



BHARAT HEAVY ELECTRICALS LIMITED
TRANSMISSION BUSINESS ENGINEERING MANAGEMENT

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TYPE OF DOC.	TECHNICAL SPECIFICATION	NAME	SK	DKM	RS	
BOLTED TYPE CABLE TRAY SYSTEM FOR SWITCHYARD		SIGN	<i>hrie</i>	<i>[Signature]</i>	<i>02/02/16</i>	
		DATE	02.02.16	02.02.16	02.02.16	
		GROUP	TBEM	W.O. No	89004	
CUSTOMER	NHPC LIMITED, FARIDABAD					
PROJECT	220/33KV SWITCHYARD FOR KISHANGANGA (3X110MW) HEP					
KISHANGANGA CONSORTIUM:	HINDUSTAN CONSTRUCTION COMPANY (HCC) LTD. HALCROW SUBCONTRACTOR: BHARAT HEAVY ELECTRICALS LTD.					
CONSULTANT	HALCROW NOIDA					

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SECTION-1

SCOPE, SPECIFIC TECHNICAL REQUIREMENTS AND QUANTITIES

1.0 SCOPE

This technical specification covers the requirements of design, manufacture, testing at works, packing and dispatch of **"Bolted type" Cable Trays complete with accessories as listed** under this specification below.

The specification comprise of following sections:

- Section-1: Scope & Bill of Quantities.
- Section-2: Standard Technical Specification
- Section-3: General technical requirements for all equipment under the project.
- Section-4: Guaranteed and Technical Particulars

In case of any conflict between various sections, order of precedence shall be in the same order as listed above.

No deviation from the requirements specified in various clauses of this specification shall be allowed. A certificate to this effect shall have to be furnished along with the offer as per attached Annexure-1.

The equipment is required for the following project.

Name of Customer : NHPC Ltd.

KISHANGANGA CONSORTIUM:

Hindustan Construction Company (HCC) Ltd. / HALCROW

Subcontractor: Bharat Heavy Electricals Ltd.

Name of Consultant : HALCROW Noida

Name of the project : 220/33kV Switchyard for Kishanganga (3x110MW) HEP

Refer Section - 3 for Project Details and General Specifications.

1.1 TECHNICAL PARAMETERS

Material of cable trays:	Galvanized MS
Thickness of sheet metal for trays & fittings	2 mm thick
Coupler Plate	3 mm thick
Rung	2 mm thick
Side member	2 mm thick
Whether Ladder type or perforated type	Ladder and Perforated
Accessories and Flexible supports	Coupler Plates and Hardware for Tray interconnection and for fixing to supports, Flexible support system including Cantilever arm, single channel, double channel , mounting base plate etc.
Details of tray and accessories	As per Guaranteed and Technical Particulars in Section-4 and Drawing No. TB 329 316 029 in Section-5.

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1.2 BILL OF QUANTITIES

1.2.1 Perforated Cable Trays (MS Galvanised)

MS galvanized Perforated cable tray, 2mm thick, 2.5 meter long with 2 Nos. galvanized Side coupler plate(3mm thick), along with 8 nos. M8x20 bolts with nuts and washers and 4 nos. Z-Clamps (for fixing cable tray on support) along with 4 sets of M8 spring-channel-nut and M8x35 round head bolt, as per drawing enclosed in Section-5 having following details. Galvanizing thickness min. 70 microns.

S. No.	Item Description	Quantity (Nos.)
1.	450mm wide tray (100 MM High)	305
2.	150mm wide tray (50 MM High)	280

1.2.2 Accessories For Perforated Type MS Cable Trays

All accessories made of 2mm sheet thickness, galvanized, with coupler plate each having 8 nos. M8x20 bolts with nuts and washers, galvanizing thickness min. 70 microns as per drawings enclosed in Section-5, having following details.

S. No.	Item Description	Quantity (Nos.)
1.	Galvanized MS Clamps for holding tray to the Flexible support (Cantilever)	100

1.2.3 Ladder Type MS Cable Trays

MS galvanized Ladder type cable tray, 2mm thick, 2.5 meter long with 2 Nos. galvanized Side coupler plate(3mm thick), along with 8 nos. M8x20 bolts with nut and washer and 4 nos. Z-Clamps for fixing cable tray on support along with 4 sets of M8 spring-channel-nut and M8x35 round head bolt, as per drawing enclosed in Section-5 having following details. Galvanizing thickness min. 70 microns.

S. No.	Item Description	Quantity (Nos.)
1.	600mm wide tray (100 MM High)	300
2.	450mm wide tray (100 MM High)	500
3.	300mm wide tray (100 MM High)	120
4.	150mm wide tray (100 MM High)	10

1.2.4 Accessories For Ladder Type MS Cable Trays

All accessories made of 2mm sheet thickness, galvanized, with coupler plate each having 8 nos. M8x20 bolts with nuts and washers, galvanizing thickness min. 70 microns as per drawings enclosed in Section-5, having following details.

S. No.	Item Description	Quantity (Nos.)
1.	Galvanized MS Clamps for holding tray to the Flexible support (Cantilever)	50

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1.2.5 Material for Flexible Cable Tray Support

S. No.	Item Description	Quantity (Nos.)
1.	Cantilever Arms - 750mm length for horizontal tray, Cantilever Arm MS Galvanised 2.5mm thick including 2 sets of MS, M12 Spring Channel Nut and M12x35 Hex. Head Bolt + 2 Set of M8 Spring Channel Nut & M8x35 Round head bolt Galvanizing min. 70 microns	1200
2.	Cantilever Arms - 600mm length, Cantilever Arm MS Galvanised 2.5mm thick including 2 sets of MS, M12 Spring Channel Nut and M12x35 Hex. Head Bolt + 2 Set of M8 Spring Channel Nut & M8x35 Round head bolt Galvanizing min. 70 microns	1570
3.	Cantilever Arms - 450mm length, Cantilever Arm MS Galvanised 2.5mm thick including 2 sets of MS, M12 Spring Channel Nut and M12x35 Hex. Head Bolt + 2 Set of M8 Spring Channel Nut & M8x35 Round head bolt Galvanizing min. 70 microns	140
4.	Cantilever Arms - 300mm length, Cantilever Arm MS Galvanized 2.5mm thick including 2 sets of MS, M12 Spring Channel Nut and M12x35 Hex. Head Bolt + 2 Set of M8 Spring Channel Nut & M8x35 Round head bolt Galvanizing min. 70 microns	90
5.	Double channel - C2 MS Galvanized 2.5mm thick,(Each 1.0M Long) Galvanizing min. 70 microns	25
6.	Single channel - C1 MS Galvanized 2.5mm thick,(Each 1.2M Long) Galvanizing min. 70 microns	380
7.	Single channel - C1 MS Galvanized 2.5mm thick,(Each 1.05M Long) Galvanizing min. 70 microns	105
8.	Single channel - C1 MS Galvanized 2.5mm thick,(Each 0.75M Long) Galvanizing min. 70 microns	260
9.	Single channel - C1 MS Galvanized 2.5mm thick,(Each 0.45M Long) Galvanizing min. 70 microns	310
10.	Mounting Clamps for Wall Mounted Single Channel (Saddle Clamp) (including 2 No M12 X 100 mm Anchor Fasteners (Hilti make) and 1 set of MS, M12 Spring Channel Nut & M12x35 Hex. Head Bolt)	2480
11.	Mounting Base Plate for Double Channel (including 4 No M12 X 100 mm Anchor Fasteners (Hilti make) and 4 set of MS, M12 Spring Channel Nut & M12x35 Hex. Head Bolt)	25
12.	Anchor Fasteners of bolt size M12 x 115MM Long with nut and washer, galvanized and suitable for holding plate of maximum thickness 10mm of 220kV Cable Rack in cable tunnel having 200mm thick PCC liner of M25 grade. The fixings in concrete shall be done using cold formed stud type mechanical expansion anchors having three way expansion sleeves of stainless steel of SS316, Hilti-HST mechanical anchor fastener/equivalent. The anchors must be ETA approved and anchor should be electro galvanized to minimum 5 micron coating thickness. The anchors shall confirm to minimum grade of 5.8 as per IS 1367.	3350

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1.2.6 Miscellaneous Items for Cable Trays and Accessories

S. No.	Item Description	Quantity (Nos.)
1.	M-8 x20mm-Galvanized bolts, nuts, washers, spring washers etc. for accessories. (Erection Spare)	100
2.	Anchor Fasteners of bolt size M12 x 115MM Long with nut and washer, galvanized and suitable for holding plate of maximum thickness 10mm of 220kV Cable Rack in cable tunnel having 200mm thick PCC liner of M25 grade. The fixings in concrete shall be done using cold formed stud type mechanical expansion anchors having three way expansion sleeves of stainless steel of SS316, Hilti-HST mechanical anchor fastener/equivalent. The anchors must be ETA approved and anchor should be electro galvanized to minimum 5 micron coating thickness. The anchors shall confirm to minimum grade of 5.8 as per IS 1367: (Erection Spare)	50
3.	Anchor Fasteners (Hilti make) of Saddle Clamp, M12 x 100MM Long with nuts, washers and spring washers, galvanized, galvanizing thickness min 70 microns (Erection Spare)	150
4.	MS galvanized Coupler plates (3mm thick) for 100mm high cable trays, along with 8 nos. M8x20mm galvanized bolts with nuts and washers, (Erection Spare)	25
5.	M12 Spring Channel Nut & M12x35 Hex. Head Bolt, (Erection Spare)	60
6.	Set of M8 Spring Channel Nut & M8x35 Round head bolt, (Erection Spare)	50

Notes:

- 1) 5% extra hardware shall be supplied for item S.No. 1.2.1 to 1.2.5. For Anchor Fasteners (item S.No. 1.2.5.12), 5% extra M12 nuts, washers and spring washers shall be supplied for erection spares. No extra hardware shall be supplied for item S.No. 1.2.6.
- 2) Drawings of Cable tray and accessories enclosed as drawing no.TB 329 316 029.
- 3) The offer should be inclusive of Type test charges, if any.
- 4) All items of all Lots to be procured from single source.
- 5) All the SPARE quantities shall be packed separately, and clearly marked as spares on the packing.
- 6) All anchor fasteners shall be Hilti make.
- 7) All hardware, nuts, bolts, washers etc. shall be hot dip galvanised.
- 8) For completeness of the assembly erection of the system, if any other hardware is required other than those specified in the BOM, the same shall be deemed included in the scope of supply. Vendor should clearly bring out such requirement at the tender stage.
- 9) The quantity may vary by +/- 30 % during contract stage.
- 10) The quantity of individual items may vary up to any extent.

