BHARAT HEAVY ELECTRICALS LIMITED

PROJECT ENGINEERING MANAGEMENT, NOIDA

Date-20-Feb-25

CORRIGENDUM- 01

PROJECT	**:**	**FRAMEWORK AGREEMNT (RATE CONTRACT)**
PACKAGE	**:**	**LT PVC CONTROL CABLE**
ENQUIRY NO.	**:**	**77/24/6048/MAZ dtd 10.02.2025**
SUBJECT	**:**	**Clarification regarding clause No. 20 of NIT and due date extension**

Type of Corrigendum			
Technical Corrigendum -	☑	Commercial Corrigendum -	☑

Suppliers are requested to note:

1. Clause no. 20 of NIT may be read as under,
   "PVC (Price Variation Clause) shall be applicable as per enclosed PVC Annexure to NIT. Base date for initial prices for this tender shall be one month prior to date of NIT. All Suppliers shall quote as per the Price Variation Formulae provided in NIT. For reference dates, please refer attached IEEMA circular."

   The price variation shall be limited to + 20% of total ex-works actually supplied (cable size wise) and negative price variation shall be unlimited.

2. Technical Specification with latest QP is attached.

3. Due date & time of bid submission has been extended up to 25.02.2025 @ 12.00 PM. Bid opening shall be done at 04:00 PM on the due date.

All the other terms and conditions of the tender enquiry remain unchanged. All the Suppliers are requested to quote accordingly.

Yours faithfully,

For and on behalf of BHEL

Mazhar Wahab

Digitally signed by Mazhar Wahab
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Md Mazhar Wahab
Dy. Manager/CMM

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Cir. No. **35**/DIV/ CAB/05/ 24th April 2018

To Members of the Cable Division, Utilities, Railways & Listed purchasing organizations

Sub: Correction in PV formulae of LT XLPE Power Cable and addition of factors for HT XLPE Power Cables

We have recently published revised Price Variation Clause for LT&HT XLPE Power Cables and made it effective from 1st November 2017 vide Cir. No.111/DIV/CAB/05 dated 5th December 2017

While replying to a query of a buyer it is observed that the polymer factor for LT XLPE Power Cables (both aluminium and copper) was incorrectly represented by Table P2.

We have now corrected the anomaly by correcting the PV formulae of LT XLPE Aluminium and Copper Insulated Cables (Sl. No. D & E) by representing Polymer factor by Table L2.

We have also worked out factors for XLPE, Copper and Steel for 3 core HT XLPE Power Cables for 500 and 630 sq.mm.

We now enclose complete PV clause of Cable by including all the PV formulae of different types of power cable (Sl. No. A to I), polymer factor Table L2 and updated XL4, H2 and H5 Table of factors for your perusal & record.

We request to replace PV clause of Cable already circulated vide Cir. 111/DIV/CAB/05 dated 5th December 2017 with the enclosed PV clause in your records for future use.

Senior Director

Encl: as above

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Material Price Variation Clause For PVC And XLPE Insulated Cables

The Price quoted/confirmed is based on the input cost of raw materials/components as on the date of quotation, and the same is deemed to be related to the prices of raw materials as specified in the price variation clause given below. In case of any variation in these prices, the price payable shall be subject to adjustment up or down in accordance with the formulae provided in this document.

Terms used in price variation formulae:

P Price payable as adjusted in accordance with above appropriate formula **(in Rs/Km)**

Po Price quoted/confirmed **(in Rs/Km)**

ALUMINIUM

AIF Variation factor for aluminium

AI Price of Aluminiujm. This price is as applicable of first working day of the month, one month prior to the date of delivery.

Alo Price of aluminium. This price is as applicable on first working day of the month, one month prior to the date of tendering.

COPPER

CuF Variation factor for copper

Cu Price of CC copper rods. This price is as applicable on first working day of the month, one month prior to the date of delivery.

Cuo Price of CC copper rods. This price is as applicable on first working day of the month, one month prior to the date of tendering.

PVC COMPOUND

PVCc price of PVC compound. This price is as applicable on first working day of the month, one month prior to the date of delivery.

PVCco Price of PVC compound. This price is as applicable on first working day of the month, one month prior to the date of tendering.

CCFAI Variation factor for PVC compound/Polymer for aluminum conductor cable.

CCFCu Variation factor for PVC compound/Polymer for copper conductor cable.

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XLPE COMPOUND

Cc price of XLPE compound. This price is as applicable on first working day of the month, one month prior to the date of delivery.

Cco Price of XLPE compound. This price is as applicable on first working day of the month, one month prior to the date of tendering.

XLFAL Variation factor for XLPE compound for aluminum conductor cable.
XLFCU Variation factor for XLPE compound for Copper conductor cable.

STEEL

FeF Variation factor for steel

FeW Variation factor for round wire steel armouring

Fe Price of Steel Strips/steel wire. This price is as applicable on the first working day of the month, one month prior to the date of delivery.

Feo Price of steel strips/steel wire. This price is as applicable on first working day of the month, one month prior to the date of tendering.

The above prices and indices are as published by IEEMA vide Circular reference IEEMA (PVC)/CABLE R(1)/--/-- prevailing as on 1st working day of the month i.e. one month prior to the date of tendering.

The date of delivery is the date on which the cable is notified as being ready for inspection/dispatch (in the absence of such notification, the date of manufacturer's dispatch note is to be considered as the date of delivery) or the contracted delivery date (including any agreed extension thereto), whichever is earlier.

Notes

(a) All prices of raw materials are exclusive of GST amount.
(b) All prices excluding Aluminium & Copper are as on first working day of the month.
(c) The details of prices are as under:

1. Price of Aluminium is LME average Cash SELLER Settlement price of Primary Aluminium in US$ per MT as published by London Metal Bulletin (LME) including Premium for Aluminium Ingot in US$ per MT is converted in Indian Rs./MT.
2. Price of PVC Compound (in Rs/MT) is the ex-works price, as quoted by the manufacturer.
3. Price of XLPE Compound (in Rs/MT) is the ex-works price, as quoted by the manufacturer
4. Price of CC copper rods (in Rs/MT) is ex-works price as quoted by the primary producer.
5. Price of galvanized steel strip / steel wire (in Rs/MT) is ex-works price as quoted by the manufacturer for Round steel Wire and Flat steel strip (the relevant price of steel strip or steel wire is to be selected depending upon the type of armouring of the cable).

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Price variation formulae for 'Power Cables'

A. Aluminum conductor PVC insulated 1.1 kV power cables

P = Po + AlF (AL – Alo) + CCFAl (PVCc – PVCco) + FeF (Fe - Feo)

For unarmourd multicore cables (without steel armour); FeF = 0

Table References:

ALP	Aluminium conductor in single core unarmoured & multicore cables
P1	Aluminium conductor aluminium armour in single core armoured cables
P2	PVC compound
P3	Steel armour

B. Copper conductor PVC insulated 1.1 kV power cables

P = Po + CuF (Cu – Cuo) + CCFCu (PVCc – PVCco) + Fef (Fe – Feo) + AlF (Al – Alo)

For steel armoured cables; AlF = 0 For aluminium armoured cables; FeF = 0
For unarmoured cables; FeF, AlF = 0

Tables References:

CUP	Copper conductor
P2	PVC compound
P3	Steel armour
P4	Aluminium armour

C. Copper conductor PVC insulated 1.1 kV control cables

P = Po + CuF (Cu – Cuo) + CCFCu (PVCc-PVCco) + FeF (Fe-Feo)

For unarmoured cables; FeF = 0

Tables References:

CUC	Copper conductor
P5	PVC compound
P6	Steel armour

D. Aluminum conductor XLPE insulated 1.1 kV power cables

P = Po + AlF (AL – Alo) +XLFAL(CC-Cco)+ CCFAl (PVCc – PVCco) + FeF (Fe - Feo)

For unarmourd multicore cables (without steel armour); FeF = 0

Table References:

ALP	Aluminium conductor in single core unarmoured & multicore cables
P1	Aluminium conductor aluminium armour in single core armoured cables
L2	Polymer (CCFAl)
P3	Steel armour
XL1	XLPE Compound (XLFAL)

E. Copper conductor XLPE insulated 1.1 kV power cables

P = Po + CuF (Cu – Cuo) + XLFCU (CC-Cco)+ CCFCu (PVCc – PVCco) + Fef (Fe – Feo) + AlF (Al – Alo)

For steel armoured cables; AlF = 0 For aluminium armoured cables; FeF = 0

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For unarmoured cables; FeF, AIF = 0

Tables References:

CUP	Copper conductor
L2	Polymer (CCFCu)
P3	Steel armour
P4	Aluminium armour
XL1	XLPE Compound (XLFCu)

F. Copper conductor XLPE insulated 1.1 kV control cables

P = Po + CuF (Cu – Cuo) + XLFCU (CC-Cco)+ CCFCu (PVCc-PVCco) + FeF (Fe-Feo)

For unarmoured cables; FeF = 0

Tables References:

CUC	Copper conductor
P5	PVC compound
P6	Steel armour
XL2	XLPE Compound

G. For Aluminium conductor XLPE insulated 3.3 to 33 kV power cables

P = Po + AlF (Al – Alo) + XLFAL(CC-Cco)+CCFAl (PVCc – PVCco) + FeF (Fe – Feo)

For unarmoured multicore cables (without steel armour); FeF = 0

Table Refernces:

ALP	Aluminium conductor in single core unarmoured & multicore cables
H1	Aluminium conductor + aluminium armour in single core armoured cables
H2	Polymer
H3/H5	Steel armour (Flat/Round)
XL3/XL4	XLPE Compound (Single core /Multicore)

H. Copper conductor XLPE Insulated 3.3 to 33 kV power cables

P = Po + CuF (Cu – Cuo) + XLFCU (CC-Cco)+ CCFCu (PVCc – PVCco) + FeF (Fe – Feo) + AlF (Al – Alo)

