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ETC OF 220kV DC Transmission Line, Interconnecting cabling system of 400kV & 220kV Switchyards & associated works at Rayalseema Thermal Power Plant Stage-IV, Unit-6 (1x600MW)

SECTION-1 : SCOPE, SPECIFIC TECHNICAL REQUIREMENTS & QUANTITIES	
Project	400/220 KV SWITCHYARD- 1X600 MW RTPP UNIT#6 (STAGE-IV)
Customer	APGENCO

SCOPE & GENERAL NOTES:

A	<p>The scope in brief is as follows :</p> <ol style="list-style-type: none"> Storage, unloading, erection, testing & commissioning of 220kV D/C (Double Circuit) line consisting one Twin Moose circuit & one Single Moose circuit from 220kV Switchyard to 400kV Switchyard inside Plant boundary of Rayalseema Thermal Power Plant Stage-IV. Unit-6 (1x600MW) complete in all respects. The approximate distance between two substions is 700 m (approx.). i.e. total route length of the double circuit line to be constructed by the bidder. Supply of Transmission Line tower accessories, conductor accessories, earth wire accessories, earthing materials, earth wire etc. ETC of cable trench material & cabling including earthing between 400kV & 220kV Switchyards through trench, overhead cable trestle (for road crossings) & laying on trays mounted on RCC pedestals.
B	The quantities mentioned in the BOQ are tentative and may vary to any extent for individual items.
	Any material/services required for successful completion of the project but not covered in the BOQ shall be deemed to be included in the scope of contractor without any cost implications to BHEL. <u>The bidder is advised to visit Rayalseema site before submission of bid.</u>
C	Make of items to be supplied/used under this contract shall be subject to acceptance by customer/BHEL at contract stage.
D	Unloading & Storage of all items is in the scope of bidder.
E	Handling, shifting to & from stores at Rayalseema TPP proper storage are also included in the scope of the bidder.
F	Bidder may note that any damage of material at site during erection work shall be avoided. Further, owner (APGENCO/BHEL) shall not pay any compensation for any loss or damage to the properties during work of execution of transmission line job or for tree cutting due to bidder's work.

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TOWER LINE ERECTION AND STRINGING

1. LIST OF STANDARDS (LATEST EDITION OF STANDARDS SHALL BE FOLLOWED)

Unless specified otherwise analysis & design of various components and systems of transmission line shall be in accordance with latest editions, latest amendments, of the relevant Indian & other international standards.(except for those references where the year of publication is specifically mentioned)

	<u>Indian Standards</u>	<u>Title</u>	<u>International & Internationally recognized standards</u>
1.	IS:209	Specification for Zinc	ISO/R/752-1968 AST, B6
2.	IS:2062	Structural Steel (Standard Quality)	ISO/R/6F30-1967 CAN/CSA G40. 21 BS 4360
3.	IS:269	Ordinary rapid hardening & low heat Portland Cement.	ISO/R/597-1967
4.	IS:278	Specification for barbed wire	ASTM A 121
5.	IS:383	Coarse and fine aggregates from natural sources for concrete.	CSA A 23.1/A 23.2
6.	IS:398	Alum. Condr. galvanised steel reinforced	
7.	IS:406	Methods of Chemical Analysis of Slab Zinc	
8.	IS:432 (Part 1 & 2)	Mild steel and medium tensile bars and hard drawn steel wire for concrete reinforcement	CSA-G-30
9.	IS:456-1978	Code of practice for plan and reinforced concrete	
10.	IS:731-1971	Porcelain Insulators for Overhead lines with a Nominal Voltage greater than 1000 volts	BS:137-1973 (I & II) Power IEC:274-1968 IEC:383-1976
11.	IS:800-1984	Code of practice for use of structural in general Building construction	CSA STEAM 16.1 steel
12.	IS:802	Code of practice for use of structural steel in overhead transmission Line. (Load, Permissible stresses. Fabrication, Galvanising, Inspection, and Packing and Testing)	IEC 826 ASCE 52 BS 8100
13.	IS:1139-1966	Hot rolled mild steel medium tensile steel and high yield strength deformed Bars for concrete reinforcement	CAN / CSA G 30 18
14.	IS:1367-1967	Technical supply conditions for threaded fasteners	

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15	IS:1489-1991	Portland Pozzolena Cement	ISO/863-1968
16.	IS:1521-1972	Method of Tensile Testing of Steel wire	
17.	IS:1573-1976	Electroplated Coating of Zinc on Iron & Steel	
18.	IS:1778-1980	Reels and Drums of Barewire	
19.	IS:1786-1985	High strength deformed steel bars and wires for concrete reinforcement	
20	IS:1893-1984	Criteria of Earthquake resistant design of structures.	IEEE 693
21.	IS:2016-1967	Plain Washers	ANSI B 18.22.1 ISO/R/887-1968
22.	IS:2070-1962	Method of impulse voltage testing	
23.	IS:2071	Method of high voltage testing	
24.	IS:2121-1981 Part-I Part-II	Specification for conductors and earthwire Accessories for Overhead Power Lines Armour Rods Mid-span joints & repair sleeves for conductors	
25.	IS:2131-1967	Method of Standard penetration test for soils.	ASTM D 1883
26.	IS:2551-1982	Danger Notice Plates	
27.	IS:2486	Specification for Insulator Fittings for overhead Power Lines with a nominal voltage greater than 1000 volts Part-I General Requirements and Tests Part-II Dimensional Requirements Part-III Locking Devices	BS:3288-1972 IEC:120-1960 IEC:372-1976
28.	IS:2629-1985	Recommended practice for hot dip galvanising of iron & steel.	ASTM A 123 CAN/CSA G 164
29.	IS:2633-1986	Method of testing uniformity of coating of zinc coated articles.	ASTM A 123 CAN/CSA G 164
30.	IS:3043-1987	Code of Practice for earthing (with amendment No. 1 & 2).	
31.	IS:3063-1994	Single Coil Rectangular Section spring washers for bolts, nuts, screws.	DIN -127-1970
32.	IS:3138-1966	Hexagonal bolts and nuts	ISO/R 947 and ISO/R 272
33.	IS:3188-1980	Characteristics of string insulator units	IEC:305-1906
34.	IS:4091-1979	Code of practice for design and construction of foundation for transmission line tower and poles.	ASCE / IEEE 691
35.	IS:4218-1976	Metric Screw Threads.	ISO:68-1969 R-26-1963, R-262-1969 R-965-1965

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36.	IS:4826-1979	Galvanised coatings on round steel wire	BS:443-1969
37.	IS:5300-1980	Porcelain Guy strain insulators	
38.	IS:5358-1969	Hot dip galvanised coatings on fasteners	ASTM A 153 CAN/CSA G 164
39.	IS:5613 (Part-II) 1985	Code of practice for Design, installation & maintenance of overhead power lines	
40.	IS:6610-1972	Specification for heavy washers for steel structures.	
41.	IS:6639 -1972	Hexagonal bolts for structure	ASTM A 394 CSA B 33.4
42.	IS:6745-1972	Methods for determination of weight of Zinc coated iron and steel articles	ASTM A 90
43.	Pub. No. 19 (N)/ 700-1963	Regulation for Electrical Crossing of Railway Tracks.	
44.	IS:7814-1985	Phosphor bronze sheet, strip and foil	BS:2870-1968
45.	IS:8263-1976	Method of Radio Interference tests on high voltage insulators	NEEMA:107 – 1964 CISPR/IEC:437-1973
46.	IS:8269-1976	Method of switching impulse test on high voltage insulators	IEC:506-1975
47.	IS:8500-1991	Specification for weld-able structural steel (Medium and High strength qualities).	BS : 4360
48.	IS:9708-1993	Specifications for Stockbridge Vibration Dampers for overhead power lines	
49.		Thermal mechanical performance test and mechanical performance test on String insulator units	IEC: 575-1974

2. GENERAL REQUIREMENTS

- a) The details of the scope of erection work shall include the cost of labour, all tools and plants like tension stringing equipment and all other incidental expenses in connection with erection and stringing work.
- b) The Contractor shall be responsible for transportation of all the materials to be provided by the Contractor as per the scope of work to site, proper storage and preservation at their own cost till such time the erected line is taken over by the Owner.

3. TREATMENT OF MINOR GALVANISING DAMAGE

In case any minor damage to galvanising is noticed, the same shall be treated with zinc rich paint (having at least 90% zinc content) before erection.

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4. ASSEMBLY

I) The method followed for the erection of towers, shall ensure the points mentioned below :

- a) Straining of the members shall not be permitted for bringing them into position. It may, however, be necessary to match hole positions at joints and to facilitate this, tommy bars not more than 450 mm long may be used.
- b) Before starting erection of an upper section, the lower section shall be completely braced and all bolts provided and tightened adequately in accordance with approved drawings to prevent any mishap during tower erection.
- c) All plan diagonals relevant to a section of tower shall be placed in position before assembly of upper section is taken up.
- d) The bolt position in assembled towers shall be as per IS: 5613 (Part-II/Section 2).
- e) Tower shall be fitted with number plate, danger plate, phase plate and anti-climbing device as described.
- f) All bank holes, if any left, after complete erection of the tower, are to be filled up by bolts and nuts of correct size.

II) Tightening and Punching of Bolts and Nuts

- a) All nuts shall be tightened properly using correct size spanner/torque wrench. Before tightening, it shall be ensured that filler washers and plates are placed in gaps between members wherever applicable, bolts of proper size and length are inserted, and one spring washer is inserted under each nut. In case of step bolts, spring washers shall be placed under the outer nut. The tightening shall progressively be carried out from the top downwards, care being taken that all bolts at every level are tightened simultaneously. The threads of bolts projecting outside the nuts shall be punched at their position on the diameter to ensure that the nuts are not loosened in course of time. If during tightening a nut is found to be slipping or running over the bolt threads, the bolt together with the nut shall be replaced.
- b) The threads of all the bolts projected outside the nuts shall be welded at two diametrically opposite places. The welding shall be provided from ground level to waist level for single circuit towers and to bottom cross arm level for double circuit towers. After welding, cold galvanised paint having at least 90% Zinc content shall be applied to the welded portion. At least two coats of the paint shall be applied. The cost of welding and paint including application of paint shall be deemed to be included in the erection price.
- c) In addition to the tack welding of nuts with bolts, as described above, the Contractor can also propose some alternative arrangements, like use of epoxy resin adhesive which can serve the purpose of locking the nut permanently with the bolt and thus preventing pilferage of the tower members.

5. INSULATOR HOISTING

- a) I-Suspension insulator strings shall be used on suspension towers and tension insulator strings on angle and dead end towers. These shall be fixed on all the towers just prior to the stringing. Damaged insulators and fittings, if any, shall not be employed in the assemblies. Before hoisting, all

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insulators shall be cleaned in a manner that will not spoil, injure or scratch the surface of the insulator, but in no case shall any oil be used for the purpose. Corona control rings/arching horn shall be fitted in an approved manner. The yoke arrangements be horizontal for tensions strings. Torque wrench shall be used for fixing different line materials and their components, like suspension clamp for conductor and earthwire, etc., whenever recommended by the manufacturer of the same of river crossing towers.