1.3 TYPE TESTS

The cable tray and supports should have been type tested as per relevant IEC/International Standards on one apparatus of each type of similar rating and shall submit the reports.

The type test may not be mandatory if similar equipment has been type tested and test certificates for relevant tests are accepted by the employer.

Type Test reports of the following items shall be submitted for acceptance with adequate details/drawings to establish equivalence with the offered type:

- Cable trays and supports

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At contract stage, the reports for all type tests as per technical specification shall be submitted for BHEL/NHPC approval. In the event of any discrepancy in the test reports i.e. any test report not acceptable to NHPC due to any design / manufacturing changes (including substitution of components) or due to non-compliance with the requirement stipulated in the Technical Specification on any/all additional type tests not carried out, same shall be carried out without any additional cost implication to the Purchaser.

1.4 SHOP TEST

The following Shop Tests on cable tray and supports shall meet the requirements as per pages 786,795 and 796 of Model Quality Assurance Plan (QAP):

- Galvanization Test,
- Load Capacity Test (Deflection Test)

1.5 MINIMUM TECHNICAL QUALIFYING REQUIREMENT

The bidder should have designed, supplied and commissioned similar equipment earlier during the last ten (10) years. The system so supplied should have been successfully commissioned at least at three power stations/sub stations.

The bidder should have manufactured and type tested similar size of equipment during last ten (10) years. The equipment so manufactured should have been successfully commissioned at least at three power stations/sub-stations.

Further bidder shall also meet the following:

1. Bidder shall be Manufacturer of Trench Material.
2. Bidder should have Galvanising facility at their works.
3. Manufacturer should have manufactured and supplied at least 2MT each of Cable Racks and Cable Tray material in India in any one year during last five years from the date of Technical Bid Opening.

1.6 MANUFACTURING QUALITY PLAN

Quality Assurance Plan (Model) for cable tray and supports (Enclosed in Section-5) shall be followed.

1.7 FIELD TESTS

All field tests including tests during installation, pre-commissioning, commissioning and field acceptance tests shall be conducted by the Contractor, in presence of representative of the Employer as per Annexure-1A, clause 13.3 and 19.3 of Section-1.

Procedure to be adopted for conducting the operational, pre-commissioning, commissioning, performance and field acceptance test shall be submitted well in advance, at least six months before start of relevant testing, for approval by the employer.

1.8 INSPECTION & TESTING

Prior to dispatch, the Routine tests shall be carried out on cable tray and supports in accordance with the applicable IEC /IS and the material shall be offered for final inspection by BHEL and NHPC/HCC in accordance with quality assurance plan. Inspection and Testing shall be as per Quality Assurance Plan of NHPC in Section-5.

1.9 CHECK LIST

Duly filled and signed checklist (Annexure-2) of Section-5 shall be submitted along with the offer, in the absence of which, offer may not be considered for evaluation.

220/33kV Switchyard for Kishanganga (3x110MW) HEP for NHPC Limited

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BOLTED TYPE CABLE TRAY SYSTEM FOR SWITCHYARD

ANNEXURE-1

It is confirmed that there are no deviations and the offer is in full compliance with the specification. It is also confirmed that there are no deviations in any other form such as comments, variations and/ or exceptions. Further it is confirmed that at all drawings / data sheets/QP/ type tests reports shall be submitted to BHEL for organising approval of ultimate customer. Also, furnishing of all relevant information / repetition of type tests (if required for meeting the specification requirement) shall be carried out by us at no extra cost to BHEL & without affecting delivery requirements.

Signature of the authorized representative of Bidder

Name _____

Designation _____

Place _____

Date _____

Company seal



SECTION -2

STANDARD SPECIFICATION

2.1 GENERAL

This section covers the general technical requirements of Cable Tray Material.

Scope of work under this section covers the work necessary for the design, manufacture, quality assurance, quality control, shop assembly, shop testing, delivery at site, handing over to NHPC and guarantee for cable trays as per the specifications hereunder, each complete with all auxiliaries, accessories, spare parts and warranting a trouble free safe operation of the installation.

The requirements specified in section-2 are the detailed requirements. In case of any conflict between section-2 and any other section the requirements of section-2 shall take precedence over the other sections except section-1 which will take precedence over all sections.

2.2 APPLICABLE STANDARDS

The Cable Trench Material shall conform to the following Indian Standards:

S. No.	Standard	Description
1.	IEC 61537	Cable tray systems and cable ladder systems for cable management
2.	IS2062-1999	Steel for general structural purpose
3.	IS2633-1986	Method for testing uniformity of coating on Zinc coated articles
4.	IS2629-1985	Recommended practice for hot dip galvanising on iron & steel
5.	IS4759-1984	Hot dip Zinc coating on structural steel and other allied products
6.	IS6745-1972	Method for determination of mass of zinc coating on zinc coated iron and steel articles
7.	IS808-1989	Rolled steel beams, channel and angles
8.	IS1852-1985	Rolling and Cutting tolerances for rolled steel products
9.	IS2074-1992	Recommended practice for red oxide And zinc chromate on iron & steel
10.	ASTM-A123, A153	Support Structure
11.	IS 1730	MS Flats

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2.3 TECHNICAL REQUIREMENTS OF CABLE TRAYS

- 2.3.1 The cable trays shall be ladder and perforated type.
- 2.3.2 The cable trays including accessories like bends, elbows, tees, cross etc. shall be of perforated (long slots) and Ladder type, for proper ventilation of the cables, made out of 14-gauge mild steel sheet. The trays shall have minimum 50mm edge height.
- 2.3.3 The cable trays shall be fully galvanized and the Purchaser reserves the right to test galvanizing as per approved standard in presence of its representative.
- 2.3.4 Stainless steel cable trays are to be provided for humid premises and the area prone to water dripping and spray.
- 2.3.5 The material (Mild Steel) used for the supply shall be in sound condition and of recent manufacture, free from defects, loose mill scale, slag, pitting, rust, etc.
- 2.3.6 The cable trays shall be hot dip galvanized.
- 2.3.7 Galvanising of the trays shall be done. For all items requirement of coating thickness shall be minimum 70 microns.
- 2.3.8 The trays shall not have sharp edges cuts, abrasions etc. and the zinc coating shall be adherent, smooth and reasonably bright, continuous and free from such imperfections as flux, ash, bare and black spot, pimples, lumpiness, rust stains, bulky white deposits and blisters.
- 2.3.9 All drilling, cutting, bending etc. of fabricated steel work shall be carried out before galvanising. After galvanising, no drilling or welding shall be performed on the galvanized parts of the equipment excepting that nuts may be threaded after galvanizing. Sodium dichromate treatment shall be provided to avoid formation of white rust after hot dip galvanisation.
- 2.3.10 Bolts and nuts shall be of steel with hexagonal head GKW make or equivalent approved supplier. All bolts shall be galvanized including threaded portions. The threaded portions of all bolts shall be cleared of smear by spinning / brushing. All washers and nuts shall also be galvanized but threading of nuts shall be oiled / greased.
- 2.3.11 All angles / flats etc. shall be cut with shearing machine / power hack-saw, cutting with gas welding is not permitted.
- 2.3.12 The bidder shall indicate in his offer the final weight of each tray after punching and galvanising.
- 2.3.13 The galvanized steel shall be subjected to six one minutes dip in copper sulphate solution as per IS-2633.
- 2.3.14 Sharp edges with radii less than 2.5mm shall be able to withstand four immersions of the standard Preece test. All other coatings shall withstand six immersions.
- 2.3.15 The material for support structure/ cable racks shall be supplied/ fabricated in accordance with ASTM-A123 and A153.

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2.4 TECHNICAL REQUIREMENTS OF CABLE TRAY SUPPORT SYSTEMS

Cable tray support system shall be pre-fabricated

Support system for cable trays shall essentially comprise of the two components i.e. main support channel and cantilever arms. The main support channel shall be of two types: (i) C1:- having provision of supporting cable trays on one side and (ii) C2:having provision of supporting cable trays on both sides. The support system shall be the type described hereunder

- 2.4.1 Cable supporting steel work for cable racks/cables shall comprise of various channel sections, cantilever arms, various brackets, clamps, floor plates, all hardwares such as lock washers, hexagon nuts, hexagon head bolt, support hooks, stud nuts, hexagon head screw, channel nut, channel nut with springs, fixing studs. etc.
- 2.4.2 The system shall be designed such that it allows easy assembly at site by using bolting. All cable supporting steel work, hardwares fittings and accessories shall be prefabricated factory galvanised.
- 2.4.3 Supports and screws and bolts for cable trays shall be made of the same materials as the cable trays they support.
- 2.4.4 Tray support system shall be flexible/adjustable type having pre-fabricated sections and supports that can be assembled and bolted for quick and easy installation.
- 2.4.5 The main support and cantilever arms shall be fixed at site using necessary brackets, clamps, fittings, bolts, nuts and other hardware etc. to form various arrangements required to support the cable trays. Welding of the components shall not be allowed. However, welding of the bracket (to which the main support channel is bolted) to the overhead beams, structural steel, insert plates or reinforcement bars will be permitted. Any cutting or welding of the galvanised surface shall be brushed and red lead primer, oil primer & aluminium paint shall be applied.
- 2.4.6 All steel components, accessories, fittings and hardware shall be hot dip galvanized after completing welding, cutting, drilling and other machining operation.
- 2.4.7 The typical arrangement of flexible support system is shown in the enclosed drawings and described briefly below:
- 2.4.8 The main support channel and cantilever arms shall be fabricated out of minimum 2.5mm thick rolled steel sheet conforming to IS.
- 2.4.9 Cantilever arms of 200 111m, 350 mm and 650 r.1m in length are required, and shall be as shown in the enclosed drawings. The arm portion shall be suitable for assembling the complete arm assembly. en to component constructed of standard char:nel section. The back plate shall allow sufficient clearance for fixing bolt to be tightened with tray in position.