For steel armoured cables; AlF = 0 For aluminium armoured cables; FeF = 0
For unarmoured cables; FeF, AlF = 0

Table References:

CUP	Copper conductor
H2	Polymer
H3/H5	Steel armour (Flat/Round)
H4	Aluminium armour
XL3/XL4	XLPE Compound (Single core /Multicore)

I. Copper conductor XLPE insulated 1.0 and 1.5 kV Solar PV DC cables

P = Po + CuF (Cu – Cuo)
Table CUsdc Copper Conductor

Authorized Signatory

TABLE ALP

VARIATION FACTOR FOR ALUMINIUM (AIF)

POWER CABLES WITH ALUMINIUM CONDUCTOR
(EXCLUDING SINGLE CORE ARMOURED CABLES)

Nominal Cross Sectional Area (in Sq. mm.)	1 core	2 core	3 core	3.5 core	4 core
2.5	0.007	0.014	0.021	-	0.028
4	0.011	0.023	0.034	-	0.046
6	0.017	0.034	0.052	-	0.069
10	0.029	0.053	0.087	-	0.116
16	0.046	0.091	0.137	-	0.183
25/16	0.073	0.146	0.219	0.262	0.292
35/16	0.101	0.202	0.302	0.345	0.404
50/25	0.137	0.273	0.410	0.478	0.547
70/35	0.197	0.395	0.593	0.687	0.791
95/50	0.274	0.548	0.821	0.949	1.095
120/70	0.346	0.691	1.036	1.221	1.382
150/70	0.425	0.853	1.279	1.464	1.706
185/95	0.533	1.070	1.605	1.861	2.140
225/120	0.655	1.310	1.965	2.287	2.620
240/120	0.703	1.400	2.099	2.421	2.799
300/150	0.879	1.757	2.635	3.033	3.514
400/185	1.126	2.249	3.374	3.873	4.498
500	1.418	2.838	4.256	-	5.675
630	1.828	3.663	5.494	-	7.326
800	2.340	4.679	7.018	-	9.357
1000	2.951	5.890	8.834	-	11.779

TABLE CUP

VARIATION FACTOR FOR COPPER CONDUCTOR (CUF)

POWER CABLES WITH COPPER CONDUCTOR

Nominal Cross Sectional Area (in Sq. mm.)	1 core	2 core	3 core	3.5 core	4 core
2.5	0.023	0.046	0.069	-	0.092
4	0.036	0.076	0.112	-	0.151
6	0.056	0.112	0.171	-	0.227
10	0.095	0.174	0.286	-	0.382
16	0.151	0.299	0.451	-	0.602
25/16	0.240	0.480	0.720	0.862	0.960
35/16	0.332	0.664	0.993	1.135	1.329
50/25	0.451	0.898	1.348	1.572	1.799
70/35	0.648	1.299	1.950	2.260	2.602
95/50	0.901	1.802	2.700	3.121	3.601
120/70	1.138	2.273	3.407	4.016	4.545
150/70	1.398	2.806	4.207	4.815	5.611
185/95	1.753	3.519	5.279	6.121	7.038
225/120	2.154	4.309	6.463	7.522	8.617
240/120	2.312	4.605	6.904	7.963	9.206
300/150	2.891	5.779	8.667	9.976	11.558
400/185	3.703	7.397	11.097	12.738	14.794
500	4.664	9.334	13.998	-	18.665
630	6.012	12.048	18.070	-	24.095
800	7.696	15.389	23.082	-	30.775
1000	9.706	19.372	29.055	-	38.741

TABLE CUsdc

VARIATION FACTOR FOR COPPER CONDUCTOR (CUF)

1.0 & 1.5KV Solar PV DC Cables with Copper Conductor

Cable Size in sq.mm.	Copper content in MT/km
2.5	0.023
4	0.038
6	0.058
10	0.090

TABLE CUC

VARIATION FACTOR FOR COPPER CONDUCTOR (CUF)

CONTROL CABLES WITH COPPER CONDUCTOR

No of Cores	Core size 1.5 sq mm	Core size 2.5 sq mm
2	0.026	0.047
3	0.039	0.070
4	0.052	0.094
5	0.065	0.117
6	0.078	0.141
7	0.091	0.164
8	0.110	0.182
9	0.117	0.205
10	0.130	0.235
12	0.157	0.282
14	0.183	0.329
16	0.209	0.376
18	0.246	0.410
19	0.248	0.446
20	0.260	0.456
24	0.313	0.563
27	0.352	0.634
30	0.391	0.704
37	0.483	0.869
44	0.573	1.033
52	0.678	1.221
61	0.796	1.432

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TABLE P1

VARIATION FACTOR FOR ALUMINIUM (AIF)

ALUMINIUM ARMOURED SINGLE CORE PVC INSULATED 1.1 KV CABLES

Nominal cross sectional area (in Sq.mm)	Aluminium factor for Aluminium armoured cable with aluminium conductor
4	0.0685
6	0.0795
10	0.1017
16	0.1303
25	0.1693
35	0.2090
50	0.2597
70	0.3360
95	0.4567
120	0.5443
150	0.6427
185	0.7743
240	0.9737
300	1.2582
400	1.5502
500	1.8958
630	2.3650
800	2.9306
1000	3.7666

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TABLE P2

VARIATION FACTOR FOR PVC COMPOUND (CCFAI/CCFCu)

PVC INSULATED 1.1 KV POWER CABLES WITH COPPER/ALUMINIUM CONDUCTOR

Nominal cross Sectional Area (in Sq. mm)	1 core	2 core		3 core		3.5 core		4 core	
	Unarm	Unarm	arm	Unarm	arm	Unarm	arm	Unarm	arm
2.5	0.079	0.125	0.139	0.141	0.157	-	-	0.161	0.179
4	0.094	0.140	0.156	0.164	0.182	-	-	0.188	0.209
6	0.101	0.154	0.171	0.179	0.199	-	-	0.198	0.220
10	0.114	0.194	0.216	0.214	0.238	-	-	0.249	0.277
16	0.142	0.234	0.246	0.279	0.290	-	-	0.328	0.345
25	0.171	0.288	0.303	0.364	0.383	0.422	0.444	0.443	0.466
35	0.189	0.321	0.338	0.403	0.429	0.489	0.515	0.498	0.524
50	0.211	0.411	0.433	0.508	0.535	0.613	0.645	0.647	0.681
70	0.241	-	-	0.613	0.645	0.707	0.744	-	-
95	0.284	-	-	0.795	0.811	0.908	0.927	-	-
120	0.339	-	-	0.866	0.884	1.024	1.045	-	-
150	0.388	-	-	1.070	1.092	1.289	1.315	-	-
185	0.450	-	-	1.310	1.337	1.499	1.530	-	-
225	0.521	-	-	1.586	1.618	1.840	1.878	-	-
240	0.534	-	-	1.649	1.683	1.990	2.031	-	-
300	0.653	-	-	2.007	2.048	2.361	2.409	-	-
400	0.770	-	-	2.437	2.487	2.616	2.669	-	-
500	0.936	-	-	3.117	3.181	3.687	3.762	-	-
630	1.175	-	-	-	-	-	-	-	-
800	1.433	-	-	-	-	-	-	-	-
1000	1.642	-	-	-	-	-	-	-	-

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TABLE P3

VARIATION FACTOR FOR STEEL (FeF)

PVC INSULATED 1.1 KV POWER CABLES WITH COPPER/ALUMINIUM CONDUCTOR

Nominal Cross sectional Area (in Sq. mm)	2 core	Shape	3 core	Shape	3 ½ core	Shape	4 core	Shape
4	0.305	W	0.335	W	-	-	0.363	W
6	0.348	W	0.363	W	-	-	0.407	W
10	0.392	W	0.407	W	-	-	0.293	F
16	0.235	F	0.293	F	-	-	0.323	F
25	0.293	F	0.352	F	0.382	F	0.382	F
35	0.323	F	0.382	F	0.411	F	0.440	F
50	0.382	F	0.440	F	0.469	F	0.499	F
70	0.411	F	0.499	F	-	F	0.587	F
95	0.499	F	0.587	F	0.616	F	0.645	F
120	0.528	F	0.616	F	0.675	F	0.731	F
150	0.587	F	0.675	F	0.731	F	0.790	F
185	0.645	F	0.761	F	0.820	F	0.879	F
240	0.731	F	0.879	F	0.937	F	0.996	F
300	0.820	F	0.966	F	1.055	F	1.113	F
400	0.937	F	1.083	F	1.172	F	1.231	F
500	1.055	F	1.231	F	1.348	F	1.406	F
630	1.172	F	-	-	-	-	-	-

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TABLE P3 (Additional)

VARIATION FACTOR FOR ROUND WIRE 'W' STEEL (FeF)

PVC INSULATED 1.1 KV POWER CABLES WITH COPPER/ALUMINIUM CONDUCTOR

Nominal Cross Sectional Area (in sq. mm)	2 Core	3 Core	3 .5 Core	4 Core
1.5	0.247	0.259		0.288
2.5	0.273	0.289		0.329
4	0.305	0.335		0.363
6	0.348	0.363		0.407
10	0.392	0.407		0.533
16	0.439	0.523	0.014	0.573
25	0.526	0.625	0.664	0.685
35	0.591	0.685	0.729	0.761
50	0.661	0.790	0.864	1.108
70	0.745	1.122	1.200	1.256
95	1.085	1.286	1.376	1.443
120	1.147	1.386	1.479	1.562
150	1.267	1.526	1.684	2.173
185	1.403	2.090	2.315	2.421
240	1.994	2.397	2.641	2.722
300	2.180	2.642	3.670	3.842
400	2.987	3.728	4.126	4.292
500	3.517	4.226	5.958	6.301
630	4.774	6.018	6.737	7.141