6. HANDLING OF CONDUCTOR AND EARTHWIRE

- a) The Contractor shall be entirely responsible for any damage to the towers or conductors during stringing. While running out the conductors, care shall be taken that the conductors do not touch or rub against the ground or objects which could cause scratches or damages to the strands. The conductors shall be run out of the drums from the top in order to avoid damage due to chafing. Immediately after running out, the conductor shall be raised at the supports to the levels of the clamps and placed into the running blocks. The groove of the running blocks shall be of such a design that the seat is semi-circular and larger than the diameter of the conductor earthwire and it does not slip over or rub against the sides. The grooves shall be lined with hard rubber or neoprene to avoid damage to conductor and shall be mounted on properly lubricated bearings.
- b) The running blocks shall be suspended in a manner to suit the design of the cross arm. All running blocks, especially those at the tension end, will be fitted on the cross-arm with jute cloth wrapped over the steel work and under the slings to avoid damage to the slings as well as to the protective surface finish of the steel work. In case suspension or section towers are used even for temporary terminations, if this be unavoidable, they shall be well guyed and steps shall be taken by the Contractor to avoid damage. The drums shall be provided with a suitable braking device to avoid damages, loose running out and kinking of the conductor. The conductor shall be continuously observed for loose or broken strands or any other damage. When approaching end of a drum length, at least three coils shall be left when the stringing operations are to be stopped. These coils are to be removed carefully, and if another length is required to be run out, a joint shall be made as per the recommendations of the manufacturers.
- c) Repairs to conductors, if necessary, shall be carried out during the running out operations, with repair sleeves. Repairing of conductor surface shall be done only in case of minor damage, scuff marks etc. keeping in view both electrical and mechanical safe requirements. The final conductor surface shall be clean smooth and without any projections, sharp points, cuts, abrasions etc.
- d) Conductor splices shall be so made that they do not crack or get damaged in the stringing operation. The contractor shall use only such equipment/methods during conductor stringing which ensures complete compliance in this regard.
- e) Derricks shall be used where roads, rivers, channels, telecommunication or overhead power lines, railway lines, fences or walls have to be crossed during stringing operations. It shall be seen that normal services are not interrupted or damage caused to property. Shut down shall be obtained when working at crossing of overhead power lines. The Contractor shall be entirely responsible for the proper handling of the conductor, earth-wire and accessories in the field.

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- f) The sequence of running out shall be from top to downwards i.e. the earthwire shall be run out first, followed by the conductors in succession. Unbalances of loads on towers shall be avoided as far as possible.

7. STRINGING OF CONDUCTOR AND EARTHWIRE

- I) The stringing of the conductor shall be done by standard stringing method.
- II) After being pulled the conductor/ earthwire shall not be allowed to hang in the stringing blocks for more than 96 hours before being pulled to the specified sag.
- III) Conductor creep is to be compensated by over tensioning the conductor at appropriate temperature for which calculations are to be submitted by the contractor for Owner's approval.

IV) Jointing

- a) All the joints on the conductor and earthwire shall be of compression type, in accordance with the recommendations of the manufacturer for which all necessary tools and equipment like compressors, dies, processes etc. shall have to be arranged by the Contractor. Each part of the joint shall be cleaned by wire brush to make it free of rust or dirt etc. and properly greased with anti-corrosive compound if required, and as recommended by the contractor before the final compression is done with the compressors.
- b) All joints or splices shall be made at least 30 meters away from the structures. No joints or splices shall be made in spans crossing over main road, railways, small rivers with tension spans. During compression or splicing operation the conductor shall be handled in such a manner as to prevent lateral or vertical bearing against the dies. After pressing the joint the aluminium sleeve shall have all corners rounded, burrs and sharp edges removed and smoothed.
- c) During stringing of conductor to avoid any damage to the joint, the Contractor shall use a suitable protector with mid span compression joints in case joints are to be passed over pulley blocks/aerial rollers. The size of the groove of the pulley shall be such that the joint along with protection can be passed over it smoothly

8. SAGGING-IN-OPERATION

- I) The conductor shall be pulled upto the desired sag and left in running blocks for atleast one hour after which the sag shall be re-checked and adjusted, if necessary before transferring the conductor from the running blocks to the suspension clamps. The conductors shall be clamped within 36 hours of sagging in.
- II) The sag will be checked in the first and the last span of the section in case of sections upto eight spans and in one intermediate span also for sections with more than eight spans. The sag shall also be checked when the conductors have been drawn up and transferred from running blocks to the insulator clamps.

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- III) The running blocks, when suspended from the transmission structure for sagging shall be so adjusted that the conductors on running blocks will be at the same height as the suspension clamp to which it is to be secured,
- IV) At sharp vertical angles, the sags and tensions shall be checked on both sides of the angle, the conductor and earthwire shall be checked on the running blocks for equality of tension on both sides. The suspension insulator assemblies will normally assume vertical positions when the conductor is clamped.
- V) Tensioning and sagging operations shall be carried out in clam weather when rapid changes in temperatures are not likely to occur.

VI) Tensioning and Sagging of Conductors and Earthwire

The tensioning and sagging shall be done in accordance with the approved stringing charts before the conductors and earthwire are finally attached to the tower through the earthwire clamps for the earthwire and insulator strings for the conductor. The 'Initial' stringing chart shall be used for the conductor and 'final' stringing chart for earth-wire should be employed for this purpose. Dynamometers shall be employed for measuring tension in the conductor and earthwire. The dynamometers employed shall be periodically checked and calibrated with the standard dynamometer.

VII) Clipping In

- a) Clipping of the conductors in positions shall be done in accordance with the recommendations of the manufacturer. Conductor shall be fitted with armour rods where it is made to pass through suspension clamps.
- b) The jumpers at the section and angle towers shall be formed to parabolic shape to ensure maximum clearance requirements and shall match the jumper drops shown in the tower drawings.
- c) Fasteners in all fittings and accessories shall be secured in position. The security clip shall be properly opened and sprung into position.

VIII) Fixing of Conductor and Earthwire Accessories

Vibration dampers for conductor and earthwire and other conductor and earthwire accessories shall be installed by the Contractor as per the design requirement and respective manufacturer's instructions within 24 hours of the conductor/earthwire clamping. While installing the conductor and earthwire accessories, proper care shall be taken to ensure that the surfaces are clean and smooth and no damage shall occur to any part of the accessories.

9. REPLACEMENT

If any replacements are to be effected after stringing and tensioning or during maintenance, leg members and bracings shall not be removed without reducing the tension on the tower with

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proper guying or releasing the conductor. If the replacement of cross arms becomes necessary after stringing, the conductor shall be suitably tied to the tower at tension points or transferred to suitable roller pulleys as suspension points.

10. FINAL CHECKING TESTING AND COMMISSIONING

After completion of the works, final checking of the line shall be done by the Contractor to ensure that all the foundation works, tower erection, and stringing have been done strictly according to the specifications and as approved by the Owner. All the works shall be thoroughly inspected keeping in view of the following main points:

- a) Sufficient backfilled earth is lying over each foundation pit and it is adequately compacted.
- b) Concrete chimneys and their copings are in good finally shaped conditions.
- c) All the tower members are correctly used, strictly according to final approved drawing and are free of any defect or damage, whatsoever.
- d) All bolts are properly tightened and punched/tack welded.
- e) The stringing of the conductors and earthwire has been done as per the approved sag and tension charts and desired clearances are clearly available.
- f) All conductor and earthwire accessories are properly installed.
- g) All other requirements to complete the work like fixing of danger plate, phase plate, number plate, anti climbing device etc., are properly installed.
- h) Wherever required it should be ensured that revetment is provided.
- i) The insulation of line as a whole is tested by the Contractor by providing his own equipment, labour etc. to the satisfaction of the Owner.
- j) All towers are properly grounded.
- k) The line is tested satisfactorily for commissioning purpose.

11. TRANSMISSION LINE MATERIAL

I) GENERAL

- a) All the equipment shall be of the latest design and conform to the best modern practice adopted in the extra high voltage field. The Bidder shall offer only such equipment as guaranteed by him to be

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satisfactory and suitable for 220 kV AC transmission with twin/ single conductor and will give continued good performance.

- b) The design, manufacturing process and quality control of all the materials shall be such as to give maximum factor of safety, maximum possible working load, highest mobility, elimination of sharp edges and a good finish.
- c) All ferrous parts shall be hot dip galvanised, after all machining has been completed, nuts may, however, be tapped (threaded) after galvanising and the threads oiled. Spring washers shall be electrogalvanised. The bolt threads shall be undercut to take care of increase in diameter due to galvanising . Galvanising shall be done in accordance with IS: 2629. Fasteners shall withstand four dips while spring washers shall withstand three dips. Other galvanised materials shall be guaranteed to withstand at least six dips each lasting one minute under the standard preece tests for galvanising.
- d) The zinc coating shall be perfectly adherent, of uniform thickness, smooth, reasonably bright, continues and free from imperfection such as flux, ash, rust stains, bulky white deposits and blisters. The zinc used for galvanising shall be of grade Zn. 99.95 as per IS:209.

II) EARTHWIRE

- a) The galvanised steel earthwire shall generally conform to the specification of ACSR core wire as mentioned in IS 398 (Part-II)-1976 except where otherwise specified herein.
- b) Parameters of the earthwire – As per attached annexure

III) CONDUCTOR

- c) The conductor shall be Aluminium Core Steel Reinforced (ACSR) type. The conductor shall confirm to IS: 398 (Part-II) except where otherwise specified herein.
- d) Parameters of the conductor – As per attached annexure

IV) CONDUCTOR ACCESSORIES

A) Mid Span Compression Joint for Conductor

As per details given in IS: 2121 Part-2.

B) Repair Sleeve

Repair Sleeve of compression type shall be used to repair conductor with not more than two strands broken in the outer layer. The sleeve shall be manufactured from 99.5% pure aluminium and shall have a smooth surface. The repair sleeve shall comprise of two pieces with a provision of seat for sliding of the keeper piece. The edges of the seat as well as the keeper piece shall be of rounded that the conductor strands are not damaged during installation.

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- a) The Bidder shall clearly specify the before and after compression dimensions of the mid span compression joint and repair sleeve for owner's review. The compression pressure shall also be indicated by the Bidder.

C) Vibration Damper for conductor and Earthwire

- a) Vibration dampers of 4 R-Stock bridge type with four (4) different resonance spread within the specified aeolian frequency bandwidth shall be used at all suspension and tension points on each span to damp out the Aeolian vibrations of the conductors to the specified level as mentioned hereinafter. Two dampers minimum on each side per conductor/earthwire shall be used at tension points and one damper minimum on each side per conductor at suspension points for ruling design span.
- b) The clamp of the vibration damper shall be made of high strength aluminium alloy of type LM-6 or equivalent.
- c) The messenger cable shall be made of high strength galvanised steel/stainless steel with a minimum strength of 135 kg/mm². It shall be of pre-formed and post-formed quality in order to prevent subsequent droop of weight and to maintain consistent flexural stiffness of the cable in service. The number of strands in messenger cable shall be 19. The messenger cable other than stainless steel shall be hot dip galvanised in accordance with the recommendations of IS: 4826-1979 for heavily coated wires.
- d) The manufacturer must indicate the clamp bolt tightening torque to ensure that the slip strength of the clamp is maintained between 2.5 KN and 5KN. The clamp when installed on the conductor shall not cause excessive stress concentration on the conductor leading to permanent deformation of the conductor strands and premature fatigue failure in operation.
- e) The vibration damper for conductor shall not have magnetic power loss more than 0.5 watt at 350 Amps at 50 Hz alternating current.
- f) The vibration analysis of the system, with and without damper and dynamic characteristics of the damper shall have to be submitted by the Bidder along with his bid. The technical particulars for vibration analysis and damping design of the systems area follows:

D) EARTHWIRE ACCESSORIES

a) Mid Span Compression Joint for Earthwire

It shall be used for joining two lengths of earthwire. The joint shall be made of mild steel. The steel sleeve should not crack or fail during compression in it or service period. The Brinnel Hardness of steel should not exceed 200. The steel sleeve shall be hot dip galvanised. The joints shall not permit slipping off, damage to, or failure of the complete earthwire or any part thereof at a load not less than 95% of the ultimate tensile strength of the earthwire. The joint shall have resistivity less than 75% of resistivity of equivalent length of earthwire. The dimensions and the dimensional tolerance of the joint shall be as given below:

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Item	Dimensions before compression		Dimension after compression		
	Inner Dia. (mm)	Outer Dia. (mm)	Length (mm)	Corner to Corner width (mm)	Face to face width (mm)
Al. sleeve	22±0.5	30±0.5	315±5	29.4±0.5	25±0.5
Steel sleeve	10±0.2	21±0.5	230±5	20.2±0.5	17.5±0.5

E) Vibration Damper For Earthwire

Refer Clause IV C detailed above.