The size of structural steel members of thickness of sheet steel of main support channel and cantilever arms and other accessories as indicated above or in the enclosed drawings are indicative only. Nevertheless, the support system shall be designed by the supplier without any additional cost to the BHEL. The supplier shall submit the detailed drawings of the system offered by him along with the bid.

2.5 GUARANTEE

The equipment offered shall be guaranteed for satisfactory performance for a period as specified in "Commercial Terms and Conditions". The equipment found defective/failed

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within the above guarantee period shall be replaced or repaired by the vendor free of cost within one month from the receipt of intimation.

2.6 TESTS

2.6.1 TESTS FOR CABLE TRAYS

Tests to be conducted on Cable Trays shall be as follows:

- i. Dimensional and visual examination - As per BHEL approved drawing.
- ii. Mass of Galvanisation - IS: 6745: 1972
- iii. Test for galvanising (Acceptance Test). The test shall be done as per approved standards.
- iv. Uniformity of zinc coating - IS: 2633: 1986
- v. Deflection Test:
A 2.5M straight section of tray shall be simply supported at two ends. A uniform distributed load of 76 kg/M shall be applied along the length of the tray. The maximum deflection at the mid span shall not exceed 7 mm.
- vi. Adhesion test

2.6.2 TESTS FOR CABLE TRAY SUPPORTS

All equipment to be supplied shall be of type tested quality. The contractor shall submit for Owner's approval, the reports of all the type tests as listed in this specification and carried out within last five years from the date of bid opening. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client.

In case the contractor is not able to submit report of the type test(s) conducted within last five years from the date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct all such tests under this contract free of cost to the owner and submit the reports for approval.

All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.

The following type tests shall be conducted. The details of test specimen preparation and test procedures shall be given to Contractor after award:

Cable Tray Support System

- Load test for main support channel with cantilever arm fixed on one side,
- Load test for main support channel with cantilever arm fixed on both sides,
- Load test for channel fixed on beam / floor,
- Load test for channel supported on wall with cantilever arm,
- Channel nut slip characteristics (wherever applicable),
- Weld integrity test.

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2.6.2.1 Type tests on Cable Trays support system

a) Test 1A

On main support channel type-C2 for cantilever arms fixed on one side only. A 3.5 metre length of main support channel shall be fixed vertically at each end to a rigid structure as per the fixing arrangement as shown in the enclosed standard drawing. Eight (8) nos. 750 mm cantilever arms shall be fixed to the main channel and each arm shall be loaded over the outboard 600 mm with a uniform working load of 100 kg. Subsequently a point load of 100 kg shall be applied on arm 2. A uniform proof load on all the arms equal to twice the working load shall be then be applied. Deflections shall be measured at the points shown in the enclosed drawings and at the following load intervals:

- (i) Working load
- (ii) Working load + point load
- (iii) Off load
- (iv) Proof load + point load
- (v) Off load

The deflection measured at working loads shall not exceed 16mm. The permanent deflection after removing the combination of working load and point load shall not exceed 10 mm at the arm tips and 6 mm on the channel. No collapse of the structure shall occur with a combination of proof load and point load applied.

b)Test 1B

Test 1A shall be repeated with Eight Cantilever arms uniformly loaded and with the same point load on arm 2

2.6.2.2 Test 2: On main support channel type-C2 for cantilever arms fixed on both sides

b)Test 2A

A 3.5 m length of main support channel C2 for cantilever arms fixing on both sides shall be fixed at each end to rigid structure as per the fixing arrangement as shown in the enclosed drawing. Six (6), 750 mm cantilever arms shall be attached to each sides and each arm uniformly loaded to a working load of 100 kg over the out board 600 mm. A point load of 100 kg shall than be applied to arm 2, followed by a uniform proof load of twice the working load on all the arms; deflection shall be measured at points shown in the enclosed drawings at the following load intervals.

- (i) Working load
- (ii) Working load + Point load
- (iii) Off load
- (iv) Proof load + Point load
- (v) Off load

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The deflection measured at working loads shall not exceed 16mm. The permanent deflection after removing the combination of working load and point load shall not exceed 10 mm at the arm tips and 6 mm on the channel. No collapse of the structure shall occur with a combination of proof load and point load applied

Test 2 B: The test 2 A shall be repeated with the assembly but with an asymmetrical load on the C2 column and point load applied to arm 8. The 100 kg and 200 kg uniformly distributed loads shall be applied to the upper three arms on one side and the lower three arms on the opposite side.

2.6.2.3 Test 3 : Tests on Channel Fixed on Beam/Floor

A length of main support channel section shall be fixed to steel structure/ floor and have loads applied as shown in the drawing enclosed and as detailed below

a) Test 3A : A length of steel structure shall be rigidly supported. It should be fitted on a metre length of channel section using beam clamps welded/bolted. A point load of 1200 kg shall be applied to the centre point via two brackets. No distortion or pulling of the components shall take place.

b) Test 3B : With the components assembled as in Test 3A, two perpendicular point loads of 600 kg shall be simultaneously applied at positions 150 mm either side of the centre line, no distortion or pulling of the components shall take place.

c) Test 3C: With the components assembled as in Test 3A, a perpendicular point load shall be applied at a point 150 mm on one side of the centre line.

The load shall be gradually increased to the maximum value that can be applied without causing distortion or pulling of the components. This value shall be recorded.

2.6.2.4 Test 4: Channel nut slip characteristic (whatever applicable)

Tests 4A1, 4A2, 4A3:

A length of channel C1 section 200mm long shall have fitted bracket with the two bolt fixing as shown in drawing enclosed. With loads applied at the position shown in drawing enclosed nut slip shall be determined with bolt torque of 30NM, 50 NM and 65 NM No fewer than three measurements shall be made for each torque setting.

A minimum loading of 720 kg shall be obtained before nut slip with bolt torque of 65 NM.

Tests 4B1, 4B2, 4B3:

The length of channel C1 section 200 mm long shall have fitted bracket with the one bolt fixing as shown in drawing enclosed. With loads applied at the position shown in drawing, nut slip shall be determined with bolt torques of 30 NM, 50 NM and 65 NM. No fewer than three measurements shall be made for each torque setting. A minimum loading of 350 kg shall be obtained before nut slip with a bolt torque of 65 NM.

	PROJECT: 3X110 MW KISHANGANGA HEP, CUSTOMER: NHPC LIMITED TITLE: TECHNICAL SPECIFICATION OF CABLE TRAYS	DOC NO. HSE/KIS/6-08/05 REV: 00
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2.6.2.5 Test 5: Weld Integrity Test

After deflection test as per test 1A, 15, 2, 3 & 4, weld integrity shall be checked by magnetic particle inspection to detect sub-surface cracks developed, if any.

2.6.2.6 Routine/ Acceptance Tests

Following routine/acceptance tests shall be carried out on all the equipments, devices & materials supplied

2.6.2.7 Galvanising Tests

The quality of galvanizing shall be inspected visually and shall be smooth, continuous, free from flux stains

In addition following tests shall be conducted:

- i) Uniformity of coating - The coating of any article shall withstand four 1 minute dips in standard copper sulphate solution without the formation of an adherent red spot of metallic copper upon the basic metal.
- ii) The quality of cadmium/ zinc plating on items with screw threads shall be inspected visually and shall be free from visible defects such as unplated areas, blisters and modules.
- iii) In addition, the plating thickness shall be determined microscopically/ chemically or electronically.

2.6.2.8 Welding

The quality of welding shall be visually inspected, particular attention being paid to the following points.

The welded joints shall be continuous along its length on both sides and of uniform width and thickness. It should be free from blow holes.

The weld metal shall be properly fused with the parent metal without undercutting.

The outside surface of the weld shall be clean. All slag shall have been removed. All welding shall be regularly checked for cracking using magnetic particle inspection or their equivalent technique.

2.6.2.9 Physical and dimensional checks for all items.

2.6.2.10 Deflection test cable trays.

2.6.2.11 All acceptance and routine tests

	PROJECT: 3X110 MW KISHANGANGA HEP, CUSTOMER: NHPC LIMITED TITLE: TECHNICAL SPECIFICATION OF CABLE TRAYS	DOC NO. HSE/KIS/6-08/05 REV: 00
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2.7 DRAWING AND DOCUMENTS (TO BE SUBMITTED BY VENDOR)

2.7.1 Along with bid

- Scope of supply as per Unprice Schedule (Annexure-E, Section-5)
- Description, Catalogue of cable trays and accessories
- Schedule of Guaranteed Technical Particulars as per section 4
- Deviation from specification, if any and "Nil Deviation" Certificate
- Type Test Reports/Certificates
- Reference List of Projects executed & Performance Certificates from end users.

Incomplete OFFER will not be accepted.

