at a construction work shall be covered and/or guarded suitably by the contractor to prevent such falls.

29.20.00	Wherever the workers are exposed to the hazards of falling from height, the contractor shall provide full harness safety belts fitted with fall arresting systems to all the employees working at higher elevations and life line of 8 mm diameter wire rope with turn buckles for anchoring the safety belts while working or moving at higher elevations. Safety nets shall also be provided for saving them from fall from heights and such equipment should be in accordance with BIS standards.
29.21.00	The contractor shall provide standard prefabricated ladders on the columns where the workers are required to use them as an access for higher elevations till permanent staircase is provided. The workers shall be provided with safety belts fitted with suitable fall arresting system (Fall arrestors) for climbing/getting down through ladders to prevent fall from height.
29.22.00	In case any accident occurs during the construction/ erection or other associated activities undertaken by the Contractor thereby causing any minor or major or fatal injury to his employees due to any reason, whatsoever, it shall be the responsibility of the Contractor to promptly inform the same to the Employer in prescribed form and also to all the authorities envisaged under the applicable laws.
29.23.00	The Employer shall have the right at his sole discretion to stop the work, if in his opinion the work is being carried out in such a way that it may cause accidents and endanger the safety of the persons and/or property, and/or equipments. In such cases, the Contractor shall be informed in writing about the nature of hazards and possible injury/accident and he shall comply to remove short comings promptly. The Contractor after stopping the specific work can, if felt necessary appeal against the order of stoppage of work to the Employer within 3 days of such stoppage of work and decision of the Employer in this respect shall be conclusive and binding on the Contractor.
29.24.00	The Contractor shall not be entitled for any damages/ compensation for stoppage of work due to safety reasons as provided in para 29.18 above and the period of such stoppage of work will not be taken as an extension of time for completion of work and will not be the ground for waiver of levy of liquidated damages.
29.25.00	The Contractor shall follow and comply with all NTPC Safety Rules, relevant provisions of applicable laws pertaining to the safety of workmen, employees plant and equipment as may be prescribed from time to time without any demur, protest or contest or reservation. In case of any inconformity between statutory requirement and NTPC Safety Rules referred above, the later shall be binding on the Contractor unless the statutory provisions are more stringent.
29.26.00	If the Contractor fails in providing safe working environment as per NTPC Safety Rules or continues the work even after being instructed to stop work by the Project Manager as provided in para 29.18.00 above, the Contractor shall promptly pay to NTPC, on demand by the Employer compensation at the rate of Rs. 5,000/- per day or part thereof till the instructions are complied with and so certified by the Project Manager. However, in case of accident taking place causing injury, to any individual, the provisions contained in para 29.22.00 shall also apply in addition to compensation mentioned in this para.

29.27.00	<p>If the Contractor does not take all safety precautions and/or fails to comply with the Safety Rules as prescribed by NTPC or under the applicable law for the safety of the equipment and plant and for the safety of personnel and the Contractor does not prevent hazardous conditions which cause injury to his own employees or employees of other contractors, or NTPC employees or any other person who are at Site or adjacent thereto, the Contractor shall be responsible for payment of compensation to NTPC as per the following schedule :-</p>		
a)	Fatal injury or accident causing death	Rs. 1,00,000/- per person	: These are : applicable : for death/
b)	Major injuries or accident causing 25% or more permanent disablement to workmen or employees	Rs. 20,000/- per person	: injury to : any : person : whosoever.
	<p>Permanent disablement shall have same meaning as indicated in Workmen's Compensation Act. The compensation mentioned above shall be in addition to the compensation payable to the workmen/employees under the relevant provisions of the Workmen's Compensation Act and rules framed thereunder or any other applicable laws as applicable from time to time. In case the Employer is made to pay such Compensation then the Contractor is liable to reimburse the Employer such amount in addition to the compensation indicated above.</p>		
29.28.00	<p>If the Contractor observes all the Safety Rules and Codes, Statutory Laws and Rules during the currency of Contract awarded by the Employer and no accident occurs then NTPC may consider the performance of the Contractor and award suitable "ACCIDENT FREE SAFETY MERITORIOUS AWARD" as per scheme as may be announced separately from time to time.</p>		
30.00.00	FOREIGN PERSONNEL		
30.01.00	<p>The Contractor shall submit to the Employer data on all personnel he proposes to bring into India for the performance of the Works under the Contract, at least sixty (60) days prior to their departure to India. Such data will include for each person the name, his present address, his assignment and responsibility in connection with the works, and a short resume of his qualification, experience, etc. in relation to the work to be performed by him.</p>		
30.02.00	<p>Any person unsuitable and unacceptable to the Employer shall not be brought to India. Any person brought to India, if found unsuitable or unacceptable by the Employer, the Contractor shall within a reasonable time make alternate arrangements for providing a suitable replacement and repatriation of such unsuitable personnel.</p>		
30.03.00	<p>No person brought to India for the purposes of the works shall be repatriated without the consent of the Employer in writing, based on a written request from the Contractor for such repatriation giving reasons for such an action to the Project Manager. The Employer may give permission for such repatriation provided he is satisfied that the progress of work will not suffer due to such repatriation.</p>		
30.04.00	<p>The cost of passports, visas and all other travel expenses to and from India, incurred by</p>		