F) Flexible Copper Bond: As detailed in IS: 2121 part3.

G) Suspension Clamp for Earthwire: As Detailed in IS: 2121 Part3

- a) At all suspension towers, suitable suspension clamp shall be used to support the earthwire of 7/3.15 mm size, the clamp shall be of either free-centre type or trunion type and shall provide adequate area of support to the earthwire.
- b) The total drop of the suspension assembly from the center point of the attachment to the centre point of the Earthwire shall not exceed 150 mm. The complete assembly shall be guaranteed for slip strength of not less than 9 kN and not more than 14 kN. The breaking strength of the assembly shall not be less than 25 kN.
- c)]The clamping piece and the clamp body shall be clamped by at least two U-bolts of size not less than 10 mm diameter having one nut and 3 mm thick lock nut with washer on each of its limbs. Suspension clamps shall be provided with inverted type U-bolts. One limb of the Ubolt shall be long enough to accommodate the lug of the flexible copper bond.

H) Tension Clamp for Earthwire

The details shall be as per IS: 2121 part-3. Only Compression type tension clamp shall be used to hold galvanised steel earthwire. Anchor shackle shall be supplied which shall be suitable for attaching the tension clamp to strain plates.

I) HARDWARE FITTINGS

Drawings attached for reference.

J) INSULATOR

Drawings attached for reference.

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12. TOWER ACCESSORIES

I) **STEP BOLTS & LADDERS**

Each tower shall be provided with step bolts of not less than 16mm diameter and 175 mm long, spaced not more than 450mm apart and extending from about 3.5 meters above the ground level to the top of the tower. Step bolt shall be provided with two nuts on one end to fasten the bolt securely to the tower and button head at the other end to prevent the feet from slipping away. The step bolts shall be capable of withstanding a vertical load not less than 1.5 KN. For special structures, where the height of the super structure exceeds 50 meters, ladders along with protection rings shall be provided in continuation of the step bolts on one face of the tower from 30 meters above ground level to the top of the special structure. From 3.5 m to 30 m height of super structure step bolts shall be provided. Suitable railing for access from step bolts to the ladder and from the ladder to each cross arm tip and the groundwire support shall be fixed on tower by using countersunk bolts.

II) **ANTI-CLIMBING DEVICE**

Barbed wire type anti-climbing device shall be provided and installed by the Contractor for all towers. The height of the anti-climbing device should be provided approximately 3m above ground level. The barbed wire shall conform to IS-278-1978. The barbed wires shall be given chromating dip as per procedure laid down in IS: 1340-1959.

A) Danger plate, Number plates, Circuit Plate, Phase plate & Bird Guards.

Danger, Number Plates, Phase Plates & Bird Guards shall be provided and installed by the Contractor:

- a) Each tower shall be fitted with a number plate, and danger plate. Each tension tower shall be provided with a set of phase plates also. The arrangement for fixing these accessories shall not be more than 4.5m above the ground level.
- b) The letters, figures and the conventional skull and bones of data plates shall conform to IS: 2551-1963 and shall be in a single red on the front of the plate.
- c) The corners of the number and danger plate shall be rounded off to remove sharp edges.
- d) To prevent birds from perching immediately above the suspension insulator strings and thus fouling it with droppings suitable birdguards shall be provided at cross arm tips of all suspension towers. The arrangement shall conform to IS: 5613 part-2/Sec-I.

13. TOWER EARTHING

The footing resistance of all towers shall be measured by the Contractor in dry weather after tower erection but before the stringing of earthwire. All the towers are to be earthed. In no case tower footing resistance shall exceed 10 ohms. Pipe type earthing and counterpoise type earthing wherever required shall be provided in accordance with the stipulations made in IS: 3043-1987 and IS: 5613 (part-II/

PROJECTS : 400/220kV Switchyard- RTPP Stage-IV Unit#6 CUSTOMER: APGENCO, Hyderabad	
Section-2: ETC OF 220kV DC Transmission Line	Doc. No .TB-344-316-001TLW Rev - 00

Section-2) 1985. The details for pipe and counterpoise type earthing are given in drawing enclosed with the specification.

14. TESTS FOR TL. LINE MATERIAL

The materials shall conform to all the type tests as per relevant standards. The acceptance, routine tests and tests during manufacture shall be carried out on the line material as per relevant standards.

GUARANTEED TECHNICAL PARTICULARS OF ACSR MOOSE CONDUCTOR REV.01

PROJECT: 400/220KV SWITCHYARD- RAYALSEEMA TPP STAGE-IV
 CUSTOMER: APGENCO, HYDERABAD
 CONSULTANT: DESEIN PRIVATE LIMITED, HYDERABAD
 PO NO. : 331P329 DATED: 19.03.2012

Page 1 of 3

Contractor : M/s. Bharat Heavy Electricals Ltd.
 Transmission Business Group (M.M)
 New Delhi

Guaranteed Technical Particulars of ACSR 'MOOSE' Conductor

Sl. No.	Description	Unit	Particulars
1.	Name & address manufacturer		Prem Conductors Pvt. Ltd 1678/2/2, Village Naroli Silvassa D & N H (U.T.)
2.	PARTICULARS OF RAW MATERIALS		
2.1	Aluminium		
	(a) Minimum Purity of aluminium	%	99.5
	(b) Maximum Copper Content	%	0.04
2.2	Steel Wires/Rods		
	(a) Carbon	%	0.50 to 0.85
	(b) Manganese	%	0.50 to 1.10
	(c) Phosphorous	%	Not more than 0.035
	(d) Sulphur	%	Not more than 0.045
	(e) Silicon	%	0.10 to 0.35
2.3	Zinc		
	(a) Minimum purity of zinc	%	99.95
3.	ALUMINIUM STRANDS AFTER STRANDING		
3.1	Diameter		
	(a) Nominal	mm	3.53
	(b) Maximum	mm	3.55
	(c) Minimum	mm	3.51
3.2	Minimum Breaking load of strand		
	(a) Before stranding	kN	1.57
	(b) After stranding	kN	1.49
3.3	Maximum Resistance of 1 m length of strand at 20 deg. C.	ohm	0.002921

For, Prem Conductors Pvt. Ltd.

P. M. [Signature]
 Director



2313
 [Handwritten initials]

23-4-12

Sl. No.	Description	Unit	Particulars
4.	STEEL STRANDS AFTER STRANDING		
4.1.	Diameter		
	(a) Nominal	mm	3.53
	(b) Maximum	mm	3.59
	(c) Minimum	mm	3.47
4.2.	Minimum Breaking load of strand		
	(a) Before stranding	kN	12.86
	(b) After stranding	kN	12.22
4.3.	Galvanizing		
	(a) Minimum mass of zinc coating per sqm. Of uncoated wire surface.	gm	275
	(b) Minimum number of one minute dips that the galvanized strand can withstand in the standard precece test	Nos	3
	(c) Min.no. of twists in a gauge length equal to 100 times dia of wire which the strand can withstand in the torsion test.	Nos	16-after stranding 18-before stranding
5.	ACSR CONDUCTOR		
5.1.	No. of Strand	Aluminium Wires Steel Wires	54/3.53 mm 7/3.53 mm
5.2.	Total Sectional area	mm.sq	597.0
	Sectional area of Aluminium	mm.sq.	528.5
5.3.	Overall diameter	mm	31.77
5.4.	UTS of Conductor	kN	161.2
5.5.	Lay ratio of conductor	Minimum	Maximum
	(a) Outer Steel layer	16	18
	(b) 12 Wires aluminium layer	12	14
	(c) 18 Wire aluminium layer	11	13
	(d) 24 Wire aluminium layer	10	12
5.6.	Maximum DC resistance of conductor at 20°C	ohm/km	0.05552

For, Prem Conductors Pvt. Ltd.



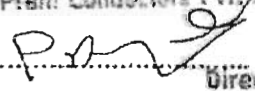
Director



Sl. No.	Description	Unit	Particulars
5.7	Minimum Corona Extinction Voltage (line to ground) under Dry condition.	kV (rms)	320
5.8	RIV at 1 MHz at 305.kV (rms) under dry conditions	micro volts	Below 1000
5.9	Standard length of conductor	meters	1800 / 1500
5.10	Maximum length of conductor that can be offered as single length	meters	2000
5.11	Tolerance on standard length of conductor	%	±5
5.12	Direction of lay for outside layer		Right
5.13	Linear mass of the Conductor		
	(a) Standard	kg/km	2004
	(b) Minimum	kg/km	1962
	(c) Maximum	kg/km	2032
6.0	Drum is as per specification		Yes
7.0	No. of cold pressure butt welding Equipment available at works.	Nos.	2 Nos.
8.0	Modulus of Elasticity	Kg / sq.cm	686000 [R1]
9.0	Temperature coefficient of resistance at 20°C	per Deg C	0.00403 [R1]
10.0	Coefficient of linear expansion	per Deg C	0.00001991 [R1]
11.0	Type of Paper and Water Proof Material used In packing		a) double corrugated paper on barrel b) bitumen paper on inside of flanges c) 100 GSM craft paper in between layers of cond. [R1] d) 300 gauge polythin sheet on outermost layer of cond

For, Prem Conductors Pvt. Ltd.

Date : 18.04.2012

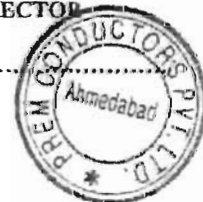
(Signature).....  Director

Place : AHMEDABAD

(Printed Name) P.A. MEHTA

(Designation) DIRECTOR

(Common Seal).....



BHARAT WIRE ROPES LTD.

GUARANTEED TECHNICAL PARTICULARS

Contractor : Bharat Heavy Electricals Limited.