2.7.2 After Award of Contract:

All the drawings, manufacturing & quality schedules, operating and maintenance instructions shall be required on seven(7) soft copies in C.D. & Eight(8) reproducible of as built drawings along with the properly bound hard copies of final document as follows:

Please note that the following drawing and documents shall be submitted during execution stage for Scope-1 and Scope-2 separately for approval from BHEL/NHPC:

S. No	Documents / Drawings	A/I	No. of copies	Time of schedule
1.	Bill of materials indicating complete list of materials	A	8	Within 21 days of placement of LOI
2.	Guaranteed Technical Particulars of Cables as per Section-4	A	8	Within 21 days of placement of LOI
3.	Detailed drawing of cable trays and all the accessories	A	8	Within 21 days of placement of LOI
4.	Type test reports		8	Within 21 days of placement of LOI
5.	Routine and Shop test certificates as per clause no. 2.11.2	A	8	Within 15 days of approval of all drawings
6.	Manufacturing Quality Plan (Annexure-C, Section-5)	A	8	Within 21 days of placement of LOI
7.	Technical Literature / manuals	I	8	The draft O&M Manual within 8 weeks after placement of LOI
8.	Package/Consignment Data dully filled (Annexure-B, Section-5)	A	8	Within 21 days of placement of LOI
9.	O&M Manual giving instruction for initial checking, storage instructions shall be supplied as per relevant standard for Cable Trays.	A	12	Within 15 days of approval of all the drawings and documents
10.	CD for all drawings/documents mentioned in S. No. 1 to 9	I	7 Sets	Within 15 days of approval of all the drawings and documents

*** A = for approval I = for information**

	PROJECT: 3X110 MW KISHANGANGA HEP, CUSTOMER: NHPC LIMITED TITLE: TECHNICAL SPECIFICATION OF CABLE TRAYS	DOC NO. HSE/KIS/6-08/05 REV: 00
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Purchaser shall return back one copy to the Vendor after marking approved/ approved with comments, for necessary corrections at vendor's end. The vendor will supply the required nos. of revised documents as detailed above after incorporating the commented changes. Cable trays shall conform to the drawings/ documents approved by Customer.

All the drawings to be submitted in A3 size white paper and all documents are required to be submitted in A4 size white paper only. Ammonia prints/ blue prints shall not be acceptable.

Revised drawing/ documents in the same number of copies to be submitted within 2 weeks.

- 2.7.3 Final approval shall be given by customer. All the drawings and documents shall be submitted in required sets of hard copies and soft copies too. The soft copy of drawings shall be editable and preferably made in auto-cad software platform.
- 2.7.4 Whenever drawings & documents are revised after comments, the vendor shall resubmit required number of copies (hard copies and soft copies too) for approval. About one week time will be required for review of drawings by BHEL and one month for Customer's approval. Drawings shall necessarily have title block as per customer's requirements (will be given along with the order). All the drawings and documents shall be properly marked with revision no., date and signed without which the drawings will not be considered for review/approval.
- 2.7.5 The required no. of hard copies of Instruction manuals & drawings & soft copies of drawings (in CDs) shall be supplied prior to dispatch of the equipments. The manuals shall contain all final drawings, equipment description and instruction for installation of the equipment.
- 2.7.6 Packing list giving details of items packed, for each box shall be sent for approval prior to dispatch of the equipment.

BOLTED TYPE CABLE TRAY SYSTEM FOR SWITCHYARD

SECTION - 3

PROJECT DETAILS AND GENERAL SPECIFICATIONS

3.0 INTRODUCTION

Kishanganga Hydroelectric project (3x110=330MW) is located in Baramulla district of Jammu and Kashmir state of India. As a part of the project, 220/33 kV Switchyard is being carried out.

3.1 PROJECT INFORMATION

SL. NO	DESCRIPTION	
a)	Customer	NATIONAL HYDRO ELECTRIC POWER CORPORATION LIMITED (NHPC) <u>KISHANGANGA CONSORTIUM:</u> Hindustan Construction Company (HCC) Ltd. HALCROW <u>Subcontractor:</u> Bharat Heavy Electricals Ltd. (BHEL)
b)	Project	220/33kV Switchyard for Kishanganga (3x110MW) HEP
c)	Project locations	Kishanganga Hydroelectric project(3x110=330MW) is located in Baramulla district of Jammu and Kashmir state of India. Refer Project Details from Contract Specification attached herewith.
d)	Nearest Airport	Srinagar is the nearest city, well connected by Air.
e)	Nearest Railway station /Gauge Distance from Railway Station	Jammu is the nearest broad guage railway head
f)	Road Approach	Refer Project Details from Contract Specification attached herewith.
	Transport Limit	Refer Project Details from Contract Specification attached herewith.

3.2 SITE CONDITIONS

S.N	DESCRIPTION	
i.	Altitude	About 1795 m above mean sea level.
ii.	Rainfall (Average annual rainfall)	Refer Project Details from Contract Specification attached herewith.
iii.	AMBIENT AIR TEMPERATURE (a) Max. temp (b) Min. temp	38 deg C -12 deg C
iv.	RELATIVE HUMIDITY (a) Maximum (b) Minimum	94% 62%

Equipment to be supplied against this specification shall be suitable for satisfactory

BOLTED TYPE CABLE TRAY SYSTEM FOR SWITCHYARD

continuous operation under the above tropical conditions.

Seismic Design

The project is situated in a hilly seismic area and falls within Zone V of the seismic zoning Map of India. Value of horizontal component of peak ground acceleration for Maximum Credible Earthquake (MCE) and for Design basis Earthquake (DBE) shall be 0.36g and 0.18g respectively. The forces being caused by earthquake including hydraulic loads, which may occur additionally, shall be taken into account for the computations. Stresses resulting after including these loads shall not exceed permissible stresses.

The Contractor shall design all equipment supplied under this contract to satisfy the seismic criteria. The Contractor shall submit the method of calculation and relevant codes he intends to use for this purpose.

In addition to above, the IS 1893 shall be adopted for seismic design. Hydrodynamic forces due to seismic conditions shall be considered on HM or EM equipment in addition to hydro static loads.

3.3 INSPECTION, TESTING AND INSPECTION CERTIFICATE

All equipment being supplied shall conform to type tests and shall be subject to routine tests in accordance with relevant standards.

All tests and inspection of the equipment specified shall be performed to the extent and in the manner as stipulated in the relevant standards and in this specification. All type test/routine tests/acceptance tests as specified shall be conducted in the presence of BHEL/NHPC. Wherever equipment similar to the one being offered has already been type tested in an independent government laboratory or in the presence of representative of State Electricity Board or other reputed public undertakings, Type test reports of the same shall be submitted for approval of BHEL /NHPC.

If these are not found technically acceptable, contractor will have to carry out the type test without any extra cost and/ or delivery implications in presence of BHEL/NHPC.

Where specified by the purchaser, type tests will have to be conducted by the sub-contractor on the equipment in the scope of supply. Such test shall be witnessed by the customer and BHEL, for which the test charges and delivery implications if any shall be indicated separately by the sub-contractor.

The contractor shall give the Owner/Inspector 3 week's written notice of any material being ready for inspection/testing. Such tests shall be to the Contractor's account except for the expenses' of the Inspector.

The purchaser NHPC/BHEL or their authorized representative shall have at all reasonable times free access to the contractor's works and shall have the power at all reasonable times to inspect the material and workmanship of the works during manufacturing or erection if part of the works is being manufactured or assembled at other premises. Inspection may be made at any stage of manufacture, dispatch or at site at the option of NHPC/BHEL and the equipment if found unsatisfactory due to bad workmanship or quality is liable to be rejected.

When the factory tests have been completed at the subcontractor's works the Owner/Inspector shall issue a certificate to this effect after completion of tests. But if the tests are not witnessed

BOLTED TYPE CABLE TRAY SYSTEM FOR SWITCHYARD

by the Owner/Inspector, the waiver shall be issued by the Owner/Inspector within fifteen (15) days of the receipt of the Contractor's test certificate. Failure of the Owner/Inspector to issue such a waiver shall not prevent the contractor from proceeding with the works. The completion of these tests or the issue of the waiver shall not bind the Owner to accept the equipment should it, on further tests after erection be found not to comply with the Contract. However, in case of waivers, the contractor shall ensure to carry out the testing as per approved quality plans and specification requirements and send two copies of all the test results to the Owner for his review and approval.

In all cases where the Contract provides for tests at the premises or works of the contractor, the contractor, except where otherwise specified shall provide free of charge such items as labor materials, electricity, fuel; water, stores, apparatus and instruments as may be reasonably demanded by Owner/Inspector or his authorized representatives to carry out such tests.

The Inspection by Employer and issue of inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Contractor in respect of the agreed quality assurance programme forming a part of the contract.

The owner will have the right of having at his own expenses any other test(s) of reasonable nature carried out at contractor premises or at site or in any other place in addition of aforesaid type and routine tests, to satisfy that the material comply with the specification.

The Employer reserves the right for getting any field tests conducted on the completely assembled equipment at site.

3.4 QUALITY ASSURANCE PROGRAMME

The supplier should adopt suitable quality assurance programme to control all necessary activities to ensure that the equipment and / or services under the scope are in accordance with this specification. A quality plan detailing out the specific quality measure and procedures adopted for controlling the quality characteristics to be submitted for BHEL and NHPC approval.

The quality programme is defined by ISO 9001, 1994 Quality systems - Model for quality assurance in design, development, production, installation and servicing.

3.5 DOCUMENTATION

The Contractor shall submit a detailed list of all drawings he proposes to submit for approval/information after the award of the contract. This list shall be revised and extended, as necessary, during the progress of work.

All drawings submitted by the Contractor shall be in sufficient detail to indicate the type, size, arrangement weight of each component, breakdown for packing and shipment, the external connections, fixing arrangements required, the dimensions required for installation and interconnections with other equipment and materials. clearances and spaces required between various portions of equipment and any other information specifically requested.