	the Contractor shall be to his account. The Employer will not provide any residential accommodation and/or furniture for any of the Contractor's personnel including foreign personnel and Contractor shall make his own arrangements for such facilities in the area allotted at Site, to him by the Employer for that purpose.
30.05.00	The Contractor and his expatriate personnel shall respect all Indian Acts, Laws, rules and regulations and shall not in any way interfere with Indian political and religious affairs and shall conform to any other rules and regulations which the Government of India, the Employer and the Project Manager may establish from time to time, on them. The Contractor's expatriate personnel shall work and live in close co-operation and coordination with their co-workers and the community and shall not engage themselves in any other employment neither part-time or full-time nor shall they take part in any local politics.
30.06.00	The Employer shall assist the Contractor, to the extent possible, in obtaining necessary permits to travel to India and back, by issue of necessary certificates and other information needed by the Government agencies.
31.00.00	CODE REQUIREMENTS The erection requirements and procedures to be followed during the installation of the equipment shall be in accordance with the relevant Indian Boiler Regulations, ASME codes and accepted good project manageering practice, the Project Manager's drawings and other applicable Indian recognised codes and laws and regulations of the Government of India.
32.00.00	FOUNDATION DRESSING & GROUTING
32.01.00	The surfaces of foundations shall be dressed to bring the top surface of the foundations to the required level, prior to erection of equipment/equipment bases.
32.02.00	All the equipment bases and structural steel base plates, shall be grouted and finished as per these specifications unless otherwise recommended by the equipment manufacturer.
32.03.00	The concrete foundation surfaces shall be properly prepared by chipping, grinding as required to bring the type of such foundation to the required level, to provide the necessary roughness for bondage and to assure enough bearing strength. All laitance and surface film shall be removed and cleaned.
32.04.00	Grouting Mix The Grouting mixture shall be composed of portland cement, sand and water. The portland cement to be used shall conform to ISI No. 269 or equivalent sand shall conform to ISI No. 383/2386 or equivalent. The grout proportions for flat bases where the grouting space does not exceed 35 mm shall be 50 kg bag of cement to 75 kg of sand. Only the required quantity of water shall be added so as to make the mix quaky and flowable and the mix shall not show excess water on top when it is being puddled in place. For thicker grout beds upto 65 mm, the amount of sand shall be increased to 105 Kg per bag of cement. Bases which are hollow and are to be filled full of grouting shall be filled to a level of 25 mm above the outside rim with a mortar mix in the

	<p>volumetric proportions of one part of cement and 1.5 part sand and 1.5 part 6 mm granite gravel. An acceptable plasticiser may be added to the grout mixes in a proportion recommended by the plasticisers manufacturer. All such grouts shall be thoroughly, mixed for not less than five minutes in an approved mechanical mixer and shall be used immediately after mixing.</p>
32.05.00	Placing of Grout
32.05.01	<p>After the base has been prepared, its alignment and level has been checked/approved and before actually placing the grout, a low dam shall be set around the base at a distance that will permit pouring and manipulation of the grout. The height of such dam shall be at least 25mm above the bottom of the base. Suitable size and number of chains shall be introduced under the base before placing the grout, so that such chains can be moved back and forth to push the grout into every part of the space under the base.</p>
32.05.02	<p>The grout shall be poured either through grout holes it provided or shall be poured at one side or at two adjacent sides giving it a pressure head to make the grout move in a solid mass under the base and out in the opposite side. Pouring shall be continued until the entire space below the base is thoroughly filled and the grout stands at least 25 mm higher all around than the bottom of the base. Enough care should be taken to avoid any air or water pockets beneath the bases.</p>
32.06.00	Finishing of the Edges of the Grout
	<p>The poured grout should be allowed to stand undisturbed until it is well set. Immediately thereafter, the dam shall be removed and grout which extends beyond the edges of the structural or equipment base plates shall be cut off, flushed and removed. The edges of the grout shall then be pointed and finished with 1:2 cement mortar pressed firmly to bond with the body of the grout and smoothed with a tool to present a smooth vertical surface. The work shall be done in a clean and scientific manner and the adjacent floor spaces, exposed edges of the foundations, and structural steel and equipment base plates shall be thoroughly cleaned of any spillage of the grout.</p>
32.07.00	Checking of Equipment After Grouting
	<p>After the grout is set and cured, the Contractor shall check and verify the alignment of equipments, alignment of shafts of rotating machinery, the slopes of all bearing pedestals, centering of rotors with respect to their sealing bores, couplings, etc. as applicable and the like items to ensure that no displacement had taken place during grouting. The values recorded prior to grouting shall be used during such post grouting check- up and verifications. Such pre and post grout records of alignment details shall be maintained by the Contractor in a manner acceptable to the Project Manager.</p>
33.00.00	SHAFT ALIGNMENTS
	<p>All the shafts of rotating equipment shall be properly aligned to those of the matching equipments to as perfect an accuracy as practicable. The equipment shall be free from excessive vibration so as to avoid overheating of bearings or other conditions which may tend to shorten the life of the equipment. All bearings, shafts and other rotating parts shall be thoroughly cleaned and suitably lubricated before starting.</p>