Project: APGENCO Rayalseema STAGE- IV

Galvanised Steel Earth Wire of size 7/3.66 mm

<p>Name and Address of Manufacturer</p> <ul style="list-style-type: none">• Office• Factory	<p>Bharat Wire Ropes Ltd. Regd. Office :A-701,Trade World, Kamla City, Lower Parel (W) Mumbai 400 013</p> <p>Bharat Wire Ropes Ltd. Plot No.1 & 4, Atgaon Industrial Complex, Mumbai Nashik Road (NH 3), Taluka Shahapur, Atgaon (East), Dist.Thane 421 601 (Maharashtra) (India)</p>
<p>Particulars of Raw Materials</p>	
<p><u>Steel Wires/Rods</u></p> <p>Carbon Manganese Phosphorous Sulphur Silicon Lead Cadmium Iron</p>	<p>Not more than 0.55% 0.40% to 1.10% Not more than 0.05% Not more than 0.05% 0.15% to 0.35% N/A N/A N/A</p>
<p><u>Zinc</u></p> <ul style="list-style-type: none">• Minimum Purity of Zinc	<p>99.95%</p>
<p>Steel Strands Before Stranding</p>	
<p><u>Diameter</u></p> <ul style="list-style-type: none">• Nominal• Maximum• Minimum	<p>3.66 mm 3.74 mm 3.58 mm</p>
<p><u>Tensile Strength</u></p> <ul style="list-style-type: none">• Before Stranding• After Stranding	<p>981 N/mm² 931 N/mm².</p>



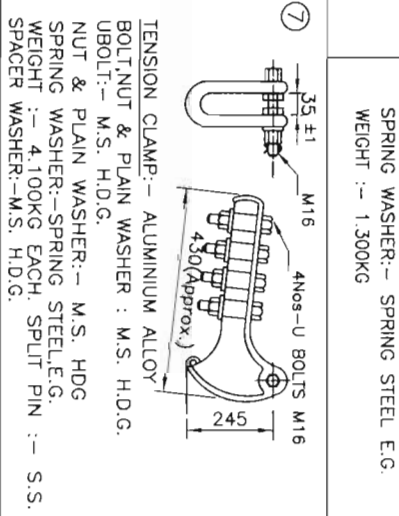
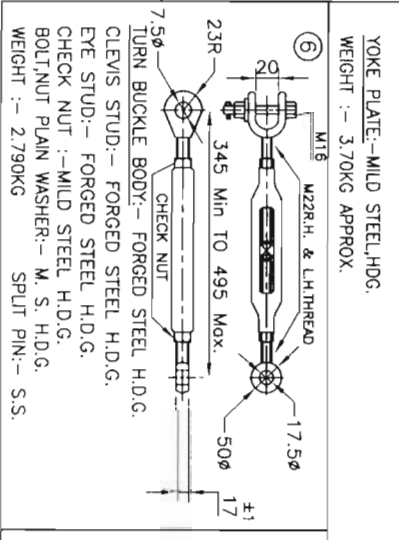
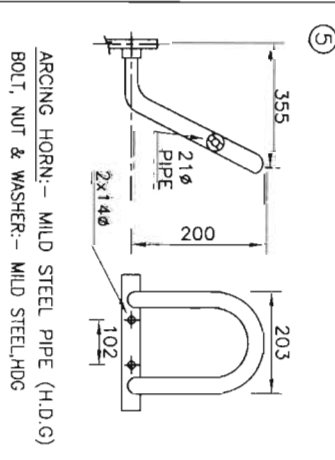
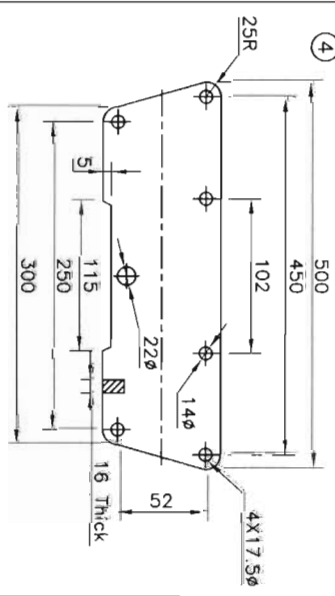
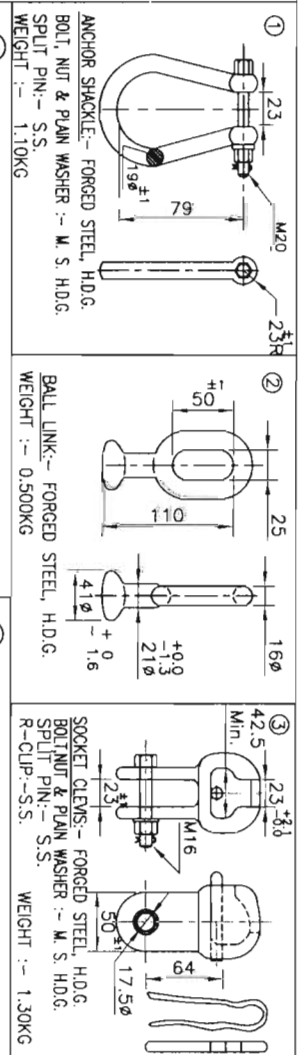
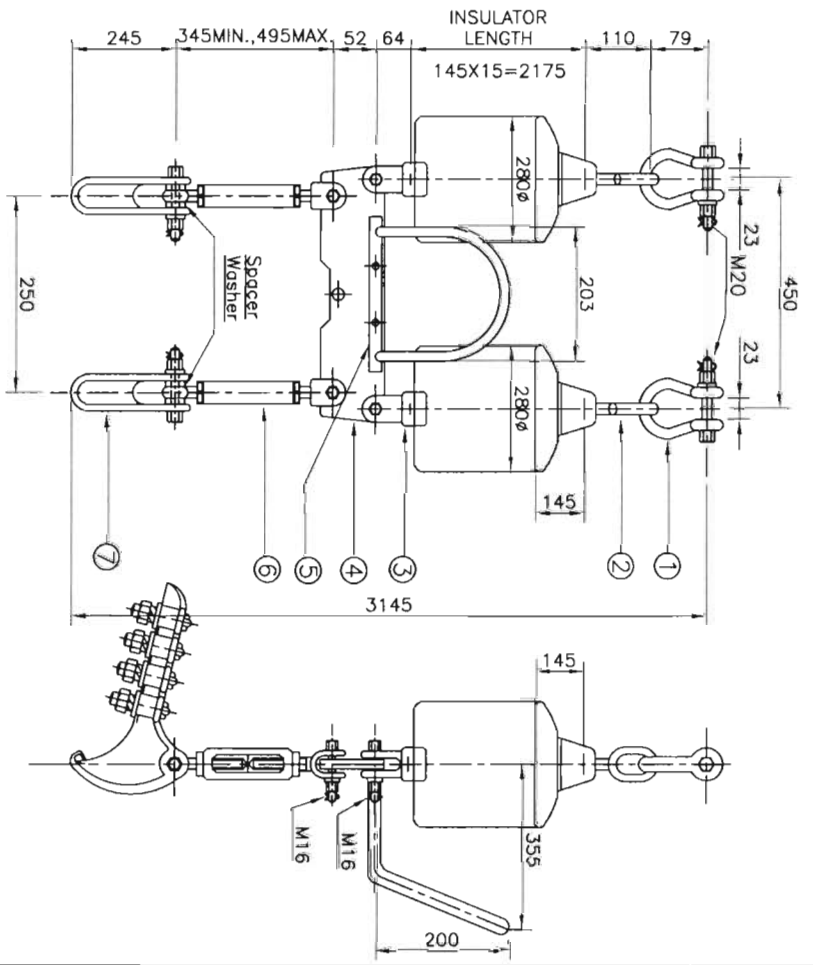
BHARAT WIRE ROPES LTD.

<p>Galvanizing</p> <ul style="list-style-type: none"> • Minimum Weight of Zinc Coating per sq.meter on uncoated wire surface • Minimum Number of One Minute Dips that the Galvanised Strand can withstand in the Standard Preece Test • Minimum Number of Twists in Gauge Length equal 100 times the dia.of the Wire which the Strand can withstand in the Torsion Test 	<p>Before Stranding : Min. 250 gm. After Stranding : Min. 238 gm.</p> <p>Before Stranding : 1 Min.= 3 Dips After Stranding : 1 Min. = 2 Dips ½ Min. = 1 Dip</p> <p>Before Stranding : 20 Nos. After Stranding : 18 Nos.</p>
<p>Stranded Earthwire</p>	
<p>No.of Strands</p>	<p>Steel Core = 1 & Outer Steel Wire = 6</p>
<p>Stranding and Wire Diameter</p>	<p>7/3.66 mm</p>
<p>Total Sectional Area</p>	<p>73.61 mm²</p>
<p>Overall Dia.of Earthwire</p>	<p>10.98 mm</p>
<p>UTS of Earthwire</p>	<p>64.8 kN</p>
<p>Lay Length of Outer Steel Layer</p>	<p>Min. 143 mm and Max. 307 mm</p>
<p>DC Resistance of Earthwire at 20 Deg.C</p>	<p>Max. 2.51 ohm/km</p>
<p>Standard Length of Earthwire</p>	<p>2000 meter</p>
<p>Tolerance</p>	<p>+ 100 meter</p>
<p>Direction of Lay of Outer Layer</p>	<p>Right Hand</p>
<p>Linear Mass of Earthwire</p> <ul style="list-style-type: none"> • Standard • Minimum • Maximum 	<p>575 kg/km (Approx.) 604 kg/km (Approx.) 553 kg/km (Approx.)</p>
<p>Elongation of Wire</p>	<p>Before Stranding- 4% After Stranding- 3.5%</p>
<p>Modulus of Elasticity</p>	<p>19 x 10³ kgf/mm²</p>
<p>Maximum Temp</p>	<p>Ambient Temp</p>
<p>Specification</p>	<p>IS : 12776 of 2002 & Tech.Spec with enquiry</p>

For **BHARAT WIRE ROPES LTD.**

Abhivand
Authorized Signatory





- ELECTRICAL CHARACTERISTICS:-**
1. RATED VOLTAGE - 245KV.
 2. POWER FREQUENCY WITHSTAND VOLTAGE (WET) - 460KV (rms).
 3. LIGHTNING IMPULSE WITHSTAND VOLTAGE (DRY) - ±11050KVp.
 4. CORONA EXTINCTION VOLTAGE - 156KV (rms) MINIMUM.
 5. RIV AT 156KV rms - 1000 MICROVOLTS MAXIMUM.

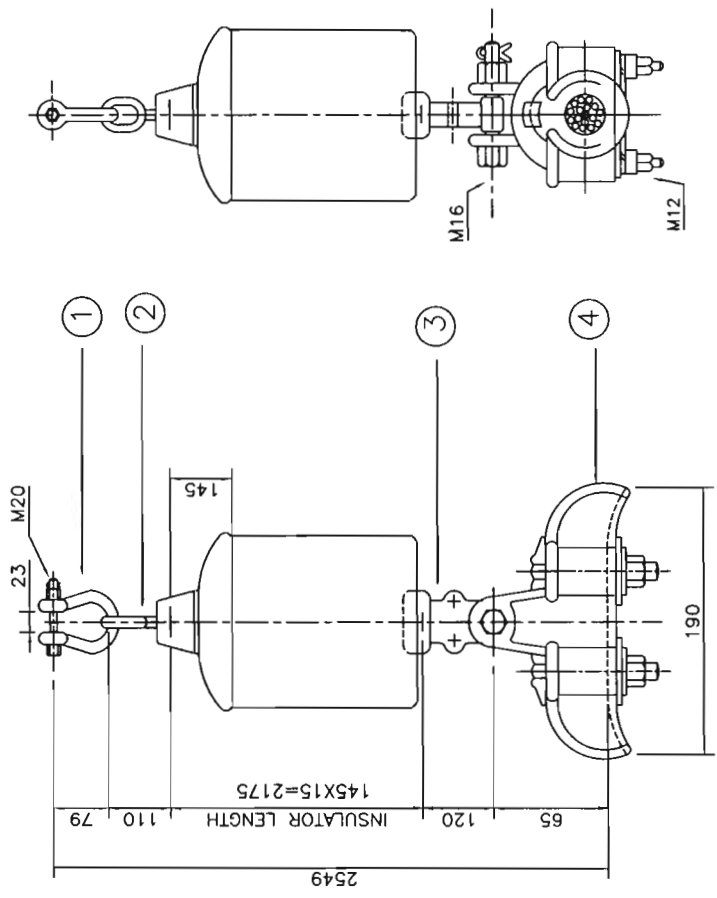
- NOTES:-**
1. ALL DIMENSIONS ARE IN mm.
 2. GENERAL TOLERANCE ±3%.
 3. BALL AND SOCKET 20mm AS PER IS-2486 (PT-II).
 4. MIN. BREAKING STRENGTH OF STRING 120KN.
 5. U.T.S. OF THE CLAMP:- 70KN.
 6. TOTAL WEIGHT 25,00kg (APPROX.).
 7. ALL FERROUS PARTS HOT DIP GALVANISED AS PER IS-2633/2629.
 8. NUTS, BOLTS & WASHER BELOW M12 WILL BE ELECTRO GALVANISED AND FOR OTHERS HOT DIP GALVANISED.
 9. EACH INSULATOR STRING COMPRISES OF 15NOS. DISC INSULATORS.
 10. TOTAL CREEPAGE DISTANCE >6125mm.
 11. ALL HARDWARE SHALL BE BOLTED TYPE.
 12. ALL FORGING COMPONENTS ARE MADE BY DROP FORGING METHOD AS PER IS-2004