After the award of the Contract, the Contractor shall submit, (as per the Distribution Schedule enclosed at the end of this section as a Table) copies of design basis reports/concept notes, design calculations, material specifications and detailed drawings as called for in the Contract for the Owner's / Owner's Representative review. The Contractor must satisfy the Owner's / Owner's Representative as to the validity of his design with reference to the requirements of

BOLTED TYPE CABLE TRAY SYSTEM FOR SWITCHYARD

Statutory Codes / Authorities, local regulations and the contract specifications.

All dimensions on drawings shall be in Metric Units, unless otherwise specified. The details in the drawings shall be in English language only.

Drawings submitted by the Contractor will be checked/reviewed by the Owner/Engineer and comments, if any, on the same will be conveyed to the Contractor. It is the responsibility of the Contractor to incorporate correctly all the comments conveyed by the Owner/Engineer on the Contractor's drawings. The drawings which are approved with comments are to be resubmitted to the owner/Engineer for purpose of records. Such drawings will not be checked/reviewed by the Owner/Engineer to verify whether all the comments have been incorporated by the Contractor. If the Contractor is unable to incorporate certain comments in his drawings he shall clearly state in his forwarding letter such non-compliance along with valid reasons and justification.

The Contractor shall not be relieved of his obligations under the Contract if he has not included features in the specification, including but not limited to his Guarantee obligations stated herein, by incorporating the Owner's / Owner's Representative comments.

Any work performed or material ordered by the Contractor prior to receipt of drawings stamped 'Approved with comments as noted', by the Owner/Engineer Shall be at the risk of the Contractor. After print of any drawing has been returned 'Approved', the Contractor may release the parts covered by the drawing, for production.

Drawings prepared by the Contractor and approved by the Owner/Engineer shall be considered as a part of the Contract Specification. However, examination and approval of the drawings by the Owner/Engineer shall not relieve the Contractor of his responsibility for engineering, design, workmanship, materials and construction under the Contract.

If, at any time before the completion of the work, changes are made necessitating revision of approved drawings, the Contractor shall make such revisions and proceed in the same routine as for the original approval.

3.5.1 OTHER REQUIREMENTS OF DOCUMENTATION

Upon completion of the installation, the Contractor shall furnish a complete set of drawings on reproducible tracing film on which the VENDOR/Contractor shall make in a neat and accurate manner, a complete record of all changes and revisions to, the original design, as installed in the completed work. These drawings shall be submitted to the Owner/Engineer.

AS BUILT DRAWINGS

The Contractor shall prepare and submit to the Owner/Engineer "As- Built drawings" of the Works, showing all Works as executed. The drawings shall be prepared as the Works proceed, and shall be submitted to owner/Engineer for his inspection. The Contractor shall obtain the consent of the Owner as to the drawing size, the referencing system and other pertinent details.

The drawings/documents distribution schedule shall be as indicated below.

The title block of drawings shall contain the following information incorporated in all contract drawings

BOLTED TYPE CABLE TRAY SYSTEM FOR SWITCHYARD

CUSTOMER	National Hydroelectric Power Corporation Limited (NHPC)				
PROJECT	220/33kV Switchyard for Kishanganga (3x110MW) HEP <u>KISHANGANGA CONSORTIUM:</u> Hindustan Construction Company (HCC) Ltd. HALCROW <u>Subcontractor:</u> Bharat Heavy Electricals Ltd. (BHEL)				
BHEL P.O. No.		PROJ. DOC. No.		REV. No.	
CONTRACTOR	BHARAT HEAVY ELECTRICALS LIMITED 				
VENDOR'S STANDARD TITLE BLOCK					

DOCUMENTS TO BE SUBMITTED ALONGWITH OFFER

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

DOCUMENTATION SCHEDULE AT CONTRACT STAGE

A	For Approval
7 (6+1)	Copies of GA drawings with projects details, dimension, equipment weight, fixing details, tolerances and terminal details etc.
7 (6+1)	Copies of type test reports
7 (6+1)	Copies of shipping list detailing the description & quantities of all items being dispatched separately, with shipping weights, number of cases and dimensions.
7 (6+1)	Copies of manufacturing and field quality plan.
B	After Approval and For Information/Distribution.
11 (10+1)	Copies of All drawings plus 2 Set Reproducibles.
11 (10+1)	Bound sets containing all 'as built' drawings/manuals, type and routine test reports etc. along with sub-vendor's test reports for all bought out assemblies/components/parts including Internal wiring diagrams and exploded diagrams of assemblies/ parts, shall be furnished plus 2 Set IR
11(10+1)	Copies of Installation, Operation & Maintenance manual.
11(10+1)	Sets of Spare parts catalogue.
5	Set of Computer CD-ROMs containing all 'as-built' drawings/documents.

All the technical documents and drawings required to be furnished under this contract as per specification shall be prepared in internationally accepted software of latest version used for preparation of documents and drawings.

All the drawings and documents shall be submitted in presentable folders properly bound and catalogued for easy retrieval / reference. Drawings shall be submitted in A0 / A2 /A3 and all documentation in A4 size. All drawings shall be digitally printed/ plotted. Ammonia print/ blue print shall not be accepted.

Time schedule of drawings/documents required at contract stage shall be furnished by the supplier.

Material shall not be dispatched without the approval of test certificates by purchasers.

BOLTED TYPE CABLE TRAY SYSTEM FOR SWITCHYARD

3.6 MATERIALS AND WORKMANSHIP

3.6.1. GENERAL REQUIREMENTS

Where the specification does not contain characteristics with reference to workmanship, equipment materials and component of the covered Equipment, it is understood that the same must be new, of highest grade of the best quality of their kind, conforming to the best engineering practice and suitable for the purpose for which they are intended.

The equipment must be new, of highest grade, the best quality of their kind, to best engineering practice, latest state of art and in accordance with purpose for which they are intended and to ensure satisfactory performance throughout the service life.

In case where the equipment material or components are indicated in the specification as "similar" to any special standard, the employer shall decide upon the question of similarity. When required by the specification or required by the employer the supplier shall submit, for approval, all the information concerning the material or components supplied, installed or used. Without such approval shall run the risk of subsequent rejection, it being understood that the cost as well as the time delay associated with the rejection shall be borne by the Supplier.

The design of the work shall be such that Installation, future expansions, replacement and general maintenance may be undertaken with a minimum of time and expenses. Each component shall be designed to be consistent with its duty and suitable factors of safety, subject to mutual agreements and shall be used throughout the design. All Joints and fastenings shall be devised, constructed and documented so that the component part shall be accurately positioned and retained to fulfill their required function. In general, screw threads shall be standard metric threads. The use of other thread forms will only be permitted when prior approval has been obtained from the Employer.

Whenever possible, all similar part of the works shall be made to gauge and shall also be made interchangeable with similar parts. All spare parts shall be interchangeable with, and shall be made of the same material and workmanship as the corresponding parts of the equipment supplied under specification. Where feasible, common component units shall be employed in different pieces of the equipment in order to minimize spare parts stocking requirements. All equipment of the same type and rating shall be physically and electrically interchangeable.

All material and equipment shall be installed in strict accordance with the manufacturer's recommendation(s). Only first-class work in accordance with the best modern practice will be accepted. Installation shall be considered as being the erection of equipment at its permanent location. This, unless otherwise specified, shall include unpacking, cleaning and lifting into position, grouping, leveling, aligning, coupling of or bolting down to previously installed equipment bases/ foundation, performing the alignment check and final adjusting prior to initial operation, testing and commissioning in accordance with the manufacturer's tolerances and instruction and the specification. All factory assembled rotating machinery shall be checked for alignment and adjustments made as necessary to re-establish the manufacturer's limits suitable guards shall be provided for the protection of personnel on all exposed rotating and/or moving machine parts and shall be designed for easy installation and removal for maintenance purpose. The spare equipment(s) shall be installed at designated location and tested for healthiness.

BOLTED TYPE CABLE TRAY SYSTEM FOR SWITCHYARD

The Supplier shall apply oil and grease of the proper specification to suit the machinery, as is necessary for the installation of the equipment. Lubricants used for installation purpose shall be drained out and the system flushed through where necessary for applying the lubricant required for operation. The Supplier shall apply all operational lubricants to the equipment installed by him.

All oil, grease and other consumables used in the Works/Equipment shall be purchased in India unless the Supplier has any special requirement for the specific application of a type of oil or grease not available in India. If such is the case he shall declare in the proposal, where such oil or grease is available. He shall help Employer in establishing equivalent India make and Indian supplier. The same shall be applicable to other consumables too.

A cast iron or welded steel base plate shall be provided for all rotating equipments which are to be installed on a concrete base unless otherwise agreed to by the Employer. Each base plate shall support the units and its drive assembly, shall be of design with pads for anchoring the units and shall have a raised up all around and shall have threaded in air connections, If so required.

All components exposed to rain shall be designed with sloped upper surface to avoid water pools.

3.7 PACKING AND SHIPPING

All the equipment shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at site till the time of erection. While packing all the materials, the limitation from the point of view of availability of Railway wagon sizes in India should be taken account.

The Contractor shall mark all containers with the implementing document number pertinent to the shipment. Each shipping container shall also be clearly marked on at least two sides as follows:

- ◆ Consignee : to be furnished at a later date
 - Contract No. :
 - Country of Origin :
 - Port of entry :
 - Item number (if applicable) :
 - Package number, in sequence :
 - and quantity per package :
 - Description of Works :
 - Net and gross weight, volume :

The Contractor shall be responsible for any loss or damage during transportation, handling and storage due to Improper packing. Employer takes no responsibility of the wagons.