34.00.00	<p>DOWELLING</p> <p>All the motors and other equipment shall be suitable dowelled after alignment of shafts with tapered machined dowels as per the direction of the Project Manager.</p>
35.00.00	<p>CHECK OUT OF CONTROL SYSTEMS</p> <p>After completion of wiring,cabling furnished under separate specification and laid and terminated by the Employer, the Contractor shall check out the operation of all control systems for the equipment furnished and installed under these specifications and documents.</p>
36.00.00	<p>COMMISSIONING SPARES</p>
36.01.00	<p>It will be the responsibility of the Contractor to provide all commissioning spares including consumable spares like indicating lights/lamps, diodes, fuses recorder charts,ink pads/pens etc. required for initial operation till the equipment is declared by the Employer as having satisfactorily completed the Trial Operation. The Contractor shall have full responsibilities to supply all commissioning spares so that initial operation do not suffer for want of commissioning spares. All commissioning spares shall be deemed to be included in the scope of the Contract and the cost of the same shall be included in the bid price.</p>
36.02.00	<p>These spare will be received and stored by the Contractor atleast 3 months prior to the schedule date of commencement of trial operation of the respective equipment and utilised as and when required.</p>
37.00.00	<p>CABLING</p>
37.01.00	<p>All cables shall be supported by conduits or cable tray run in air or in cable channels. These shall be installed in exposed runs parallel or perpendicular to dominant surfaces with right angle turn made of symmertical bends for fittings. When cables are run on cable trays, they shall be clamped at a minimum intervals of 2000mm or otherwise as directed by the Project Manager.</p>
37.02.00	<p>Each cable, whether power or control, shall be porvided with a metallic or plastic tag of an approved type, bearing a cable reference number indicated in the cable and conduit list (prepared by the Contractor), at every 5 meter run or part thereof and at both ends of the cable adjacent to the terminations. Cable routing is to be done in such a way that cables are accessible for any maintenance and for easy identification.</p>
37.03.00	<p>Sharp bending and kinking of cables shall be avoided. The minimum radii for PVC insulated cables 1100 V grade shall be 15 D where D is the overall diameter of the cable. Installation of other cables like high voltage, coaxial, screened, compensating, mineral insulated shall be in accordance with the cable manufacturer's recommendations. Wherever cables cross roads and water, oil, sewage or gaslines, special care should be taken for the protection of the cables in designing the cable channels.</p>
37.04.00	<p>In each cable run some extra length shall be kept at a suitable point to enable one or</p>

	two straight through joints to be made, should the cable develop fault at a later date.
36.05.00	Control cable terminations shall be made in accordance with wiring diagrams, using identifying codes subject to Project Manager's approval. Multicore control cable jackets shall be removed as required to train and terminate the conductors. The cable jacket shall be left on the cable, as far as possible, to the point of the first conductor branch. The insulated conductors from which the jacket is removed shall be neatly twined in bundles and terminated. The bundles shall be firmly but not tightly tied utilising plastic or nylon ties or specifically treated fungus protected cord made for this purpose. Control cable conductor insulation shall be securely and evenly out.
37.06.00	The connectors for control cables shall be covered with a transparent insulating sleeve so as to prevent accidental contact with ground or adjacent terminals and shall preferably terminate in Elmex terminals and washers. The insulating sleeve shall be fire resistant and shall be long enough to over pass the conductor insulation. All control cables shall be fanned out and connection made to terminal blocks and test equipment for proper operation before cables are corded together.