TABLE P4

VARIATION FACTOR FOR ALUMINIUM (AIF)
PVC INSULATED 1.1 KV POWER CABLES WITH COPPER CONDUCTOR

Nominal Cross Sectional Area (in Sq. mm)	Aluminium Factor for Aluminium armoured cable with copper conductor
4	0.058
6	0.063
10	0.073
16	0.084
25	0.096
35	0.108
50	0.123
70	0.139
95	0.183
120	0.198
150	0.218
185	0.241
240	0.271
300	0.379
400	0.424
500	0.478
630	0.537
800	0.591
1000	0.816

TABLE P5

VARIATION FACTOR FOR PVC COMPOUND (CCFCu)
PVC INSULAYTED CONTROL CABLES WITH COPPER CONDUCTOR

No of cores	Core size 1.5 sq mm		Core size 2.5 sq mm	
	Unarm	Arm	Unarm	Arm
2	0.118	0.121	0.125	0.139
3	0.121	0.131	0.141	0.157
4	0.137	0.152	0.161	0.179
5	0.157	0.174	0.187	0.206
6	0.179	0.199	0.234	0.260
7	0.179	0.199	0.234	0.260
8	0.193	0.215	0.292	0.325
9	0.216	0.241	0.300	0.335
10	0.236	0.262	0.303	0.337
12	0.249	0.277	0.334	0.371
14	0.311	0.327	0.389	0.409
16	0.344	0.362	0.435	0.458
18	0.352	0.371	0.474	0.500
19	0.375	0.395	0.476	0.501
20	0.391	0.412	0.519	0.546
24	0.457	0.481	0.584	0.615
27	0.491	0.517	0.631	0.664
30	0.529	0.557	0.706	0.743
37	0.615	0.647	0.835	0.879
44	0.739	0.778	1.019	1.026
52	0.845	0.889	1.100	1.158
61	0.952	1.002	1.246	1.312

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TABLE P6

VARIATION FACTOR FOR STEEL (FeF)

PVC INSULATED CONTROL CABLES WITH COPPER CONDUCTOR

No of cores	Core size 1.5 sq mm	Shape of armour	Core size 2.5 sq mm	Shape of armour
2	0.243	W	0.277	W
3	0.257	W	0.289	W
4	0.277	W	0.314	W
5	0.303	W	0.342	W
6	0.329	W	0.379	W
7	0.329	W	0.379	W
8	0.341	W	0.456	W
9	0.383	W	0.275	F
10	0.408	W	0.325	F
12	0.289	F	0.342	F
14	0.306	F	0.360	F
16	0.317	F	0.372	F
18	0.332	F	0.350	F
19	0.343	F	0.397	F
20	0.368	F	0.400	F
24	0.398	F	0.475	F
27	0.414	F	0.478	F
30	0.425	F	0.503	F
37	0.461	F	0.548	F
44	0.507	F	0.601	F
52	0.556	F	0.641	F
61	0.585	F	0.685	F

IEEMA (PVC)/CABLE(R-1)/2017 **Effective from: 1st November 217**

TABLE P6 (Additional)

VARIATION FACTOR FOR ROUND WIRE 'W' STEEL (FeF)

PVC INSULATED CONTROL CABLES WITH COPPER CONDUCTOR

No. of Cores	Core size 1.5 sq mm	Core size 2.5 sq mm
2	0.243	0.273
3	0.257	0.289
4	0.277	0.314
5	0.303	0.342
6	0.329	0.379
7	0.329	0.379
8	0.341	0.456
9	0.383	0.508
10	0.408	0.535
12	0.510	0.572
14	0.546	0.625
16	0.581	0.660
19	0.608	0.696
24	0.714	0.819
25	0.679	0.798
27	0.732	0.837
28	0.696	0.815
30	0.758	0.881
33	0.747	0.883
37	0.820	1.217
44	0.926	1.355
48	1.122	1.308
50	1.122	1.308
52	1.149	1.361
56	1.202	1.388
61	1.299	1.520

TABLE L2

VARIATION FACTOR FOR POLYMER (CCFAI / CCFCu)

XLPE INSULATED 1.1 KV POWER CABLES WITH COPPER / ALUMINIUM CONDUCTOR

Nominal Cross Sectional Area (in Sq. mm)	1 core	2 core		3 core		3.5 core		4 core	
	Unarm	Unarm	Arm	Unarm	Arm	Unarm	Arm	Unarm	Arm
2.5	0.055	0.163	0.175	0.166	0.177	-	-	0.177	0.188
4	0.075	0.201	0.204	0.205	0.213	-	-	0.218	0.213
6	0.085	0.213	0.234	0.205	0.230	-	-	0.242	0.232
10	0.082	0.252	0.280	0.217	0.251	-	-	0.285	0.298
16	0.089	0.278	0.341	0.289	0.246	-	-	0.300	0.279
25	0.101	0.307	0.278	0.276	0.247	0.295	0.264	0.331	0.290
35	0.109	0.330	0.319	0.305	0.270	0.328	0.292	0.368	0.319
50	0.124	0.482	0.685	0.348	0.311	0.372	0.335	0.422	0.394
70	0.146	0.354	0.335	0.469	0.397	0.489	0.420	0.528	0.464
95	0.163	0.436	0.389	0.504	0.441	0.544	0.471	0.591	0.523
120	0.176	0.475	0.421	0.556	0.498	0.599	0.538	0.722	0.656
150	0.217	0.510	0.490	0.690	0.611	0.717	0.633	0.840	0.762
185	0.236	0.631	0.608	0.836	0.738	0.854	0.756	1.007	0.899
240	0.273	0.750	0.726	1.002	0.842	1.079	0.952	1.238	1.119
300	0.303	0.919	0.887	1.161	1.012	1.170	1.031	1.457	1.414
400	0.372	1.093	1.040	1.376	1.283	1.545	1.379	1.778	1.626
500	0.413	1.342	-	1.568	1.400	1.806	1.456	-	-
630	0.469	1.546	-	-	-	-	-	-	-
800	0.569	-	-	-	-	-	-	-	-
1000	0.667	-	-	-	-	-	-	-	-

TABLE XL1

VARIATION FACTOR FOR XLPE COMPOUND (XLFAL/XLFCU)

XLPE INSULATED 1.1 KV POWER CABLES WITH COPPER/ALUMINIUM CONDUCTOR

Nominal cross Sectional Area (in Sq. mm)	1 core		2 core		3 core		3.5 core		4 core	
	Unarm	Arm	Unarm	Arm	Unarm	arm	Unarm	Arm	Unarm	arm
2.5	0.007	0.010	0.014	0.014	0.021	0.021			0.028	0.028
4	0.009	0.012	0.018	0.018	0.027	0.027			0.036	0.036
6	0.010	0.015	0.022	0.022	0.033	0.033			0.043	0.043
10	0.013	0.018	0.025	0.025	0.039	0.039			0.053	0.053
16	0.016	0.023	0.034	0.034	0.049	0.049			0.065	0.065
25	0.021	0.030	0.048	0.048	0.070	0.070	0.084	0.084	0.093	0.093
35	0.025	0.035	0.059	0.059	0.084	0.084	0.099	0.099	0.112	0.112
50	0.033	0.044	0.075	0.075	0.108	0.108	0.130	0.130	0.144	0.144
70	0.042	0.054	0.095	0.095	0.137	0.137	0.160	0.160	0.179	0.179
95	0.048	0.062	0.110	0.110	0.160	0.160	0.190	0.190	0.211	0.211
120	0.060	0.076	0.138	0.138	0.200	0.200	0.239	0.239	0.266	0.266
150	0.078	0.095	0.180	0.180	0.259	0.259	0.296	0.296	0.344	0.344
185	0.097	0.116	0.224	0.224	0.324	0.324	0.369	0.369	0.430	0.430
240	0.116	0.137	0.266	0.266	0.388	0.388	0.446	0.446	0.518	0.518
300	0.138	0.164	0.325	0.325	0.467	0.467	0.540	0.540	0.620	0.620
400	0.175	0.214	0.357	0.357	0.536	0.536	0.619	0.619	0.714	0.714
500	0.217	0.260	0.440	0.440	0.660	0.660	0.769	0.769	0.880	0.880
630	0.265	0.318	0.542	0.542	0.814	0.814	0.941	0.941	1.085	1.085
800	0.323	0.389								
1000	0.375	0.444								

TABLE XL2
VARIATION FACTOR FOR XLPE COMPOUND (XLFCU)
XLPE INSULAYTED CONTROL CABLES WITH COPPER CONDUCTOR

No of cores	Core size 1.5 sq mm		Core size 2.5 sq mm	
	Unarm	Arm	Unarm	Arm
2	0.010	0.010	0.012	0.012
3	0.016	0.016	0.018	0.018
4	0.021	0.021	0.025	0.025
5	0.026	0.026	0.031	0.031
6	0.031	0.031	0.037	0.037
7	0.036	0.036	0.043	0.043
8	0.036	0.036	0.043	0.043
9	0.042	0.042	0.049	0.049
10	0.052	0.052	0.061	0.061
12	0.062	0.062	0.074	0.074
14	0.073	0.073	0.086	0.086
16	0.083	0.083	0.098	0.098
18	0.094	0.094	0.110	0.110
19	0.099	0.099	0.116	0.116
20	0.104	0.104	0.123	0.123
24	0.125	0.125	0.147	0.147
27	0.140	0.140	0.165	0.165
30	0.156	0.156	0.184	0.184
37	0.192	0.192	0.227	0.227
44	0.229	0.229	0.270	0.270
52	0.270	0.270	0.319	0.319
61	0.317	0.317	0.374	0.374

TABLE XL3

VARIATION FACTOR FOR XLPE(XLFAL/XLFCU)