NO	DESCRIPTION	MATERIAL	QTY.	U.T.S. KN
1	ANCHOR SHACKLE	FORGED STEEL H.D.G.	2	120
2	BALL LINK	FORGED STEEL H.D.G.	2	120
3	SOCKET CLEVIS	FORGED STEEL H.D.G.	2	120
4	YOKE PLATE	MILD STEEL H.D.G.	1	120
5	ARCING HORN	MILD STEEL HDG (PIPE)	1	1.5
6	TURN BUCKLE	FORGED STEEL H.D.G.	2	120
7	TENSION CLAMP	ALU. ALLOY, LM-6	2	70

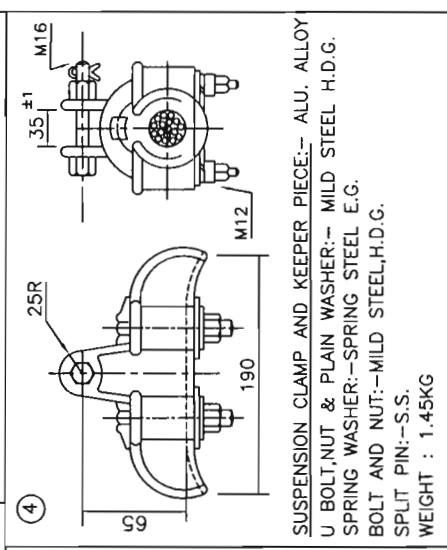
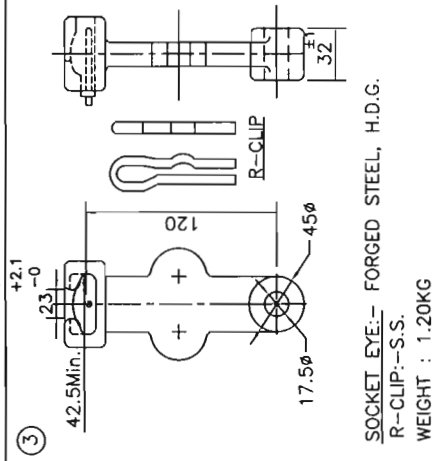
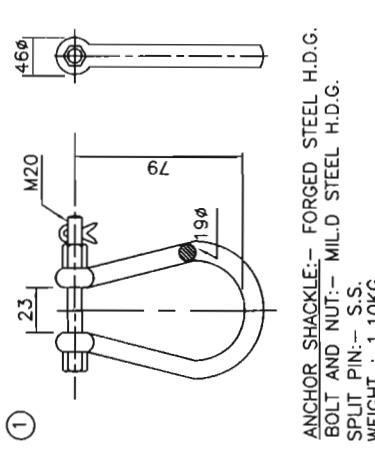
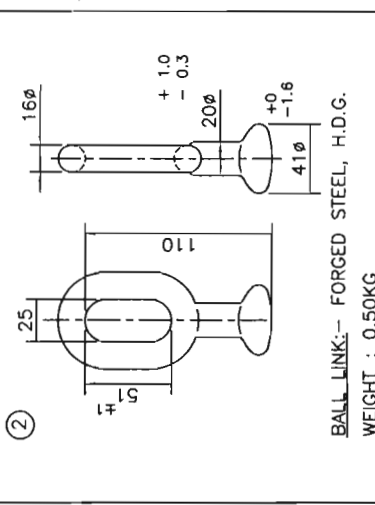
NAME OF CUSTOMER: APGENCO, Hyderabad
 NAME OF PROJECT : 400/220KV Switchyard-Rayalseema TPP stage-IV (600MW Unit#6)
 NAME OF CONSULTANT : Desain Pvt. Ltd., Hyderabad
 CONTRACTOR : Bharat Heavy Electricals Ltd.



DRG. NO. :- ITL/DTS-4U-250-TB	DATE
DRAWN	09.04.12
CHECKED	REV. 00
APPROVED	
NAMARATA	
TITLE:- 245KV DOUBLE TENSION STRING WITH DOUBLE ANCHORING POINTS FOR TWIN MOOSE CONDUCTOR WITH TURN BUCKLE	SCALE N.T.S.

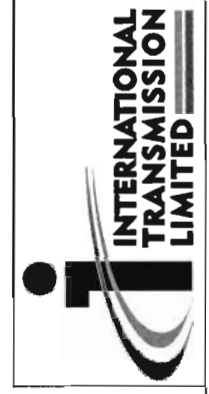


- ELECTRICAL CHARACTERISTICS:-**
1. RATED VOLTAGE - 245KV.
 2. POWER FREQUENCY WITHSTAND VOLTAGE (WET) - 506KN (rms).
 3. LIGHTNING IMPULSE WITHSTAND VOLTAGE (DRY) - ±1175kVp.
 4. CORONA EXTINCTION VOLTAGE -156KV (rms) MINIMUM.
 5. RV AT 156KV rms- 1000 MICROVOLTS MAXIMUM.
- NOTES:-**
1. ALL DIMENSIONS ARE IN mm.
 2. GENERAL TOLERANCE:- ±3%.
 3. BALL AND SOCKET SIZE:-20mm AS PER IS-2486 PART II.
 4. MIN. BREAKING STRENGTH OF STRING 120KN.
 5. MIN. BREAKING STRENGTH OF CLAMP 70KN.
 6. ALL FERROUS PARTS HDG AS PER IS:2633/2629.
 7. SPRING WASHER E.G.
 8. EACH INSULATOR STRING COMPRISES OF 15NOS.DISC INSULATORS
 9. NUTS, BOLTS & WASHER BELOW M12 WILL BE ELECTRO GALVANISED FOR OTHERS HOT DIP GALVANISED.
 10. TOTAL CREEPAGE DISTANCE >6125mm.
 11. ALL HARDWARE SHALL BE BOLTED TYPE.
 12. ALL FORGING COMPONENTS ARE MADE BY DROP FORGING METHOD AS PER IS-2004



NAME OF CUSTOMER : APGENCO, Hyderabad
 NAME OF PROJECT : 400/220kV Switchyard- Rayalseema TPP stage-IV (600MW Unit#6)
 NAME OF CONSULTANT : Desein Pvt. Ltd., Hyderabad
 CONTRACTOR : Bharat Heavy Electricals Ltd.

NO.	DESCRIPTION	MATERIAL	QTY.	UTS KN.
4.	SUSPENSION CLAMP	ALUMINIUM ALLOY, A6	1	70
3.	H. H. SOCKET EYE	FORGED STEEL, H.D.G.	1	120
2.	BALL LINK	FORGED STEEL, H.D.G.	1	120
1.	ANCHOR SHACKLE	FORGED STEEL, H.D.G.	1	120



DRG. NO.:-	ITL/SS-M	DATE	25.07.12
DRAWN	CHECKED	APPROVED	REV. 01
NAMRATA			
TITLE:- 245KV SINGLE SUSPENSION STRING WITH SUSPENSION CLAMP FOR SINGLE MOOSE ACSR.		SCALE	N.T.S.



सेरामिक बिजनेस यूनिट
सैरामिक बिजनेस यूनिट
CERAMIC BUSINESS UNIT

11E - 5076

Page 1 of 2

NAME OF CUSTOMER : M/s.APGENCO Ltd RTPP STAGE IV
NAME OF THE PROJECT : 400/220 KV Switchyard -Royalseema TPP Stage -IV
(600MW Unit #6)
NAME OF CONSULTANT : Desein Pvt Ltd, Hyderabad

GUARANTEED TECHNICAL PARTICULARS

SL.NO	PARTICULARS	UNIT	120 KN A/F Disc Insulator
1	Manufacturer's name & Address		Bharat Heavy Electricals Ltd., Electroporcelains Division Bangalore 560012,INDIA
2	Type of insulator		Ball & Socket type
3	Size & designation of ball & socket parts and standard	mm	20 as per IS:2486- II, IEC - 120
4	Type of security clip		'R' Clip (s,steel)
5	Colour of glaze		Brown
6	Size of insulator: a) Diameter b) Spacing	mm mm	280±12 146±5
7	Total creepage distance(min)	mm	430+50 -00
8	Electromechanical failing load	kN	120
9	P.F. Dry flashover Voltage	kV(rms)	80
10	P.F. Dry withstand voltage	kV(rms)	75
11	P.F. Wet flashover voltage	kV(rms)	45
12	P.F.Wet withstand voltage	kV(rms)	40
13	Impulse flashover voltage - dry (+ ve & - ve)	kVp	130
14	Impulse withstand voltage - dry (+ ve & - ve)	kVp	120
15	Visible discharge voltage	kV(rms)	18
16	RIV test at 1 MHZ (Dry)	Micro volts	50
17	PF Puncture Voltage	kV(rms)	120
18	Weight of unit (approx)	kg	8
19	Standard testing spec.		IS:731/IEC:60383
20	Reference drawing (Unit)		4 980 17 01700/02

DESEIN PRIVATE LIMITED
CONSULTING ENGINEERS

A. Approved/Proceed with fabrication.

B. Approved with comments/proceed with fabrication, considering our comments. resubmit for record.

C. See attached memo.

D. Resubmit for approval.

E. Information furnished noted.

Order No. 02800 Date 29/12/12
DESEIN

This drawing is construed to apply to the particular arrangement only & shall not relieve the supplier from entire responsibility for the correctness of its dimensions and details and fulfillment of contract obligations.



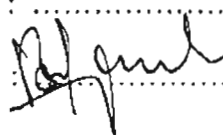
**Guaranteed Technical Particulars of Insulator Strings
(With Disc Insulators) Along With Hardware Fittings**

Sl. No	Description	Unit	400KV (Twin ACSR Moose Conductor)		220KV (Twin ACSR Moose Conductor)	
			Single Suspension String 1x25	Double Tension string 2x25	Single suspension string 1x15	Double Tension string 2x15
1.0	Power frequency withstand voltage of string with arcing horns, corona control rings/grading rings under wet&dry condition	kV(rms)	680	680	460	460
2.0	Impulse withstand voltage (Dry)					
a)	Positive	kV(peak)	1550	1550	1050	1050
b)	Negative	kV(peak)	1550	1550	1050	1050
3.0	Minimum Corona extinction Voltage under dry condition	kV(rms)	320	320	156	156
4.0	RIV at 1 MHZ when the string is energized at 105 kV(rms) under dry condition	Micro volt	1000 (max)	1000 (max)	1000 (max)	1000 (max)
5.0	Maximum Voltage distribution across any disc of line to each voltage	%	9	10	13	14

Date :
Place:

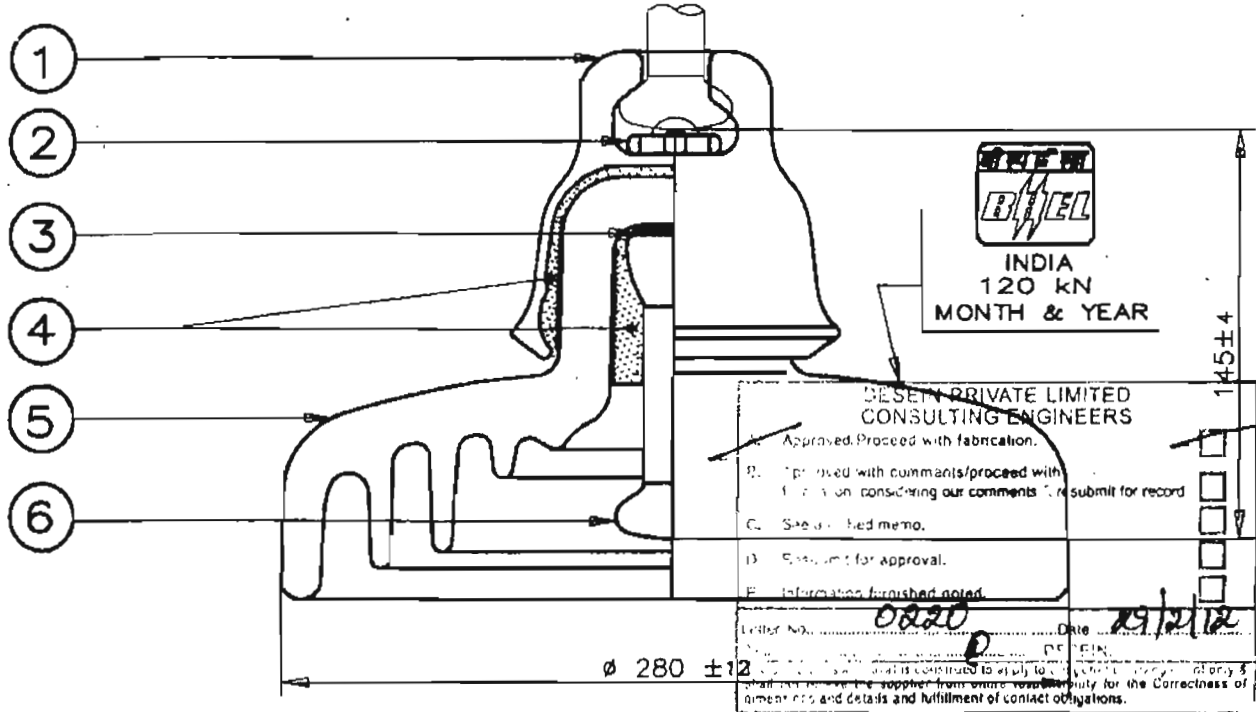
Signature :

Printed Name :

Designation : 

Common Seal :

THE INFORMATION ON THIS DOCUMENT IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LIMITED., IT MUST NOT BE USED DIRECTLY OR INDIRECTLY IN ANY WAY DETRIMENTAL TO THE INTEREST OF THE COMPANY



NOTES:

- 1 BALL AND SOCKET PARTS CONFORM TO 20 mm DESIGNATION OF IS:2486 (Part-II)-1989 OR BS:3288:Part 3-1989 OR IEC Pub 120-1984
- 2 PERMISSIBLE LIMITS OF VISUAL DEFECTS ON PORCELAIN CONFORM TO IS:13305-1992 OR JIS C 3802-1964

CONTROLLED COPY

ITEM No.	DESCRIPTION	MATERIAL	QTY
6	BALL PIN	FORGED STEEL	1
5	SHELL	PORCELAIN	1
4	BINDING MATERIAL	PORTLAND CEMENT	-
3	CUSHION	SYN. FOAM/CORK	1
2	STANDARD SPLIT PIN ('R' TYPE)	STAINLESS STEEL	1
1	SOCKET CAP	S G IRON	1

FERROUS PARTS ARE HOT-DIP GALVANIZED AS PER IS:2629 TESTS CONFORM TO IS:2633 /IEC 383/ BS EN ISO 1461(LATEST REVISION)	NAME OF CUSTOMER	M/s APGENCO, HYDERABAD
PORCELAIN BROWN GLAZED	NAME OF CONSULTANT	DESEIN Pvt Ltd., HYDERABAD
	NAME OF PROJECT	400 kV/220 kV SWITCHYARD FOR RAYALSEEMA TPP STAGE-IV (600 MW UNIT# 6)

<p>BHARAT HEAVY ELECTRICALS LTD; ELECTROPORCELAINS DIVISION BANGALORE 560 012</p>	NAME	SIGN	DATE
	DRN	N K IDDALAGI	22.12.2011
	CHD	B M H	23.12.2011
	APPD	Y B R	23.12.2011

DEPT CODE	GRADE OF TOL. DIM. C/M/F		SCALE NTS	WEIGHT (kg) 8.0 (Approx)	REF. TO ASSY DRG.	ITEM No.	No. OF ITEMS
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INVENTORY No.	TITLE	CARD CODE	DRAWING No.	REV.
	ANTIFOG DISC INSULATOR FOR 120 kN EMS		EL DG 4 980 17 01700	A0
			SUB No. 126	No. OF SHEETS

SECTION – 3
PROJECT DETAILS AND GENERAL SPECIFICATIONS

SL.NO.	DESCRIPTION	
1.	PROJECT INFORMATION	
	a) Customer	APGENCO, Hyderabad
	b) Consultant	Desein Consulting Engineers, New Delhi
	b) Projects	1x600MW RayalseemaTPP, Stage-IV, Unit#6-400/220kV Switchyard
	c) Project locations	The project site is located in VV Reddy nagar, Post- Karamala Distt Kadapa (Formarely Cuddapah) about 30KM west-south of Proddatur & 20KM from Yerraguntla. Approx. 7 km north of Chillamkur Village. Nearest Rail head is Muddanur, which is approx. 10 km from Site. Site is approximately 480KM from Hyderabad and 350KM from Chennai.

Equipment to be supplied against this specification shall be suitable for satisfactory continuous operation under the following tropical conditions:

2.	SITE CONDITIONS	
i.	Maximum Ambient air temp. (max.)	40.3 °C
ii.	Minimum Ambient air temp. (max.) °C	19.1 °C
iii.	Design ambient temperature	50 °C
iv.	Altitude above MSL	190m
v.	Basic wind speed	39m/s at 10m above retarding surface
vi.	Seismic acceleration	Zone-III As per IS-1893
vii.	Terrain Classification	Category-2
viii.	Average Rainfall	742.8 mm Average
ix.	Humidity	Max: 49-74% (June to Oct) Min: 35-60% (march to June)

3. Auxiliary Supply

Normal Voltage	Variation in Voltage	Frequency in Hz	Phase/Wire	Neutral Connection
415 Volts	± 10%	50 ± 5%	3 phsae/4 wire	Solidly earthed
240 Volts	± 10%	50 ± 5%	1 phase/2 wire	Solidly earthed
220 Volts	190V to 240V	DC	---	Isolated 2 wire system (ungrounded)

Combined variation of voltage and frequency shall be limited to ± 10%.

5. DOCUMENTS TO BE SUBMITTED ALONGWITH OFFER

- 1) Drawings.
- 2) Guaranteed Technical Particulars
- 3) Type Test Reports
- 4) Manufacturing Quality Plan

6. DOCUMENTATION SCHEDULE AT CONTRACT STAGE

A : For & After Approval	Soft copies as per clause no. 5 in 1 set
B : For Approval	Hard copies as per clause no. 5 in 12 sets
B : After Approval	Bound sets of Approved Hard copies and Installation, Operation & Maintenance manual and all as built drawings in 20 sets
	3 Set of Computer CD-ROMs (with unbreakable CD Covers) containing all as-built drawings in Auto-Cad version 2006 or later with 2D and 3D drawings, Instruction Manual and GTP.

7. **Title block:** Title block shall be forwarded to successful bidder after placement of order.

8. All outdoor enclosures shall provide a degree of protection of not less than IP 55 as per IS-13947 & colour shade of RAL 7032 and one enclosures of each type shall be tested for the same or evidence of testing shall be furnished in lieu of type testing.

9. CONTROL CABINETS, JUNCTION BOXES, TERMINAL BOXES & MARSHALLING BOXES FOR OUTDOOR EQUIPMENT

All types of boxes, cabinets, etc. shall generally conform to & be tested in accordance with IS-5039/ IS 8623, IEC: 439, as applicable, and the clauses given below:

Control cabinets, junction boxes, Marshalling boxes and terminal boxes shall be made of sheet steel or aluminium enclosure and shall be dust, water and vermin proof. Sheet steel used shall be at least 2.0 mm thick cold rolled or 2.5 mm hot rolled. The thickness of aluminium sheet shall be minimum 3mm. However the junction boxes & switch boxes shall be hot dip galvanized.

Protection Class shall be as follows:

- | | | |
|------|------------------------------|-------|
| i) | INDOOR Air conditioned area- | IP 31 |
| ii) | Indoor Non AC Areas- | IP 54 |
| iii) | Outdoor Areas- | IP 55 |
| iv) | Motors- | |
| | a) Indoor- | IP 54 |
| | b) Outdoor- | IP 55 |

Cabinet/boxes shall be free-standing, floor-mounting type, wall mounting type or pedestal mounting type as per requirements. A canopy and sealing arrangement for operating rods shall be provided in Marshalling boxes/Control cabinet to prevent ingress of rain water.

10. Quality plan:

BHEL or APGENCO approved QP shall be followed.