- - x x - -

Section- 4

	PROJECT : 3x110 MW KISHANGANGA HEP	DOC NO.
	CUSTOMER : NHPC LIMITED	"
	TITLE : TECHNICAL SPECIFICATION OF CABLE TRAYS	REV. : 00

GUARANTEED AND TECHNICAL PARTICULARS
FOR GI CABLE TRAYS, ACCESSORIES
& FLEXIBLE CABLE TRAY SUPPORT SYSTEM

SR. NO.	PARAMETER	BIDDER'S DATA
1.	Name of the Project	3x110 MW KISHANGANGA HEP
2.	Bidder's Name and Address	"
3.	Manufacturer's Name and Address	"
4.	Applicable Standards	IS : 1079 / IS : 2062 / IS: 1367 IS : 2629 / IS : 2633 / IS : 4759 / IS:6745
5.	Application	For Cable Installation.
6.	Type/ Designation	Ladder / Perforated Cable Trays, Flexible Cable Tray Support System
7.	Material specification	IS: 1079 Grade-0, IS:2062
8.	Thickness of sheet metal for cable trays, Fitting ect.	Cable Tray - 2mm Thk(14 SWG). Coupler Plate - 3mm Thk. Flexible Cable Tray supports - 2.5mm Thk.
9.	Maximum permissible loading for a 2.5m long simply supported at both ends	UDL - 70 kg/mtr
10.	Corresponding deflection at centre, for the loading as in 9.0 above	7mm (Max)
11.	Weight of Zinc coating	490 gm/m ² , 70 MICRONS.
12.	Length of single cable tray piece	2500mm
13.	Maximum permissible loading at another end of tray	---
14.	Proposed Sizes (LXWXH) of cable trays	" ENGL/AM/DM

220/33kV Switchyard for Kishanganga (3x110MW) HEP for NHPC Limited

Technical Specification Doc. No. TB 329 316 029 Rev.00

BOLTED TYPE CABLE TRAY SYSTEM FOR SWITCHYARD

SECTION 5

ENCLOSURES TO SPECIFICATIONS

ANNEXURE 1	NO DEVIATION CERTIFICATE (1SHEET): ATTACHED WITH SECTION-1
ANNEXURE 2	CHECK LIST OF INFORMATION TO BE FURNISHED WITH THE OFFER (1SHEET)
ANNEXURE 3	GENERAL ARRANGEMENT DRAWING FOR HOT DIP GALVANIZED CABLE TRAYS, ACCESSORIES AND FLEXIBLE SUPPORT SYSTEM FOR CABLE TRAYS DRAWING NO. TB 329 316 029 (7 SHEETS)
ANNEXURE 4	QUALITY ASSURANCE PLAN (MODEL) FOR CABLE TRAY AND SUPPORTS (PAGE NOS. 786,795 AND 796: 3 SHEETS)
ANNEXURE 5	INFORMATION TO BE FURNISHED WITH THE OFFER (1SHEET)



Project: 3x110 MW KISHANGANGA HEP,
CUSTOMER: NHPC limited
TECHNICAL SPECIFICATION OF Switchyard - Cable Trench Material
Doc No. TB 329 316 029Rev: 00

Annexure-2

**CHECK LIST FOR INFORMATION TO BE FURNISHED WITH OFFER
(RETURN THIS CHECKLIST AS PART OF THE OFFER DULY SIGNED)**

The offer may not be considered if the following information and this Checklist are not enclosed with the Offer.

BHEL ENQUIRY. NO:

BIDDER OFFER REFERENCE:

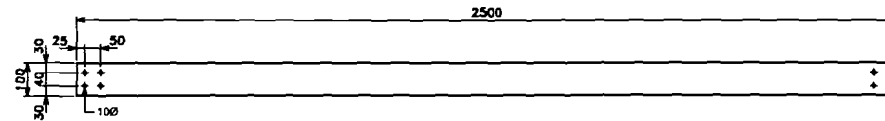
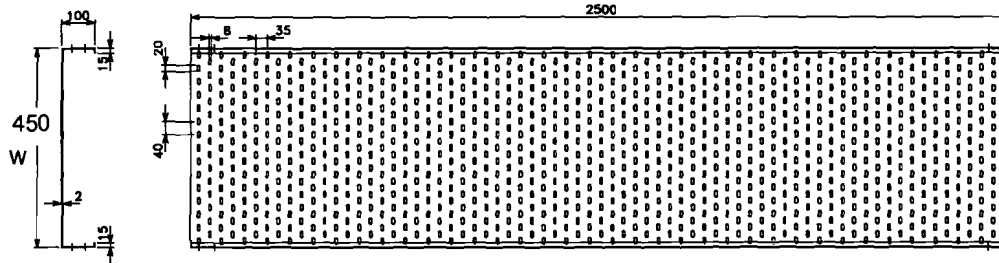
(1)	(2)	(3)	(4)	(5)
S.No.	Parameter	Requirement	Yes / No	Remarks in case reply in Col (4) is NO
1.	Equipment	Cable tray		
2.	Thickness of Tray	2.0mm	YES / NO	
3.	Type of cable-tray	Ladder/ Perforated		
a)	Ladder type		YES / NO	
b)	Perforated type		YES / NO	
4.	Material certificate	As per Relevant Standard (cl.2.2)	YES / NO	
5.	Weight of zinc coating	min. 490 gm/M ²	YES / NO	
6.	Maximum permissible deflection at centre of 2.5m long tray simply supported at both ends after applying the uniformly distributed required load	≤ 7mm	YES / NO	
7.	Required accessories (as per cl. 1.1 of standard spec.)	Included	YES / NO	
8.	Conformance to the Applicable standard	IS:2629, IS:2633, IS:6745, IS:4759	YES / NO	
9.	Information furnished as per clause 2.5.1 of section-2		YES / NO	

Section-5

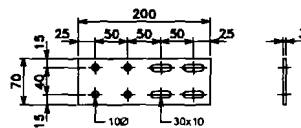
GENERAL ARRANGEMENT DRAWING FOR
SS/HOT DIP GALVANIZED CABLE TRAYS, ACCESSORIES
AND FLEXIBLE SUPPORT SYSTEM FOR CABLE TRAYS

Sheet No. 1 of 7

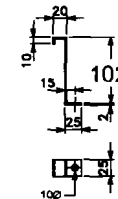
DRAWING NO. TB 329 316 029



STRAIGHT SECTION FOR
100MM HEIGHT CABLE TRAY



COUPLER PLATE FOR
100MM HEIGHT CABLE TRAY



Z-CLAMP FOR
100MM HEIGHT CABLE TRAY

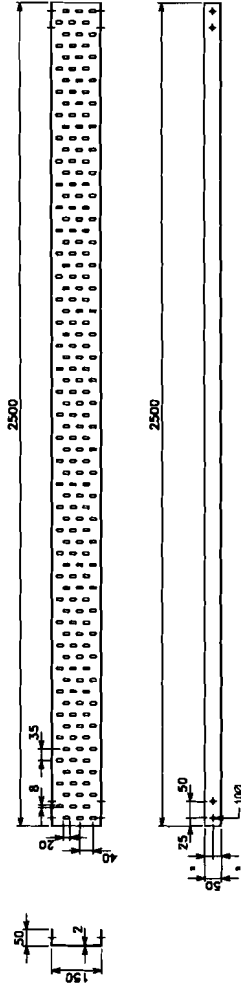
NOTES :-

01. ALL CABLE TRAYS & 'Z' CLAMPS ARE OF 2MM (14 SWG) THICK MS SHEET AS PER IS:1079 Gr-O.
ALL COUPLER PLATES ARE OF 3MM THICK MS SHEET AS PER IS:1079 Gr-O.
02. ALL CABLE TRAYS WILL BE HOT DIP GALVANIZED AFTER FABRICATION AS PER IS: 2629 / 2633 / 4759 / 6745.
ZINC COATING (AVERAGE) WILL BE 490 gms/Sq.mtr or 70 MICRONS.
03. ALL TOLERANCES WILL BE AS UNDER
LENGTH (-5 +10), WIDTH (-3 +5), HEIGHT (-3 +5), RADIUS (-25 +25), THICKNESS (-0.2 + 0.2) (NEGATIVE TOLERANCE AS PER IS:1852)
04. 2 NOS. COUPLER PLATES & 4 NOS. 'Z' CLAMPS WILL BE PROVIDED FOR EACH STRAIGHT SECTION OF CABLE TRAY.
05. ALL HARDWARE FOR COUPLER PLATES & 'Z' CLAMP ARE ELECTRO GALVANIZED & CONFORMS TO IS:1367.
8 SETS OF M8x20 HARDWARE FOR EACH COUPLER PLATE & 1 SET OF M8x35 HARDWARE FOR EACH 'Z' CLAMP WILL BE PROVIDED.
(1 SET OF M8x20 = 1 NO. M8x20 HEX HEAD BOLT + 1 NO. M8 HEX NUT + 1 NO. PLAIN WASHER + 1 NO. SPRING WASHER)
(1 SET OF M8x35 = 1 NO. M8x35 ROUND HEAD BOLT + 1 NO. M8 SPRING CHANNEL NUT + 1 SPRING WASHER)
06. ALL DIMENSIONS ARE IN 'MM' UNLESS OTHERWISE SPECIFIED.

Sheet No. 2 of 7

HOT DIP GALVANIZED
PERFORATED CABLE TRAYS

DRAWING NO. TB 329 316 029



STRAIGHT SECTION FOR
50MM HEIGHT CABLE TRAY

NOTES :-

01. ALL CABLE TRAYS " ARE OF 2MM (14 SWG) THICK MS SHEET AS PER IS:1079 G-O.
02. ALL CABLE TRAYS WILL BE HOT DIP GALVANIZED AFTER FABRICATION AS PER IS: 2629 / 2633 / 4759 / 6745. ZINC COATING (AVERAGE) WILL BE 490 gms/Sq.mtr or 70 MICRONS.
03. ALL TOLERANCES WILL BE AS UNDER
LENGTH (+5 +10), WIDTH (+3 +5), HEIGHT (+25 +25), THICKNESS (+0.2 + 0.2) (NEGATIVE TOLERANCE AS PER IS:1832)

06. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.