SINGLE CORE ARMOURED /UNARMOURED XLPE INSULATED 3.3 to 33 KV POWER CABLES WITH CU / AL CONDUCTOR

Nominal Cross Sectional Area (in Sq. mm.)	XLPE Factor for Armoured/ Unarmoured Cable with AL /CU Conductor					
	3.3 KV	6.6 KV (E)	11 KV (E)/ 6.6 KV (UE)	11 KV (UE)	22 KV (E)	33 KV (E)
25	0.110	0.131	0.170	0.279		
35	0.122	0.137	0.175	0.284	0.317	0.522
50	0.135	0.151	0.191	0.307	0.341	0.563
70	0.155	0.172	0.215	0.342	0.379	0.615
95	0.174	0.193	0.241	0.377	0.417	0.670
120	0.192	0.212	0.262	0.407	0.449	0.713
150	0.209	0.229	0.283	0.437	0.481	0.757
185	0.228	0.250	0.308	0.471	0.518	0.809
240	0.255	0.279	0.343	0.519	0.569	0.883
300	0.280	0.322	0.372	0.560	0.613	0.943
400	0.326	0.392	0.420	0.625	0.683	1.041
500	0.388	0.461	0.469	0.694	0.757	1.142
630	0.467	0.520	0.529	0.777	0.845	1.265
800	0.567	0.593	0.602	0.874	0.949	1.407
1000	0.656	0.665	0.660	0.955	1.036	1.525

Note : XLPE factors include Semicons for Conductor & Insulation screen

TABLE – XL4

VARIATION FACTOR FOR XLPE (CCF1Al / CCF1Cu)

3 CORE XLPE INSULATED 3.3 to 33 KV POWER CABLES WITH COPPER / ALUMINIUM CONDUCTOR

Nominal Cross Sectional Area (in Sq. mm)	3.3 KV ARM	6.6 KV (E) ARM	6.6 KV (UE) / 11 KV (E) ARM	11 KV (UE) ARM	22 KV (E) ARM	33 KV (E) ARM
25	0.315	0.394	0.511	0.838		
35	0.339	0.427	0.545	0.880	0.982	1.638
50	0.378	0.474	0.600	0.957	1.065	1.751
70	0.435	0.541	0.679	1.067	1.183	1.916
95	0.489	0.604	0.755	1.171	1.295	2.071
120	0.537	0.661	0.822	1.265	1.396	2.210
150	0.585	0.719	0.890	1.359	1.497	2.350
185	0.642	0.784	0.968	1.468	1.614	2.513
240	0.717	0.873	1.074	1.615	1.773	2.732
300	0.781	1.006	1.167	1.744	1.928	2.919
400	0.886	1.227	1.314	1.948	2.130	3.229
500	0.956	1.421	1.446	2.148	2.381	3.538
630	1.129	1.582	1.609	2.382	2.630	3.940

Note : XLPE factors include Semicons for Conductor & Insulation screen

TABLE H1

VARIATION FACTOR FOR ALUMINIUM (AIF)

ALUMINIUM ARMOURED SINGLE CORE XLPE INSULATED 3.3 TO 33 KV CABLES

Nominal Cross Sectional Area (in Sq. mm.)	Aluminium Factor for Aluminium Armoured Cable with Aluminium Conductor					
	3.3 KV	6.6 KV (E)	11 KV (E)/ 6.6 KV (UE)	11 KV (UE)	22 KV (E)	33 KV (E)
35	0.251	0.284	0.301	0.344	0.358	0.473
50	0.312	0.336	0.352	0.397	0.408	0.672
70	0.385	0.409	0.423	0.469	0.501	0.723
95	0.476	0.500	0.518	0.637	0.656	0.856
120	0.561	0.586	0.601	0.726	0.744	0.949
150	0.653	0.678	0.696	0.823	0.842	1.050
185	0.773	0.797	0.893	0.949	0.965	1.183
240	0.997	1.063	1.083	1.139	1.154	1.387
300	1.209	1.271	1.283	1.333	1.307	1.753
400	1.438	1.556	1.565	1.620	1.636	2.046
500	1.873	1.901	1.910	2.110	2.128	2.484
630	2.337	2.361	2.369	2.580	2.595	2.978
800	3.007	3.071	3.080	3.145	3.163	3.588
1000	3.737	3.741	3.749	3.804	3.822	4.565

TABLE H2

VARIATION FACTOR FOR POLYMER (CCFAI / CCFCu)

3 CORE XLPE INSULATED 3.3 to 33 KV POWER CABLES WITH COPPER / ALUMINIUM CONDUCTOR

Nominal Cross Sectional Area (in Sq. mm)	3.3 KV ARM	6.6 KV (E) ARM	6.6 KV (UE) / 11 KV (E) ARM	11 KV (UE) ARM	22 KV (E) ARM	33 KV (E) ARM
35	0.374	0.990	1.142	1.604	1.782	-
50	0.445	1.119	1.260	1.834	2.046	2.864
70	0.547	1.290	1.396	2.011	2.284	3.219
95	0.594	1.440	1.647	2.269	2.428	3.367
120	0.732	1.692	1.877	2.498	2.715	3.646
150	0.812	1.906	2.061	2.767	2.931	3.927
185	0.960	2.086	2.406	3.028	3.180	4.166
240	1.130	2.484	2.744	3.398	3.580	4.589
300	1.219	2.912	3.161	3.840	4.016	5.029
400	1.313	3.530	3.664	4.353	4.666	5.736
500	1.652	3.925	3.971	4.621	4.878	5.913
630	1.949	4.487	4.982	5.225	5.477	6.696

Fillers added in PVC consumption

TABLE H3

VARIATION FACTOR FOR STEEL (FeF)

XLPE INSULATED 3.3 TO 33 KV POWER CABLES WITH COPPER / ALUMINIUM CONDUCTOR

Nominal Cross Sectional Area Sq. mm.	3.3 KV	6.6 KV (E)	11 KV (E) / 6.6 KV (UE)	11 KV (UE)	22 KV (E)	33 KV (E)
25	**0.551**	**0.604**	**0.656**	**0.814**		
35	0.645	0.645	0.731	0.879	0.937	-
50	0.675	0.703	0.761	0.937	0.966	1.181
70	0.761	0.761	0.849	0.996	1.055	1.289
95	0.820	0.849	0.907	1.083	1.113	1.348
120	0.879	0.907	0.966	1.142	1.172	1.406
150	0.966	0.966	1.055	1.201	1.259	1.494
185	1.025	1.055	1.113	1.259	1.318	1.553
240	1.142	1.142	1.231	1.377	1.406	1.641
300	1.231	1.259	1.318	1.465	1.524	1.758
400	1.348	1.406	1.435	1.582	1.641	1.876

TABLE H4

VARIATION FACTOR FOR ALUMINIUM (AIF)

XLPE INSULATED SINGLE CORE 3.3 TO 33 KV POWER CABLES WITH COPPER CONDUCTOR

Nominal Cross Sectional Area (in Sq. mm.)	Aluminium Factor for Aluminium Armoured Cable with Copper Conductor					
	3.3 KV	6.6 KV (E)	11 KV (E)/ 6.6 KV (UE)	11 KV (UE)	22 KV (E)	33 KV (E)
35	0.153	0.187	0.204	0.247	0.258	0.372
50	0.179	0.203	0.220	0.262	0.275	0.425
70	0.196	0.219	0.233	0.278	0.311	0.444
95	0.213	0.237	0.254	0.373	0.392	0.470
120	0.228	0.253	0.268	0.393	0.410	0.488
150	0.243	0.269	0.287	0.414	0.432	0.504
185	0.261	0.285	0.381	0.437	0.455	0.526
240	0.324	0.389	0.410	0.465	0.480	0.556
300	0.365	0.428	0.440	0.490	0.510	0.737
400	0.432	0.471	0.480	0.536	0.552	0.783
500	0.489	0.517	0.526	0.726	0.744	0.844
630	0.544	0.568	0.572	0.787	0.801	0.902
800	0.706	0.787	0.797	0.862	0.880	0.982
1000	0.824	0.865	0.867	0.923	0.940	1.324

TABLE - H5

VARIATION FACTOR FOR STEEL (FeW)

XLPE INSULATED 3.3KV TO 33 KV POWER CABLES WITH COPPER / ALUMINIUM CONDUCTOR

Nominal Cross Sectional Area in Sq. mm	3.3/3.3 KV	3.3/6.6 KV	11 KV (E) / 6.6 KV (UE)	11 KV (UE)	22 KV (E)	33 KV (E)
25	1.258	1.457	1.612	2.509	1.503	--
35	1.361	1.569	1.853	2.644	2.797	2.517
50	1.682	1.687	2.321	2.800	2.921	4.569
70	2.033	1.979	2.503	3.219	3.347	4.809
95	2.202	2.507	2.718	4.019	4.200	5.437
120	2.371	2.675	2.882	4.241	4.416	6.713
150	2.870	2.847	3.265	4.447	4.621	6.976
185	3.121	3.309	4.148	4.726	5.289	7.356
240	3.758	4.227	4.442	5.442	6.651	7.718
300	4.099	5.024	5.182	6.894	7.084	8.187
400	5.750	6.572	6.658	7.433	7.657	8.760
500	6.716	6.777	6.861	7.588	7.797	8.830
630	7.492	7.465	7.477	8.209	8.386	9.413

RATE CONTRACT

TECHNICAL SPECIFICATION
FOR
LT PVC CONTROL CABLE

SPECIFICATION No. **PE-TS-999-507-E003**
ISSUE NO. 01
REV NO. 00

BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA, INDIA

INDEX

SCOPE

SCOPE OF THIS PACKAGE COVERS THE FOLLOWING:

SL.NO	PARAMETERS	REQUIREMENT
1	Supply Including Design, Engineering, Manufacturing of LT PVC Control cable	YES
a)	Main Supply	YES
b)	Commissioning Spares	NO
2	Painting	NO
3	Inspection & Testing	YES
4	Packing	YES
5	Transportation & Delivery To Site	YES
6	Erection & Commissioning	NO
7	Supervision of Erection & Commissioning	NO
8	Mandatory Spares	NO
9	O & M Service	NO
10	O & M Spares	NO

	GENERAL TECHNICAL REQUIREMENT
1	It is not the intent to specify herein all the details of design and manufacturing. Bidder shall ensure that the offered equipment confirms in all respects to high standards of design, engineering and workmanship.
2	Bidder shall also ensure that the offered equipment shall comply with all applicable statutory and regulatory requirements.
3	In the event of any conflict between the requirements of two clauses of this specification, documents or requirements of different codes and standards specified, the more stringent requirement as per the interpretation of the owner shall apply.
4	Drawing/document submission shall be through web based Document Management System(DMS) of BHEL. Bidder would be provided access to the DMS for drawing/document submission. Bidder to ensure internet connectivity of min speed of 2Mbps at their end.
5	Drawings/ documents submitted by vendor at any stage shall be complete in all respects. Any incomplete drawing submitted shall be treated as non-submission with delays attributable to vendor. For any clarification/ discussion required to complete the drawings, the bidder shall depute his personnel to BHEL / Customer's Office as per the requirement for across the table submission/ finalizations of drawings.
6	Latest codes and standards shall be complied.
7	Bidder shall furnish Type Test Certificate of specified Type Test as per quality plan which has been conducted within period of 10 years i.e. from 07/10/2024 up to 08/10/2014 . These reports should be for the tests conducted on the LT PVC Control Cable identical in all respects to those proposed to be supplied under this contract and test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client.
8	Bidder shall confirm compliance with the Quality Plan attached with the specification without any deviations. At contract stage, the Quality Plan as enclosed in the technical specification is to be appended with cover sheet bearing document number and description. The signed and stamped copy of the same shall be submitted to BHEL without making any changes in the contents of the document. There shall be no commercial implication to BHEL on account of minor changes in QP during contract stage.
9	Equipment must be safe, reliable and easy to maintain at all operating condition

	TECHNICAL SPECIFICATION LT PVC CONTROL CABLE (RATE CONTRACT)	PE-TS-999-507-E003 Issue No: 01 Rev. No. 00 Date :22.11.2024

TECHNICAL DATA - PART - A			
SL.NO	**DESCRIPTION**	**UOM**	**DETAIL**
1.0	**DESIGN CODES & STANDARDS**		
1.1	Standard applicable in general (Latest amendment to be referred if any)		IS:1554 (Part-1)
1.2	Current rating of cables		As per IS:3961 (P-2)
1.3	Short circuit rating		IEC 60949
1.4	Conductor		IS: 8130
1.5	PVC Insulation		IS 1554 (Part-1)
1.6	Inner sheath		IS 1554 (Part-1)
1.7	Outer sheath		IS 1554 (Part-1)
1.8	Core Identification (Upto 5 core)		Colour coding as per IS 1554 (Part-1)
1.9	Core Identification (Above 5 core)		By numbering as per IS 1554 (Part-1). Insulation to have black colour.
1.10	Armour		Galvanised Steel Round Wire/ Galvanised Steel Formed Wire Conforming to : (i) Type 'b' as per Table-5 of IS 1554-I and (ii) IS 3975; as per project requirements.
2.0	**DESIGN /SYSTEM PARAMETERS**		
2.1	Type of Cable		Flame Retardant-Low Smoke (FR-LSH) LT CABLE
2.2	Voltage Grade		1.1 kV
2.3	INSTALLATION CONDITIONS AT SITE		
2.3.1	Ambient air temperature	deg. C	50
2.3.2	Ground temperature	deg. C	30
3.0	**CONSTRUCTION FEATURES**		
3.1	CONDUCTOR		
3.1.1	Material type		Annealed Bare Copper (ABC)
3.1.2	Grade		Annealed high conductivity
3.1.3	Class		Class 2 (Stranded)
3.1.4	Shape		Circular

3.1.5	Compaction		Compacted
3.1.6	Cable Size	sq.mm	As per unpriced 'price schedule'
3.2	PVC INSULATION		
3.2.1	Nominal thickness of insulation	mm	As per IS: 1554 (Part-1) Table-2
3.2.2	Material		Extruded PVC Type-A
3.2.3.1	Continuous withstand temperature	deg. C	70
3.2.3.2	Short-circuit withstand temperature	deg. C	160
3.2.4	Volume Resistivity	ohm cm	$1X10^{13}$ ohm cm at 27 deg C $1X10^{10}$ ohm cm at 70 deg C
3.3	Extrusion		Sleeve extrusion not permitted.
3.3.1	Method of extrusion		Pressure Extruded / Vacuum Extruded
3.4	CORE IDENTIFICATION		As per IS
3.5	INNERSHEATH		
3.5.1	Thickness of inner sheath		As per IS 1554 (Part-1) Table-4
3.5.2	Material		Extruded PVC Type ST-1
3.5.3	Colour		Black
3.5.4	Whether FR-LSH		NO
3.5.5	Material of fillers (for multicore cables)		Same as inner sheath
3.5.6	Method of application		Extrusion
3.5.6.1	Multi-core cables:		Pressure extruded / Vacuum extruded
3.6	Armour (Applicability per BOQ mentioned in Unpriced 'Price Schedule')		
3.6.1	Dimension		As per IS: 1554 Part-1 and tolerance as per IS:3975
3.6.2	Material		
3.6.2.2	Multi core		Galvanised steel round wire / Galvanised steel formed wire
3.6.3	Gap between armour wire		Not more than one armour wire space (No cross over / No over riding)
3.6.4	Paint on joint		Zinc rich paint shall be applied on armour joint surface of G.S.wire / formed wire
	Minimum Coverage		90%
3.6.5	Breaking load of Joint		95% of normal armour

3.7	OUTERSHEATH		
3.7.1	Thickness of outer sheath		As per Table-7 of IS: 1554 (Part-1)
3.7.2	Material		Extruded PVC Type ST1 as per IS: 5831.
3.7.3	Colour		Black/ Grey (Project specific requirement shall be informed during detailed engineering)
3.7.4	Whether FR-LSH		YES
3.7.5	Method of application		Extruded
3.7.6	Marking/ Embossing on Outer sheath		
3.7.6.1	At every 5 Meters		(i) Owner's Name (project specific) (ii) Manufacturer’s name and trade mark (iii) Year of manufacture (iv) Type of cable and voltage class (v) Nominal cross section area of conductor and no. of cores (vi) ‘BHEL-UNIT NAME’ (Shall be informed during detailed engineering) (vii) 'FRLS'/ FRLSH
3.7.6.2	At every 1 Meters by embossing/ printing		Progressive Sequential length.Drum no. shall also be embossed/ printed.
3.8	FR-LSH CHARACTERISTICS		
3.8.1	Oxygen index		Minimum 29 as per ASTMD 2863
3.8.2	Temperature index		Minimum 250º C as per ASTMD 2863
3.8.3	Acid gas generation		Maximum 20% by weight as per IEC 60754-1
3.8.4	Smoke density rating		Maximum 60% as per ASTMD 2863
3.8.5	Flame retardance test for single cable (for cable OD ≤ 35mm)		As per IS 10810 Part 61
3.8.6	Flame retardance test for bunched cables		As per IS 10810 Part 62/ IEC-332 Part-3 (Category -B)
3.9	DIAMETERS		
3.9.1	Tolerance on overall diameter	mm	(±) 2 mm over the declared value

3.10	CABLE DRUM DETAILS		
3.10.1	Type		Steel
3.10.2	Standard drum length		AS per BOQ cum Un-priced schedule
3.10.3	Tolerance on drum length		(±) 5%
3.10.4	Details of marking on Drum		a) Manufacturer's name or trade make, address & contract no. b) Type of cable & voltage grade. c) Year of manufacture. d) Type of insulation. e) No. of core and sizes of cables. f) Cable code - FRLS. g) Single length of cable on drum. h) Direction of rotation, by arrow. i) Approx. gross mass.(on both sides of drum) j) Drum no. k) 'BHEL-UNIT NAME' (Shall be informed during detailed engineering)
4.0	**INSPECTION/TESTING**		
4.1	Type test conduction required	No* (* : Refer Sl. No. 4.2 below)	
4.2	Validity of type test report	As per Quality Plan vendor to furnish Type Test Certificate of specified Type Test which has been conducted within period of 10 years i.e. from 07/10/2024 up to 08/07/2014 . These reports should be for the tests conducted on the cable identical in all respects to those proposed to be supplied under this contract and test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. In absence of valid Type Test report vendor to conduct the same without any commercial & delivery implication to BHEL.	
4.3	Acceptance & Routine test	All acceptance and routine tests as per Quality plan shall be carried out. Charges for these shall be deemed to be included in the cable price.	