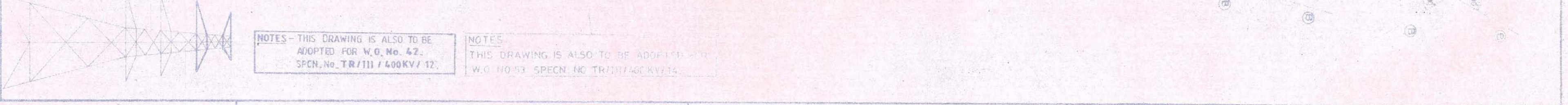
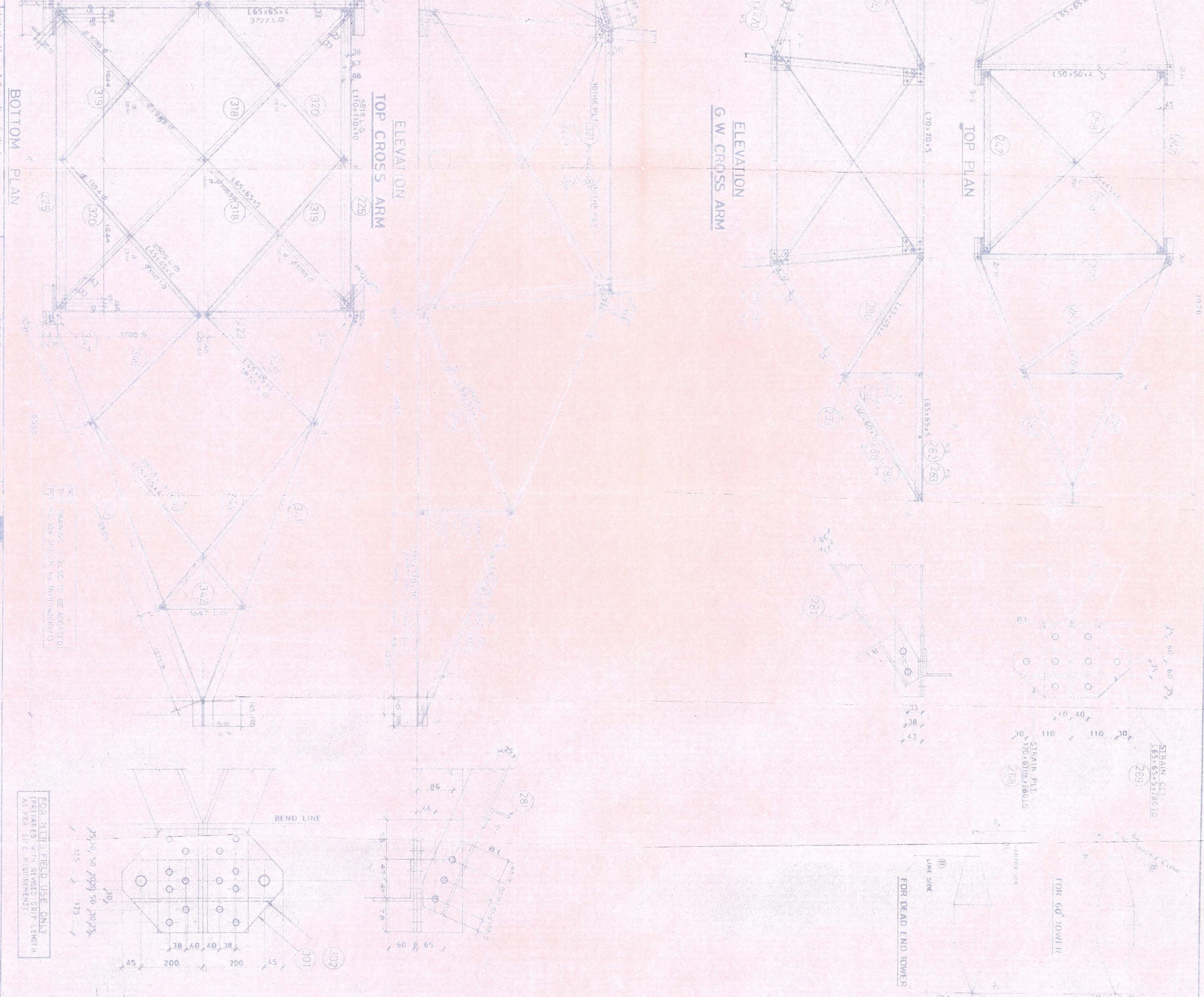
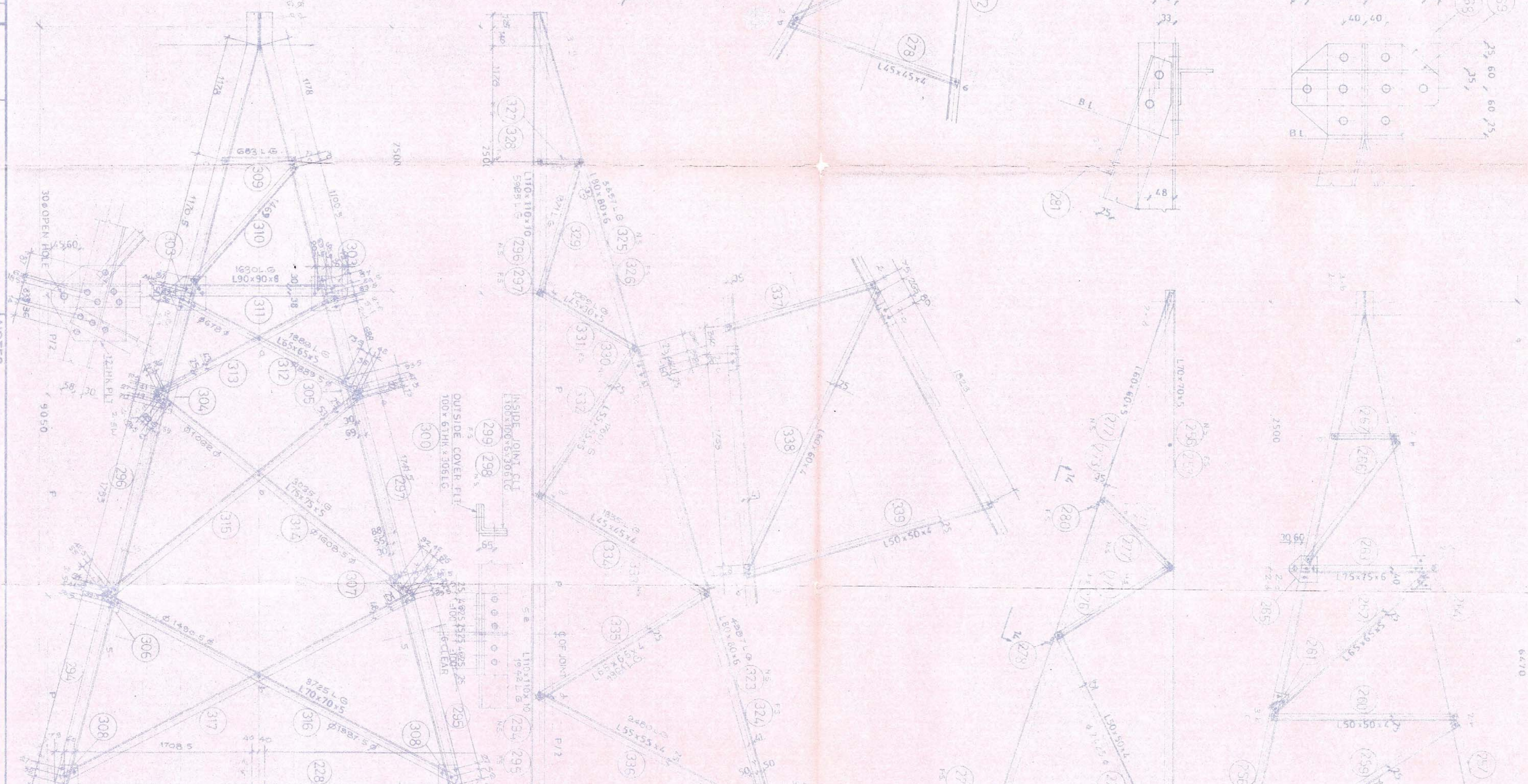
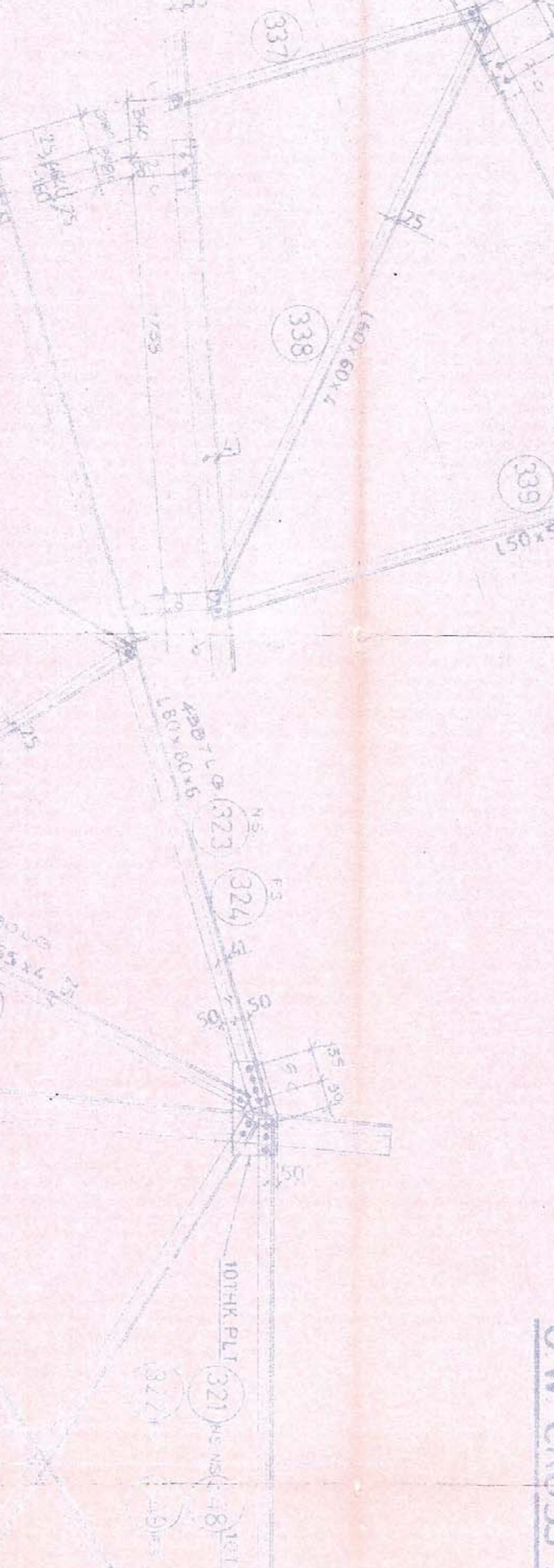
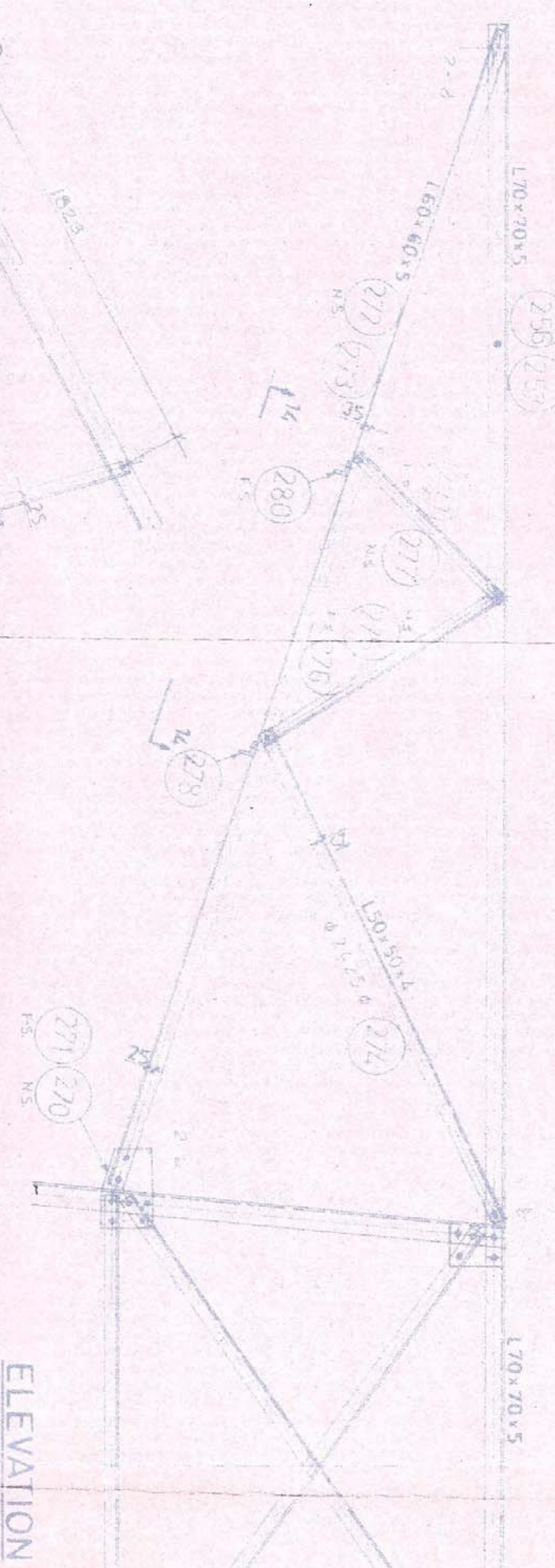
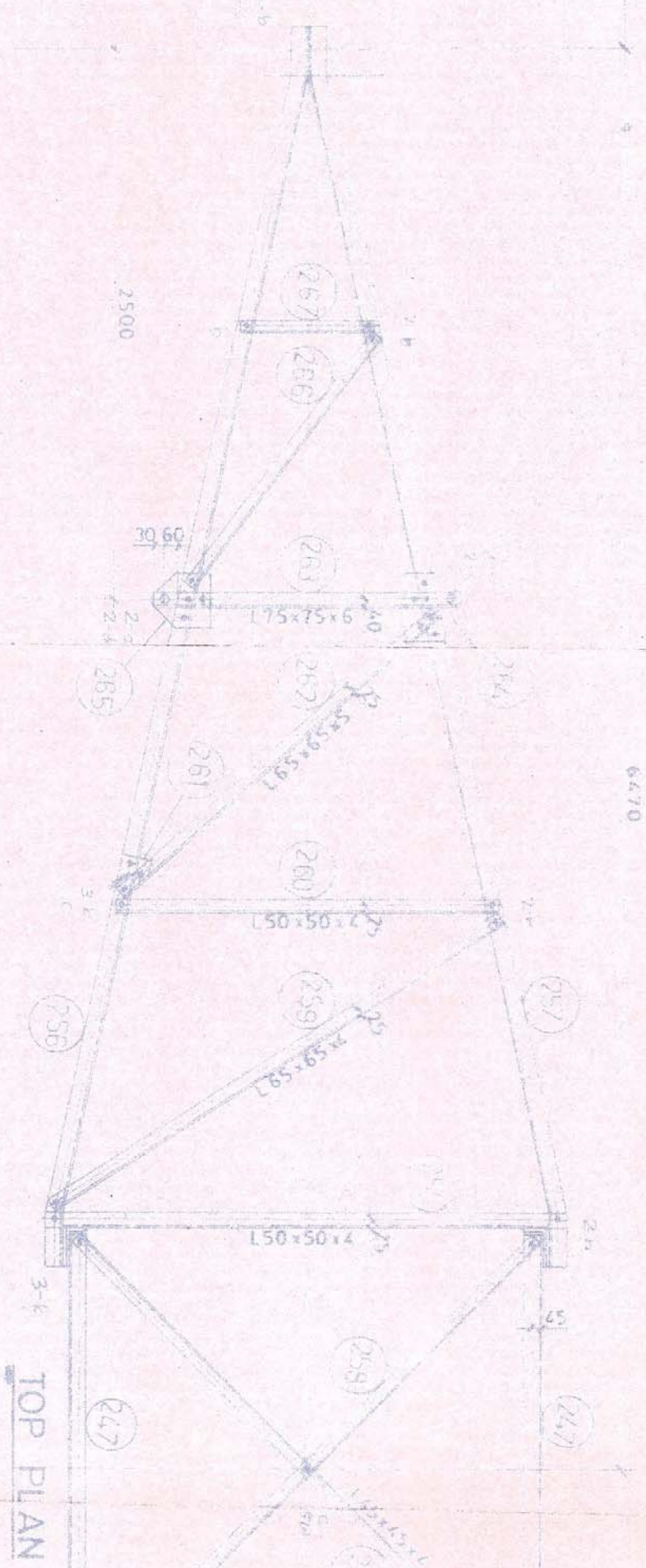
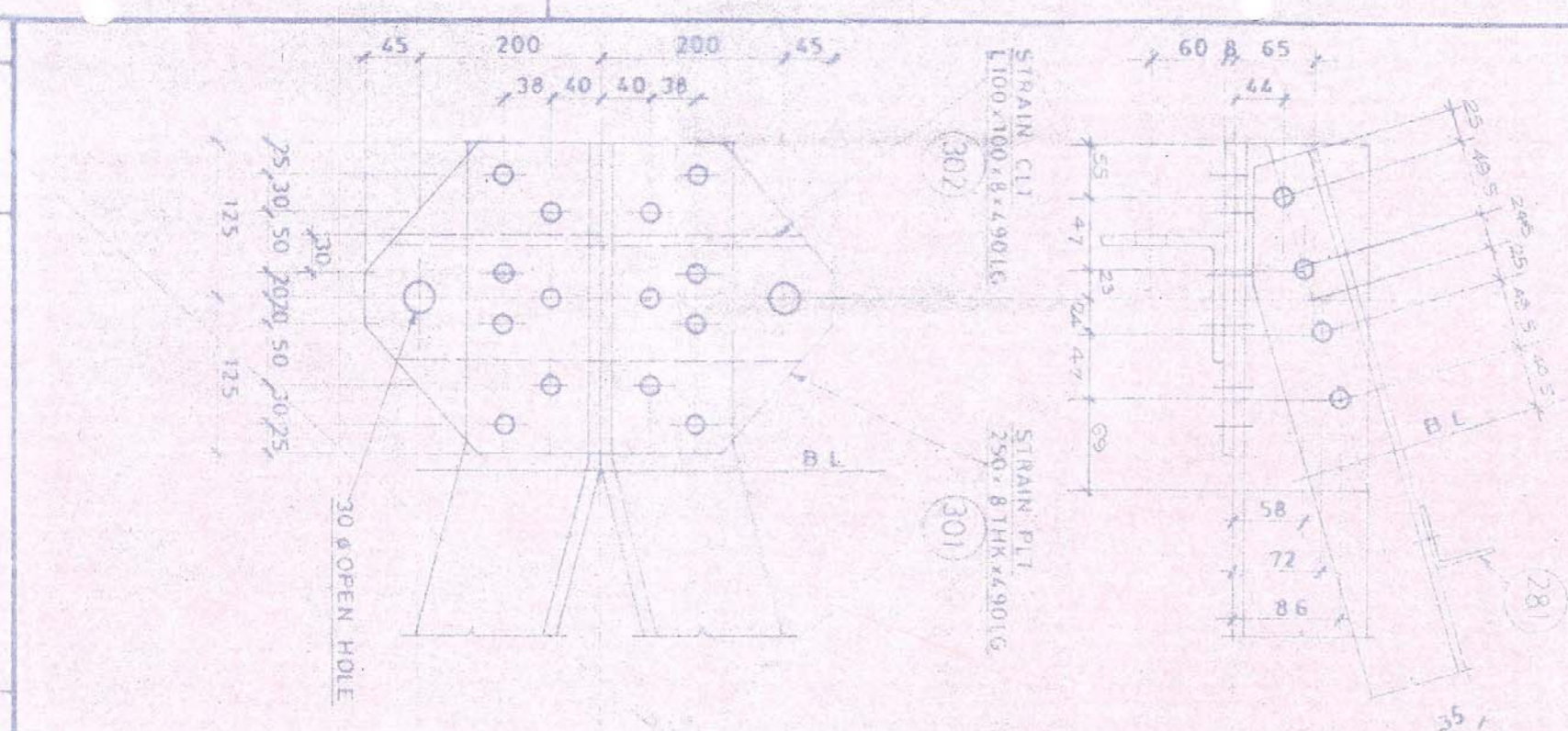
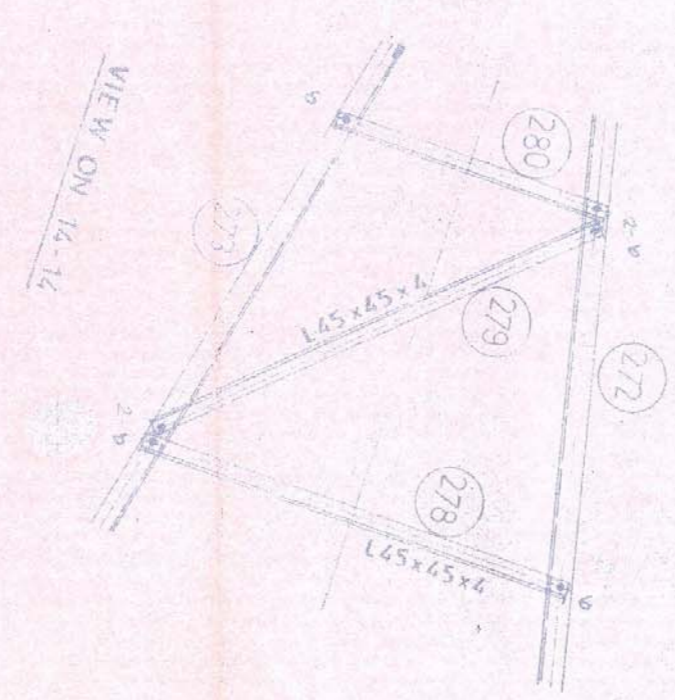
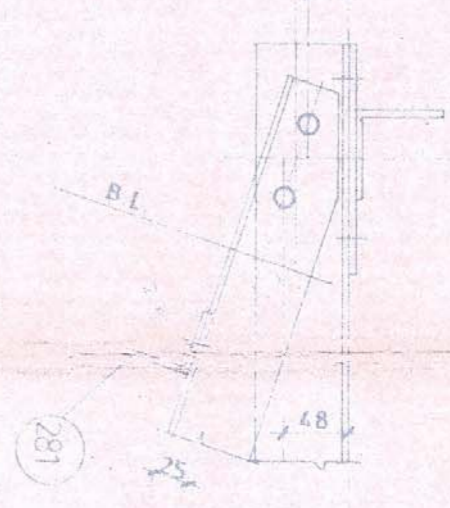
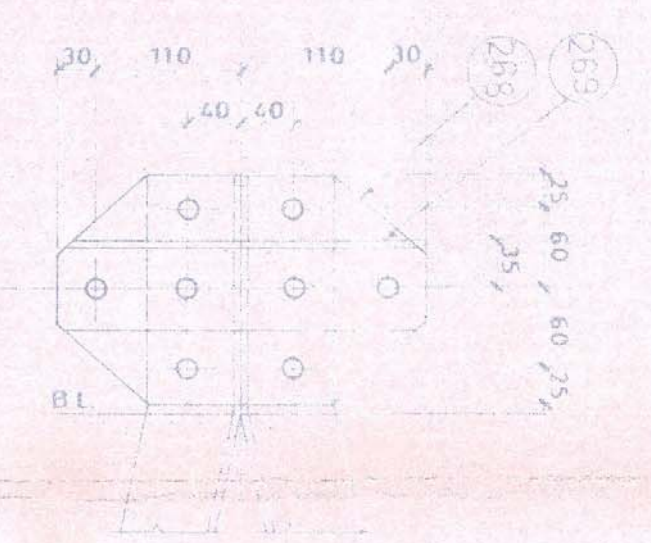
11. Type Test reports:

Bidder shall submit valid type test reports (as per relevant IEC/IS Standard) of the tests carried out within last seven (7) years from the date of bid opening (10.02.2011). The report should have been conducted on identical or similar equipment/ components to those offered. In case type test reports are more than 7 years old OR the reports of type tests are found to be technically unacceptable, the type test shall be conducted without cost and delivery implication to BHEL/APGENCO.

12. INSPECTION, TESTING AND INSPECTION CERTIFICATE

Inspection testing shall be done as per customer specification and inspection plan.

-- x x --



NO.	DATE	REVISIONS	REMARKS	BY/APP.	DRG. NO.	DESCRIPTION	REFERENCE DRAWINGS
1	20.6.9		REVISED AS PER TOWER TEST				

LIST OF 16 mm φ Bolts	SIZE	QTY	SIZE	QTY	REFERENCE LETTER	DATE	DESIGNED BY	CHECKED BY	APPROVED BY
1	25.18	94	25.18	94	1	20.6.9	h. t.	h. t.	h. t.
2	40.18	66	40.18	66	2	20.6.9	h. t.	h. t.	h. t.
3	45.18	69	45.18	69	3	20.6.9	h. t.	h. t.	h. t.
4	50.9	48	50.9	48	4	20.6.9	h. t.	h. t.	h. t.
5	50.9	4	50.9	4	5	20.6.9	h. t.	h. t.	h. t.
6	80.9	281	80.9	281	6	20.6.9	h. t.	h. t.	h. t.
7	101.8	4	101.8	4	7	20.6.9	h. t.	h. t.	h. t.
8	101.8	5	101.8	5	8	20.6.9	h. t.	h. t.	h. t.

APPROVAL	DATE	DESIGNED BY	CHECKED BY	APPROVED BY
h. t.	20.6.9	h. t.	h. t.	h. t.

h. t. power structure private limited
 GUJARAT ELECTRICITY BOARD
 400 K.V.D.C. TRANSMISSION LINE
 STRUCTURAL DETAILS OF TOP & G.W. CROSS ARMS
 TOWER TYPE - V
 DRG. NO. 35/01/B/T/SHEET NO. 8 OF 8 REV. 1