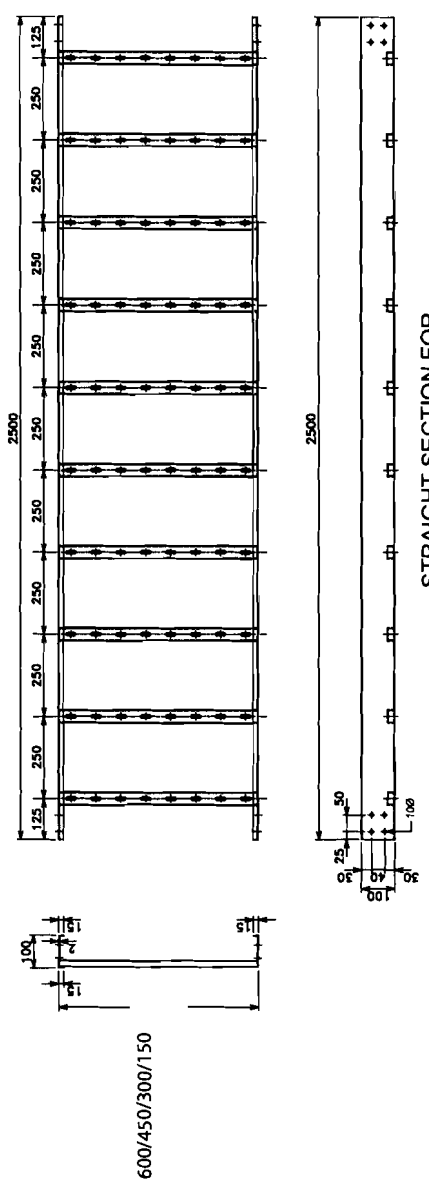
HOT DIP GALVANIZED
PERFORATED CABLE TRAYS

Sheet No. 3 of 7

DRAWING NO. TB 329 316 029

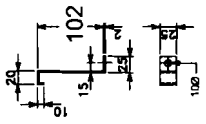
(ALL DIMENSIONS ARE IN MM)

FIRST ANGLE PROJECTION

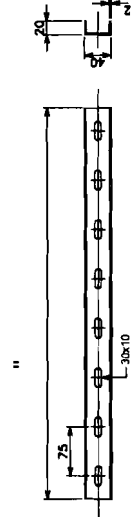


STRAIGHT SECTION FOR
100MM HEIGHT CABLE TRAY

COUPLER PLATE FOR
100MM HEIGHT CABLE TRAY



Z-CLAMP FOR
100MM HEIGHT CABLE TRAY



SLOTTED RUNG

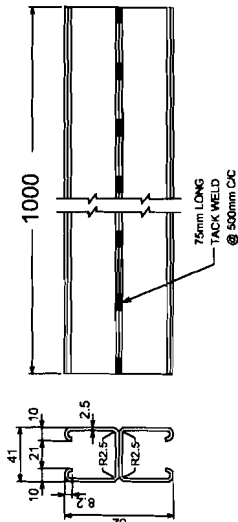
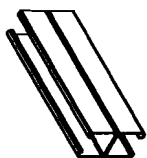
NOTES:-

01. ALL CABLE TRAYS ARE OF 2MM (14 SWG) THICK MS SHEET AS PER IS:1079 G.O.
02. ALL COUPLER PLATES ARE OF 3MM THICK MS SHEET AS PER IS:1079 G.O.
03. ALL CABLE TRAYS WILL BE HOT DIP GALVANIZED AFTER FABRICATION AS PER IS: 2639 / 2631 / 4759 / 6745.
04. ZINC COATING (AVERAGE) WILL BE 400 gms/Sq.mtr or 70 MICRONS.
05. ALL TOLERANCES WILL BE AS UNDER
LENGTH (+5 +10), WIDTH (+3 +5), HEIGHT (+3 +5), THICKNESS (+0.2 +0.2) (NEGATIVE TOLERANCE AS PER IS:1832)
06. 2 NOS. COUPLER PLATES & 4 NOS. Z CLAMPS WILL BE PROVIDED FOR EACH STRAIGHT SECTION OF CABLE TRAY.
07. ALL HARDWARE FOR COUPLER PLATES & Z CLAMP ARE ELECTRO GALVANIZED & CONFORMS TO IS:1357.
08. 8 SETS OF M8x20 HARDWARE FOR EACH COUPLER PLATE & 1 SET OF M8x35 HARDWARE FOR EACH Z CLAMP WILL BE PROVIDED.
(1 SET OF M8x20 = 1 NO. M8x20 HEX HEAD BOLT + 1 NO. M8 HEX NUT + 1 NO. PLAIN WASHER + 1 NO. SPRING WASHER)
(1 SET OF M8x35 = 1 NO. M8x35 ROUND HEAD BOLT + 1 NO. M8 SPRING CHANNEL NUT + 1 SPRING WASHER)
09. ALL DIMENSIONS ARE IN 'MM' UNLESS OTHERWISE SPECIFIED.

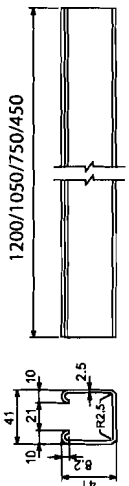
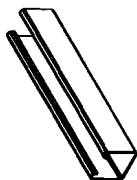
HOT DIP GALVANIZED
LADDER CABLE TRAYS

DRAWING NO. TB 329 316 029

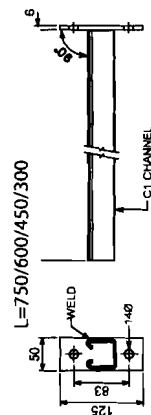
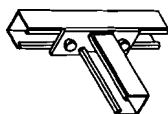
Sheet No. 4 of 7



FLEXIBLE SUPPORT CHANNEL - C2 TYPE



FLEXIBLE SUPPORT CHANNEL - C1 TYPE



CANTILEVER ARM FOR HORIZ. TRAY - C1 TYPE

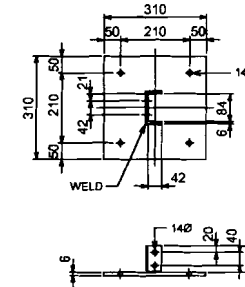
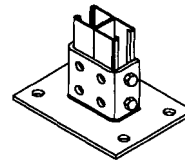
NOTES:-

01. ALL SUPPORT CHANNELS (C1 & C2) & CANTILEVER ARMS ARE OF 2.5MM THICK MS SHEET AS PER IS:1079 G-O. MS FLATS FOR CANTILEVER ARMS ARE AS PER IS:2062, GR-E250.
02. ALL SUPPORT CHANNELS (C1 & C2) & CANTILEVER ARMS WILL BE HOT DIP GALVANIZED AFTER FABRICATION AS PER IS: 2650 / 2633 / 4759 / 16745. ZINC COATING (AVERAGE) WILL BE 480 gms/Sq.mtr or 70 MICRONS.
03. ALL TOLERANCES WILL BE AS UNDER
C1 & C2 : PROFILE (±1.0), ANGULAR (±2.0), BOW, CAMBER & TWIST (±2 mm/mtr), WAVINESS (±2), LENGTH (-5+10), THICKNESS (±0.2)
04. CANTILEVER ARMS : LENGTH (±5), WIDTH (±3), HEIGHT (±2) & THICKNESS (±0.2)
ALL HARDWARE FOR CANTILEVER ARMS ARE ELECTRO GALVANIZED & CONFORMS TO IS:1387.
2 SETS OF M12x35 HARDWARE & 2 SETS OF M8x35 HARDWARE FOR EACH CANTILEVER ARM WILL BE PROVIDED.
(1 SET OF M12x35 = 1 NO. M12x35 HEX HEAD BOLT + 1 NO. M12 SPRING CHANNEL NUT + 1 SPRING WASHER)
(1 SET OF M8x35 = 1 NO. M8x35 ROUND HEAD BOLT + 1 NO. M8 SPRING CHANNEL NUT + 1 SPRING WASHER)
05. ALL DIMENSIONS ARE IN 'MM' UNLESS OTHERWISE SPECIFIED.

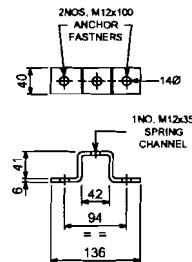
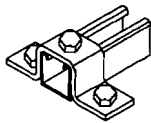
HOT DIP GALVANIZED
FLEXIBLE CABLE TRAY SUPPORT

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN MM)



MOUNTING BASE PLATE FOR C2 CHANNEL



MOUNTING CLAMP (SADDLE TYPE) FOR C1 CHANNEL

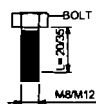
NOTES :-

01. ALL MOUNTING BASE PLATES & CLAMPS ARE OF 6MM THICK MS FLATS / SHEET & AS PER IS:2062, GR-E250.
02. ALL MOUNTING BASE PLATES & CLAMPS WILL BE HOT DIP GALVANIZED AFTER FABRICATION AS PER IS: 2629 / 2633 / 4759 / 6745. ZINC COATING (AVERAGE) WILL BE 490 gms/Sq.mtr or 70 MICRONS.
03. ALL TOLERANCES WILL BE AS UNDER
 MOUNTING BASE PLATES & CLAMPS : LENGTH (±5), WIDTH (±3), HEIGHT (±2) & THICKNESS (±0.2)
04. ALL HARDWARE FOR CANTILEVER ARMS ARE ELECTRO GALVANIZED & CONFORMS TO IS:1367.
 " 4 SETS OF M12x35 HARDWARE & 4 SETS OF M12x100 HARDWARE FOR EACH MOUNTING BASE PLATE (C2 TYPE) WILL BE PROVIDED.
 1 SET OF M12x35 HARDWARE & 2 SETS OF M12x100 HARDWARE FOR EACH MOUNTING CLAMP WILL BE PROVIDED.
 (1 SET OF M12x35 = 1 NO. M12x35 HEX HEAD BOLT + 1 NO. M12 SPRING CHANNEL NUT + 1 SPRING WASHER)
 (1 SET OF M12x100 = 1 NO. M12x100 ANCHOR BOLT + 1 NO. M12 HEX NUT + 1 PLAIN WASHER + 1 SPRING WASHER)-HILTI MAKE
05. ALL DIMENSIONS ARE IN 'MM' UNLESS OTHERWISE SPECIFIED.