TECHNICAL DATA - PART - B
(SUPPLIER DATA TO BE FURNISHED AFTER AWARD OF CONTRACT)

S NO.	PARTICULARS	
1	Name of manufacturer	
2	Place of manufacture	
3	No of cores X Nominal area of conductor (mm2)	
4	Cable Type	
5	**CONDUCTOR**	
	a) Material type & grade	
	b) Shape	
	c) No. of Strands/Diameter of each strand (No. / mm)	
6	**HRPVC INSULATION**	
	a) Material	
	b) Dielectric strength kv/mm	
	c) Nominal thickness (mm)	
	d) Volume resistivity at 27° C (ohm-cm)	
	e) Volume resistivity at 70° C (ohm-cm)	
	f) Insulation resistance constant at 27° C (M ohm km)	
	g) Insulation resistance constant at 70° C (M ohm km)	
	h) Min. Tensile strength (N/mm2)	
	i) Min. Elongation at break (%)	
	j) Negative tolerance on thickness (mm)	
	k) Fictitious dia over insulation (mm)	
7	**FILLERS**	
	a) Material	
8	**INNERSHEATH**	
	a) Material	
	b) Whether FRLS	
	c) Minimum thickness (mm)	
	d) Colour of inner sheath	
	e) Fictitious dia over inner sheath (mm)	
9	**ARMOUR**	

	a) Material	
	b) Type of armouring	
	c) Nominal size of armour (mm)	
	d) Minimum coverage	
	e) Method of jointing	
	f) Breaking load of joint	
	g) Minimum no. of wires (No.)	
	h) Armour resistance at 20 deg.C (Ohm/km) max	
	i) Max. Resistivity of GS wire (Ohm-cm) max.	
	j) Fictitious dia over Armouring (mm)	
10	**OUTERSHEATH**	
	a) Material	
	b) Whether FRLS	
	c) Thickness (mm) (Nominal)	
	d) Min. Tensile strength (N/mm2)	
	e) Min. Elongation at break (%)	
	f) Colour of Outer sheath	
	g) Tolerance on thickness in mm	
11	Permissible Voltage Variation	
12	Permissible Frequency Variation	
13	Combined Voltage & Frequency Variation	
14	Max. rated Conductor temperature	
15	Max. allowable conductor temperature during short circuit	
16	a. Continuous current carrying capacities	
	b. In Ground 30 deg.C (A)	
	c. In Duct 30 deg.C (A)	
	d. In Air 50 deg.C (A)	
	e. Depth of laying	
	f. Thermal resistivity of soil	
17	**FRLS PROPERTIES**	
	a. Oxygen Index (ASTMD 2863)	
	b. Temperature Index (ASTMD 2863-77)	
	c. Smoke density rating (ASTMD 2843)	
	d. HCL (ACID) Gas Generation (IEC 754-1)	
	e. Flammability tests	

18	**CABLE DRUMS**	
	a. Type & construction	
	b. Stranded drum length with tolerance on drum length	
19	Max. D.C. resistance of conductor at 20° C- Main (ohm/km)	
20	Max. A.C. resistance of conductor at 70° C- Main (ohm/km)	
21	Calculated star reactance (ohm/km)	
22	Approx. Cable Capacitance (micro F/km)	
23	Charging current at 415 V (A/km)	
24	Loss tangent (for reference only)	
25	**DIAMETERS**	
	a. Approx. dia over insulation (mm)	
	b. Approx. dia over inner sheath (mm)	
	c. Fictitious. dia under outer sheath (mm)	
	d. Approx. overall dia of cable (mm)	
	e. Tolerance on overall dia in mm	
26	Minimum bending radius	
27	safe pulling force when pulled by pulling eye N	
28	Approximate weight of cable (kg/km)	
29	Marking at every 5 meter on Outer Sheath by Embossing	
30	Marking at every 1 meter on Outer Sheath by Printing	

QUALITY PLAN

	STANDARD QUALITY PLAN स्टैण्डर्ड क्वालिटी प्लान	TO BE FILLED IN BY NTPC		
Item (material, class, grade, rating, range, size etc.) / मद (सामग्री, वर्ग, ग्रेड, रैटिंग, रेंज, आकार आदि): **1.1 PVC Insulated FRLS Control cables**	CONFORMING TO CODE/ कोड के अनुरूप: IS 1554 PART 1 & NTPC TECHNICAL SPECIFICATION)	QP. NO. 0000-999- QOE- S-040 क्यूपी सं..: 0000-999-क्यूओई-एस-040 REV/ संशोधित सं..:01 DATE :/तिथि: 27.08.2021 Page/ पृष्ठ 1 OF/ से 12 VALID UPTO: 26.08.2024	REVIEWED BY AMAN PANDEY AMAN DUBEY S K LAL SUNIL KUMAR LAL NISHITH AGARWAL NISHITH AGRAWAL	APPROVED BY Quality Assurance अनुमोदित Approved N.T.P.C., Kota

SL. NO क्र.सं	COMPONENT & OPERATIONS अवयव व संचालन	Characteristics/ विशेषताएं	Class /वर्ग	Type of check/जांच के प्रकार	Quantum of check		Reference Document/ संदर्भ दस्तावेज#	Acceptance Norms/ स्वीकृत मानदंड	Record Format/ रिकॉर्ड का प्रारूप	Agency / एजेंसी				Remarks/ /टिप्पणियां
					M/ एम	C/ N सी/एन					M/ ए म	C/ सी	N/ एन	
1	2	3	4	5	6		7	8	9	D*	**	10		11
Instructions: 1) Cable manufacturer to maintain records to show co- relation of raw materials to finished cables i,e raw material batch/ lot no. should be traceable to the cable drum. 2) Cable manufacturer to maintain all quality control records identified as per all QP stages enumerated below whether it is identified for NTPC verification or witness or not.														
A	**Raw material/ Bought out Items**													
1.01	Copper	1.Make	MA	Verify	100%	--	NTPC ACCEPTED SOURCES	NTPC ACCEPTED SOURCES	QCR		V	--	--	
		2. Resistivity	MA	Elect	As per cable mnfr std.	--	IS 613	IS 613	-do--		P	--	--	
1.02	PVC compound for insulation	1. Make	MA	Verify	--do--	100%	MANUFACTURER APPROVED SOURCES	MANUFACTURER APPROVED SOURCES	--do--		V	V	V	
		2. Type/ Grade	MA	Verify	100%	100%	NTPC ADS	NTPC ADS	-do--		V	V	V	
		3. All acceptance test as per manufacturer norms	MA	Verify	As per manufacturer norms	As per manufacturer norms	--do--	--do--	--do--		V	V	V	Refer note 1
1.03	PVC Compound for Inner sheath	1. Make	MA	Verify	--do--	--do--	MANUFACTURER APPROVED SOURCES	MANUFACTURER APPROVED SOURCES	--do--		V	V	V	
		2. Type/ Grade	MA	Verify	--do--	--do--	NTPC ADS	NTPC ADS	--do--		V	V	V	
1.04	Steel wire / Formed Wire (As applicable)	1. Make	MA	Verify	--do--	--do--	MANUFACTURER APPROVED SOURCES	MANUFACTURER APPROVED SOURCES	--do--		V	V	V	
		2. Dimension	MA	Meas	1 sample from each	--	NTPC APPROVED DATA SHEET & IS 3975	NTPC APPROVED	--do--		P	--	--	

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** M: MANUFACTURER / SUB-SUPPLIER /निर्माता / उप-आपूर्तिकर्ता C: MAIN CONTRACTOR / मुख्य संविदाकार, N: NTPC/ एनटीपीसी P: PERFORM/ निष्पादन W: WITNESS/ गवाह AND V: VERIFICATION. AS APPROPRIATE/ सत्यापन (जैसा उपयुक्त हो), CHP/ सीएचपी: NTPC SHALL IDENTIFY IN COLUM "N" AS 'W'.: एनटीपीसी खंड "N" में "W" के रूप में करेगा ।

	STANDARD QUALITY PLAN स्टैण्डर्ड क़्वालिटी प्लान	TO BE FILLED IN BY NTPC		
Item (material, class, grade, rating, range, size etc.) / मद (सामग्री, वर्ग, ग्रेड, रैटिंग, रेंज, आकार आदि): **1.1 PVC Insulated FRLS Control cables**	CONFORMING TO CODE/ कोड के अनुरूप: IS 1554 PART 1 & NTPC TECHNICAL SPECIFICATION)	QP. NO. 0000-999- QOE- S-040 क्यूपी सं..: 0000-999-~~क्यूओई~~ -एस-040 REV/ संशोधित सं..:01 DATE :/तिथि: 27.08.2021 Page/ पृष्ठ2 OF/ से 12 VALID UPTO: 26.08.2024	REVIEWED BY AMAN PANDEY AMAN DUBEY S K LAL SUNIL KUMAR LAL NISHITH AGARWAL NISHITH AGRAWAL	APPROVED BY Quality Assurance अनुमोदित Approved N.T.P.C., Rop B C Roy

SL. NO क्र.सं	COMPONENT & OPERATIONS अवयव व संचालन	Characteristics/ विशेषताएं	Class /वर्ग	Type of check/जांच के प्रकार	Quantum of check		Reference Document/ संदर्भ दस्तावेज#	Acceptance Norms/ स्वीकृत मानदंड	Record Format/ रिकॉर्ड का प्रारूप	Agency / एजेंसी				Remarks/ /टिप्पणियां
					M/ एम	C/N सी/एन					M/ए म	C/सी	N/एन	
1	2	3	4	5	6		7	8	9	D*	**	10		11
					size / lot			DATA SHEET & IS 3975			V	V	--	
		3. All acceptance tests as per IS 3975	MA	Verify	As per IS 3975	--	IS 3975	IS 3975	Supplier TC		V	V	--	
1.05	PVC compound for Sheath	1. Make	MA	Verfy	As per manufacturer norms	100%	MANUFACTURER APPROVED SOURCES	MANUFACTURER APPROVED SOURCES	QCR		V	V	V	
		2. Type / Grade	MA	Verify	100%	100%	NTPC ADS	NTPC ADS	--do--		V	V	V	
		3. All acceptance test as per manufacturer norms	MA	Verify	As per manufacturer norms	As per manufacturer norms	--do--	--do--	--do--		V	V	V	Refer note 1
		4. Thermal Stability	MA	Chem	One sample / Batch	--	NTPC ADS	NTPC ADS	QCR		P	--	--	
		5. Oxygen Index	MA	Chem	--do--	--	NTPC ADS/ IS 10810 Part 58	NTPC ADS/ IS 10810 Part 58	--do--		P	--	--	
		6. Acid Gas Emission	MA	Chem	--do--	--	NTPC ADS / IEC60754	NTPC ADS / IEC60754	--do--		P	--	--	
1.06	Wooden Drum	1. Dimension	MI	Meas	Manuf. Std.	--	IS 10418	IS10418	QCR		P	--	--	
		2. Anti termite treatment	MI	Chem	Cable manuf. std	--	CABLE MANUF. STD.	CABLE MANUF. STD.	COC		V	V	V	COC from drum manuf.
1.07	Steel Drum	1. Dimension	MI	Meas	--do--	--	--do--	--do--	QCR		P	--	--	
		2. Surface finish	MI	Meas	--do--	--	--do--	--do--	--do-		P	--	--	
B	**Process & Stage Inspection**													
2.01	Wire Drawing	1.Surface finish	MA	Visual	One	--	SHOULD BE SMOOTH &	SHOULD BE	QCR		P	--	--	

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SL. NO क्र.सं	COMPONENT & OPERATIONS अवयव व संचालन	Characteristics/ विशेषताएं	Class /वर्ग	Type of check/जांच के प्रकार	Quantum of check		Reference Document/ संदर्भ दस्तावेज#	Acceptance Norms/ स्वीकृत मानदंड	Record Format/ रिकॉर्ड का प्रारूप	Agency / एजेंसी				Remarks/ /टिप्पणियां
					M/ एम	C/ N सी/एन					M/ ए म	C/ सी	N/ एन	
1	2	3	4	5	6		7	8	9	D*	**	10		11
					sample/Setting of each size		FREE FROM SCRATCHES	SMOOTH & FREE FROM SCRATCHES						
		2. Wire Diameter	MA	Meas	--do--	--	NTPC ADS	NTPC ADS	--do-		P	--	--	
		3. Annealing Test	CR	Mech	--do--	Same as 6M	IS8130/NTPC ADS	IS8130/NTPC ADS	---do--		P	V	V	Refer Sl. No. 3.03(iii).
2.02	Bunching / stranding	1. No. of wires	MA	Meas	--do--	--	NTPC ADS	NTPC ADS	--do-		P	--	--	
		2.Dia of wire	MA	Meas	-do--	--	--do--	--do--	--do--		P	--	--	
		3. Dimension of Conductor	MA	Meas	--do--		--do--	--do--	--do--		P	--	--	
		4.Direction of lay	MA	Visual	--do--	---	--do-	--do--	--do--		P	--	--	
		5.Records of strand breakage / welding during conductor stranding	MA	Verify	--do--	--	IS 8130	IS8130	--do--		P	--	--	
		6.Surface finish	MA	Visual	--do--	-	--do--	--do--	--do--		P	--	--	
		7. DC Resistance	CR	Meas	--do--	-	IS8130/NTPC ADS	IS8130/ NTPC ADS	--do---		P	--	--	
2.03	Insulation extrusion	1. Surface finish	MA	Visual	--do--	-	NTPC spec	SHOULD BE SMOOTH. NO POROSITY IS PERMITTED.	--do--		P	--	--	PVC compound shall be preferably loaded in to extruder by suction method.
		2.Colour of cores	MA	Visual	--do--	-	NTPC ADS	NTPC ADS	--do--		P	--	--	

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SL. NO क्र.सं	COMPONENT & OPERATIONS अवयव व संचालन	Characteristics/ विशेषताएं	Class /वर्ग	Type of check/जांच के प्रकार	Quantum of check		Reference Document/ संदर्भ दस्तावेज#	Acceptance Norms/ स्वीकृत मानदंड	Record Format/ रिकॉर्ड का प्रारूप	Agency / एजेंसी				Remarks/ /टिप्पणियां
					M/ एम	C/N सी/एन				D*	M/ ए म	C/ सी	N/ एन	
1	2	3	4	5	6		7	8	9		**	10		11
		3.Core identification	MA	Visual	One sample/Setting of each size	--	NTPC ADS	NTPC ADS	QCR		P	--	---	Core printing shall be legible & indelible
		4.Thickness	CR	Meas	--do--	--	--do-	-do-	--do--		P	--	--	
		5.Spark Test	CR	Elect	100%	100%	CABLE MANUF. STD.	No FAILURE	QCR		P	V	V	1.Spark test failure record is to be verified. 2.Core repairing not permitted
2.04	Laying up	1. Core sequence	MA	Visual	One sample/Setting of each size	--	IS 1554 (Part I)	IS 1554 (Part I)	--do--		P	--	--	
		2. Direction of lay	MA	Visual	--do--	--	-do-	--do--	--do--		P	--	--	
		3. Dia over laid up core	MA	Meas	--do--	--	NTPC ADS	NTPC ADS	--do--		P	--	--	
2.05	Inner Sheath	1.Colour	MA	Visual	-do--	-	--do--	--do--	--do--		P	--	---	
		2. Surface Finish	MA	Visual	100%	-	NTPC SPECIFICATION	FISH EYE, BLOW HOLE NOT PERMITTED	--do--		P	--	-	
		3.Thickness	MA	Meas	One sample/Setting of each size	-	NTPC ADS	NTPC ADS	--do--		P	--	--	
		4.Dia over inner sheath	MI	Meas	--do--.	-	--do--	---do--	--do--		P	--	--	

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	STANDARD QUALITY PLAN स्टैण्डर्ड क्वालिटी प्लान	TO BE FILLED IN BY NTPC
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SL. NO क्र.सं	COMPONENT & OPERATIONS अवयव व संचालन	Characteristics/ विशेषताएं	Class /वर्ग	Type of check/जांच के प्रकार	Quantum of check		Reference Document/ संदर्भ दस्तावेज#	Acceptance Norms/ स्वीकृत मानदंड	Record Format/ रिकॉर्ड का प्रारूप	Agency / एजेंसी				Remarks/ /टिप्पणियां
					M/ एम	C/ N सी/एन					M/ ए म	C/ सी	N/ एन	
1	2	3	4	5	6		7	8	9	D*	**	10		11
2.06	Armouring (As Applicable)	1.Dimension	MA	Meas	--do--	-	--do--	--do--	--do--		P	--	--	
		2.No. of wires / strip	MA	Meas.	--do--	-	--do--	--do--	--do--		P *	--	--	
		3. Direction of lay	MA	Visual	One sample/Setting of each size	--	IS 1554 (Part 1)	IS 1554 (Part 1)	QCR		P	--	--	
		4.Coverage & Quality of armouring	MA	Meas.	100%	--	Min. area of coverage of armouring shall be 90%. The gap between amour wires / formed wires shall not exceed one amour wire/ formed wire space & there shall be no cross over/ over riding of amour wire / formed wire. Zn rich paint shall be applied on amour joint surface of G.S. Wire /formed wire. The breaking load of amour wire joint shall not be less than 95% of that amour wire / formed wire. (As per NTPC specification)		--do--		P	--	--	
		5 Dia over armouring	MA	Meas.	One sample/Setting of each size	--	NTPC ADS	NTPC ADS	--do--		P	--	--	
2.07	Outer Sheath	1. Surface finish	MA	Visual	100%	--	Pimple, Fish Eye, Burnt particles, Blow Hole not permitted. Repairing on outer sheath not permitted. (As per NTPC specification)		QCR		P	--	--	PVC FRLS compound shall be preferably loaded in to extruder by suction method.

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SL. NO क्र.सं	COMPONENT & OPERATIONS अवयव व संचालन	Characteristics/ विशेषताएं	Class /वर्ग	Type of check/जांच के प्रकार	Quantum of check		Reference Document/ संदर्भ दस्तावेज#	Acceptance Norms/ स्वीकृत मानदंड	Record Format/ रिकॉर्ड का प्रारूप	Agency / एजेंसी				Remarks/ /टिप्पणियां
					M/ एम	C/N सी/एन				D*	M/ए म	C/ सी	N/ एन	
1	2	3	4	5	6		7	8	9	D*	**	10		11
		2.Colour of sheath	MA	Visual	One sample/Setting of each size	--	NTPC ADS	NTPC ADS	QCR		P	--	--	
		3. Dia over outer sheath	MA	Meas	--do--	--	--do-	--do--	--do--		P	--	--	
		4.Thickness of outer sheath	CR	Meas	--do--	-	--do--	--do--	--do--		P	--	--	
		5. Embossing quality	MA	Visual	100%	-	Drum No.,IS 1554(Part 1) Cable size, Voltage grade & Words "FRLS" at every 5 meter is to be embossed. Embossing shall be automatic, in line & marking shall be legible & indelible. (As per NTPC specification)		--do--		P	--	--	Drum No. on Cable may be embossed/printed
		6. Sequencial marking	MA	Visual	Full length	--	Sequencial marking of length of cable in meter at every one meter is to be embossed / printed. Embossing / printing shall be progressive, automatic in line & marking shall be legible & indelible. (As per NTPC specification) In addition, Drum No. is also to be embossed/printed on full cable length		--do--		P	--	--	
C	**Finished Cables**													
3.01	Type test reports clearance from NTPC Engineering	All type tests as per NTPC specification	CR	Doc.	100%	100%	NTPC SPECIFICATION / NTPC ADS / IS 1554 (Part1)	NTPC SPECIFICATION / NTPC ADS / IS 1554 (Part1)	QCR	✓	P	V	V	
3.02	Routine Tests	1.High Voltage test	CR	Elect	100%	100%	NTPC ADS / IS 1554 (Part 1)	NTPC ADS / IS	Test	✓	P	W	V	Refer note 2