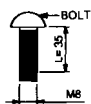
HOT DIP GALVANIZED
 FLEXIBLE CABLE TRAY SUPPORT

Sheet No. 6 of 7

DRAWING NO. TB 329 316 029



HEX HEAD BOLT



ROUND HEAD BOLT



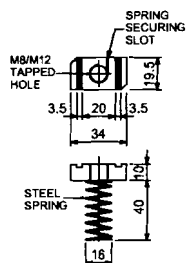
M8/M12 PLAN WASHER



M8/M12 SPRING WASHER



M8/M12 HEX NUT



SPRING NUT

NOTES :-

01. BLANK
- 02.
03. ALL TOLERANCES WILL BE AS UNDER
LENGTH (± 5), WIDTH (± 3), RADIUS (± 1) & THICKNESS (± 0.2)
04. ALL DIMENSIONS ARE IN 'MM' UNLESS OTHERWISE SPECIFIED.

MISCELLANEOUS ITEMS FOR CABLE TRAYS, ACCESSORIES
& FLEXIBLE SUPPORT SYSTEM FOR CABLE TRAYS

Sheet No. 7 of 7

DRAWING NO. TB 329 316 029

**16. MODEL QUALITY ASSURANCE PLAN (QAP) FOR POWER & CONTROL CABLES
(INCLUDING CABLE TRAYS)****Special instructions: -**

1. Contractors/Manufacturers/Sub-suppliers are advised to submit QAP for equipments/ materials after incorporating all tests for bought out items, in process inspection and final inspections as per their latest manufacturing practice and Indian/ International Standards (with latest amendments, if any).
2. Contractors/Manufacturers/Sub-suppliers are required to use properly calibrated instruments /equipments during testing/inspection, for which necessary calibration certificates are required to be provided/presented to the Inspecting Officer.
3. Contractors/Manufacturers/Sub-suppliers have to make on their own all arrangements for testing facilities at their works for testing of equipments/materials.
4. One set of complete test certificates as per the requirement of QAP be made available to the Inspecting Officer at the time of inspection/testing.
5. All the records, as per the requirement of QAP are to be made available for review by the Inspecting Officer during inspection.
6. Field tests are to be carried out as per the requirements of the contract / purchase order.



QUALITY ASSURANCE PLAN (MODEL)

Page 10 of 11

PROJECT : KISHANGANGA H.E. PROJECT
NAME OF
EQUIPMENT : Cable Tray

CLIENT: NATIONAL HYDROELECTRIC POWER CORPORATION LTD.
VENDOR :
NIT/P.O. REFERENCE :

SR. NO.	ITEM /COMPONENTS & CHARACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECKS	REFERENCE DOCUMENTS / ACCEPTANCE NORMS	RECORD FORMAT	INSP. AGENCY			REMARKS
						Perform	Witness	Verify	
1	Raw Material & Bought Out Items.								
1.1	(MS Sheet/Channel/Angle)								
a)	Chemical composition	Chem.	Sampling Plan	Tech.Spec./ Appd.drg./IS:1079	TC	3/2	-	1	TC
b)	Physical Properties	Test	-do-	-do-	TC	3/2	-	1	TC
c)	Surface Finish	Visual	-do-	-do-	TC	3/2	-	1	TC
d)	Dimensions	Measurement	-do-	Tech.Spec./ Appd.drg./IS:1852	TC	3/2	-	1	TC
1.2	Fasteners and Hardware								
a)	Visual and Dimensional	Visual & Measurement	-do-	Tech.Spec./ Appd.drg./IS:1367	TC	3/2	-	1	TC
b)	Quantity of Zinc Deposit Over Threaded Portion	Measurement	-do-	-do-	TC	3/2	-	1	TC
2	In Process Stage								
2.1	Galvanishing								
a)	Galvanisation, Chemical Composition of Zinc, Surface Defects, Bath Temperature.	Chem./Visual	Sampling plan	Tech.Spec./ Appd.drg./IS:2629	TC	3/2	-	1	TC
2.2	Galvanised Trays								
a)	Surface Defects	Visual	Sampling Plan	-do-	TC	3/2	-	1	TC
b)	Uniformity of Zinc Coating	Test	-do-	Tech.Spec./ Appd.drg./IS:2633	TC	3/2	-	1	TC
c)	Thickness of Zinc Coating	Measurement	-do-	Tech.Spec./ Appd.drg.	TC	3/2	-	1	TC
d)	Adhesion Test	Physical	-do-	Tech.Spec./ Appd.drg./IS:2629	TC	3/2	-	1	TC
e)	Weight of Zinc Coating	Measurement	-do-	Tech.Spec./ Appd.drg./IS:6745	TC	3/2	-	1	TC
2.3	Dicromating	Visual	-do-	Tech.Spec./ Appd.drg.	TC	3/2	-	1	TC

Note: a. In 'Inspection Agency' column figure 1,2,or 3 to be filled. 1- will indicate 'NHPC', 2- will indicate 'supplier' & 3- will indicate 'sub-supplier'.

b. In 'Remarks' column following abbreviations shall be used - RR-Review of Records, T.C. - Test Certificate Submission & CHP - Customer Hold Point.

c. Test certificates shall be submitted at the time of final inspection.

Signature
NHPC (QA&I DEPT.)

Signature & Seal
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)

QUALITY ASSURANCE PLAN(MODEL)

Page 11 of 11

PROJECT : KISHANGANGA H.E. PROJECT
NAME OF
EQUIPMENT : Cable Tray

CLIENT: NATIONAL HYDROELECTRIC POWER CORPORATION LTD.
VENDOR :
NIT/P.O. REFERENCE :

SR. NO.	ITEM /COMPONENTS & CHRACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECKS	REFERENCE / ACCEPTANCE DOCUMENTS NORMS	RECORD FORMAT	INSP AGENCY			REMARKS
						Perform	Witness	Verify	
3	Final Inspection								
3.1	Dimension/ Finish of Trays & Covers	Measurement & Visual	Sampling Plan	-do-	TC	3/2	-	1	TC
3.2	Load Capacity	Deflection Test	-do-	-do-	TC	3/2	-	1	TC
3.3	Surface defects / Black Spot	Visual	-do-	-do-	TC	3/2	-	1	TC
3.4	Uniformity of Zinc Coating	Test	-do-	Tech.Spec./ Appd drg./IS:2633	TC	3/2	-	1	TC
3.5	Weight of Zinc Coating	Measurement	-do-	Tech.Spec./ Appd drg./IS:6745	TC	3/2	-	1	TC
3.6	Check for Dicromating	Visual	-do-	Tech.Spec./ Appd drg./IS:2629	TC	3/2	-	1	TC
3.7	Thickness of Zinc Coating	Measurement	-do-	Tech.Spec./ Appd drg.	TC	3/2	-	1	TC
3.8	Adhesion Test	Hammer Test	-do-	Tech.Spec./ Appd drg./IS:2629	TC	3/2	-	1	TC

Note: a. In 'Inspection Agency' column figure 1,2,or 3 to be filled. 1- will indicate 'NHPC', 2- will indicate 'supplier' & 3- will indicate 'sub-supplier'.

b. In 'Remarks' column following abbreviations shall be used - RR-Review of Records, T.C. - Test Certificate Submission & CHP - Customer Hold Point.

c. Test certificates shall be submitted at the time of final inspection.



F/IA/740/01/01

Rev.-01

796

Signature
NHPC (QA&I DEPT.)

Signature & Seal
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)



Project: 3x110 MW KISHANGANGA HEP,
CUSTOMER: NHPC limited
TECHNICAL SPECIFICATION OF Switchyard - Cable Trench Material
Doc No. TB 329 316 029Rev: 00

INFORMATION TO BE FURNISHED BY THE SUPPLIER/ SUBCONTRACTOR

Annexure-5

Information / documents to be furnished at the TENDER / CONTRACT STAGE shall be as given below: (marked '√' in the appropriate column)

S. No.	DETAILS OF DOCUMENTATION TO BE FURNISHED	AT TENDER STAGE	AT CONTRACT STAGE
1.	Technical offer with details of equipment, scope etc	√	-
2.	Guaranteed Technical particulars	√	Revised and updated
3.	Schedule of Tests to be conducted	√	-
4.	Schedule of deviations, if any, clause wise, with respect to technical specifications	√	-
5.	List of past supplies complete with purchase & project ref., quantity, order ref., etc. where identical equipment have been supplied	√	-
6.	Quality Plan	√	√
7.	GA drawing with dimensions & weight and foundation/ fixing details	√	√
8.	Drg & Data submission schedule (to be furnished at contract stage shall be specified date-wise here)	√	
9.	Type test Reports	√	√
10.	Bar chart showing the time schedule indicating the time required for design, submission of drawing, manufacture of equipment, test and inspection	√	
11.	Routine / Acceptance test reports	-	√
12.	Installation, Operation & Maintenance Manual	√	√
13.	Check list and other schedules as per section 5 of this specification shall be necessarily submitted along with offer.	√	√
14.	Technical Catalogues and Leaflets	√	-