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SL. NO क्र.सं	COMPONENT & OPERATIONS अवयव व संचालन	Characteristics/ विशेषताएं	Class /वर्ग	Type of check/जांच के प्रकार	Quantum of check		Reference Document/ संदर्भ दस्तावेज#	Acceptance Norms/ स्वीकृत मानदंड	Record Format/ रिकॉर्ड का प्रारूप	Agency / एजेंसी				Remarks/ /टिप्पणियां
					M/ एम	C/ N सी/एन					M/ ए म	C/ सी	N/ एन	
1	2	3	4	5	6		7	8	9	D*	**	10		11
		at room temperature						1554 (Part I)	certificat e					
		2.Conductor Resistance	CR	Elect	100%	100%	NTPC ADS / IS 1554 (Part I)	NTPC ADS / IS 1554 (Part I)	--do--	✓	P	W	V	
3.03	**Acceptance Tests**													
3.03 (i)	Construction of finished Cable	1. OD of Cable	MA	Meas.	Each type & size of cables as per sampling plan of IS 1554 (Part 1)		NTPC ADS	NTPC ADS	--do--	✓	P	W	W	
		2. Laying of core	CR	Visual	--do--		NTPC ADS / IS 1554 (Part I)	NTPC ADS / IS 1554 (Part I)	Test certificat e	✓	P	W	W	
		3. Core Identification	CR	Visual	--do--		--do--	--do--	--do--	✓	P	W	W	Core printing shall be legible & indelible
		4. Colour of outer sheath	MA	Visual	--do--		NTPC ADS	NTPC ADS	--do--	✓	P	W	W	
		5. Inner sheath thickness	CR	Meas	- do -		--do--	--do--	--do--	✓	P	W	W	
		6. Inner sheath colour	MA	Visual	- do -		- do -	- do -	--do--	✓	P	W	W	
3.03 (ii)	Armour wires/ Formed wires (if applicable)	1.Dimensions	CR	Meas	Each type & size of cables as per sampling plan of IS 1554 (Part 1)		NTPC ADS /IS1554(Partl)/IS3975	NTPC ADS /IS1554(Partl)/IS3 975	--do--	✓	P	V	V	
		2. No. of wires/ formed wire	CR	Mech	– do –		--do--	--do--	--do--	✓	P	V	V	

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SL. NO क्र.सं	COMPONENT & OPERATIONS अवयव व संचालन	Characteristics/ विशेषताएं	Class /वर्ग	Type of check/जांच के प्रकार	Quantum of check		Reference Document/ संदर्भ दस्तावेज#	Acceptance Norms/ स्वीकृत मानदंड	Record Format/ रिकॉर्ड का प्रारूप	Agency / एजेंसी				Remarks/ /टिप्पणियां
					M/ एम	C/ N सी/एन				D*	M/ ए म	C/ सी	N/ एन	
1	2	3	4	5	6		7	8	9	D*	**	10		11
		3. Tensile test	CR	Mech	--do--		--do-	--do--	--do--	✓	P	V	V	
		4. Elongation test	CR	Mech	--do--		--do--	--do--	--do--	✓	P	V	V	
		5.Torsion test (for round wires only)	CR	Mech	--do--		--do--	--do--	--do--	✓	P	V	V	
		6. Wrapping test	CR	Mech	--do--		--do--	--do--	--do--	✓	P	V	V	
		7. Resistance test	CR	Mech	--do--		--do--	--do-	--do-	✓	P	V	V	
		8.Mass of Zinc coating	CR	Meas	--do--		--do--	--do--	--do--	✓	P	V	V	
		9. Uniformity of Zinc Coating	CR	Chem.	--do--		--do--	--do--	--do--	✓	P	V	V	
		10.Adhesion test	CR	Mech	--do--		--do--	--do-	--do--	✓	P	V	V	
		11.Freedom from defects	CR	Visual	--do--		--do--	--do--	--do--	✓	P	V	V	
3.03 (iii)	Conductor	1. Annealing Test	CR	Mech	-do--		NTPC ADS/ IS 8130	NTPC ADS/ IS 8130	--do--	✓	P	V	V	Refer Sl. No. 2.01
		2.Resistance Test	CR	Elect	--do--		--do--	--do--	--do--	✓	P	W	W	
3.03 (iv)	PVC Insulation & PVC Sheath	1.Thickness of insulation & sheath	CR	Meas.	--do-		NTPC ADS/ IS 1554(PartI)	NTPC ADS/ IS 1554(PartI)	--do--	✓	P	W	W	
		2.Tensile strength & elongation at break of insulation & outer sheath	CR	Mech	--do-		--do--	NTPC ADS/ IS 1554(PartI)	--do--	✓	P	W	W	
		3.Tensile strength & elongation of PVC at break of insulation & outer	CR	Mech	One sample per batch of offered lot (Finished Cable) irrespective of sizes		NTPC ADS/ IS 1554(PartI)	NTPC ADS/ IS 1554(PartI)	Test certificat e	✓	P	V	V	MTR of the offered lot shall be verified

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					M/ एम	C/ N सी/एन					M/ एम	C/ सी	N/ एन	
1	2	3	4	5	6		7	8	9	D*	**	10		11
		sheath (Ageing Test)												
		4. Insulation resistance (Volume resistivity method)	CR	Elect	Each type & size of cables as per sampling plan of IS 1554 (Part 1)		--do--	NTPC ADS/ IS 1554(PartI)	--do--	✓	P	W	W	
		5.High voltage test at room temperature	CR	Elect	--do--		--do--	--do--	--do--	✓	P	W	W	
		6.Thermal stability on PVC Insulation and outer sheath	CR	Chem	One sample of each offered lot of all offered sizes		-do--	--do--	--do--	✓	P	W	W	
		7.Oxygen index Test on outer sheath	CR	Chem	--do--		NTPC ADS / IS10810 Part 58	NTPC A.D.S	Test certificat e	✓	P	W	W	Refer Note 3
		8.Smoke density rating test on outer sheath	CR	Chem	--do--		NTPC ADS & ASTMD2843	NTPC ADS	-do--	✓	P	W	W	Refer Note 3
		9.Acid gas generation test on outer sheath	CR	Chem	--do--		NTPC ADS & IEC 60754-1	'NTPC ADS	--do--	✓	P	W	W	Refer Note 3
		10.Flammability test on completed cable	CR	Chem	Refer Note 4	Refer Note 4	NTPC ADS & IEC 60332 Part-3 (Category-B)	NTPC ADS	--do--	✓	P	W	W	

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NTPC	STANDARD QUALITY PLAN स्टैण्डर्ड क्वालिटी प्लान	TO BE FILLED IN BY NTPC		
Item (material, class, grade, rating, range, size etc.) / मद (सामग्री, वर्ग, ग्रेड, रैटिंग, रेंज, आकार आदि): **1.1 PVC Insulated FRLS Control cables**	CONFORMING TO CODE/ कोड के अनुरूप: IS 1554 PART 1 & NTPC TECHNICAL SPECIFICATION)	QP. NO. 0000-999- QOE- S-040 क्यूपी सं..: 0000-999-क्यूओई -एस-040 REV/ संशोधित सं..:01 DATE :/तिथि: 27.08.2021 Page/ पृष्ठ10 OF/ से 12 VALID UPTO: 26.08.2024	REVIEWED BY AMAN PANDEY AMAN DUBEY S K LAL SUNIL KUMAR LAL NISHITH AGARWAL NISHITH AGRAWAL	APPROVED BY Quality Assurance अनुमोदित Approved N.T.P.C., R'do

SL. NO क्र.सं	COMPONENT & OPERATIONS अवयव व संचालन	Characteristics/ विशेषताएं	Class /वर्ग	Type of check/जांच के प्रकार	Quantum of check		Reference Document/ संदर्भ दस्तावेज#	Acceptance Norms/ स्वीकृत मानदंड	Record Format/ रिकॉर्ड का प्रारूप	Agency / एजेंसी				Remarks/ /टिप्पणियां
					M/ एम	C/ N सी/एन					M/ ए म	C/ सी	N/ एन	
1	2	3	4	5	6		7	8	9	D*	**	10		11
		11.Surface finish & length measurement.	CR	Visual & Meas	100% (COC from Manufacturer to be submitted for surface finish as per specification's requirement)	one length of each offered lot of 50 drums of all sizes	(1)IS1554Part-I (2)Cable size, Voltage grade & Words " FRLS" at every 5 meter is to be embossed. Embossing shall be automatic, in line & marking shall be legible & indelible. (3) Sequential marking of length of cable in meter at every one meter is to be embossed / printed. Embossing / printing shall be progressive, automatic, in line & marking shall be legible & indelible (4) drum / Batch number marking on outer sheath		--do--	✓	P	W	W	Pimple, Fish Eye, Burnt particles, Blow Hole etc. not permitted. Repairing on outer sheath not permitted.
		12. Sequence of cores armour coverage, gap between two consecutive armour/ formed wire	CR	Visual & Meas	One length of each size	One length of each size	Min. area of coverage of armouring shall be 90%. The gap between armour wires / formed wires shall not exceed one armour wire/ formed wire space & there shall be no cross over/ over riding of armour wire / formed wire. Zn rich paint shall be applied on armour joint surface of G.S. Wire /formed wire		--do--	√	P	W	W	
4	Packing	1. Sealing	MA	Visual	100%	100%	(1)IS 1554(Part-I) (2) The surface of the drum and the outer most cable layer shall be covered with water proof cover. (3) Both the ends of cables shall be properly sealed with heat shrinkable PVC/ rubber caps secured by "U" nails.		QCR	✓	P	--	--	
4.01	Identification	NTPC Sealing	MA	Visual	100%	100%	Sealing shall be visible	Sealing shall be visible	--do--	✓	P	V	V	

LEGEND:/ संकेतिका: * RECORDS, INDENTIFIED WITH "TICK" (Ö) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION,/ * "टिक" (..) के साथ प्रमाणित रिकॉर्ड, क्यूए दस्तावेजीकरण में आपूर्तिकर्ता द्वारा अनिवार्य रूप से शामिल किया जाएगा।

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	STANDARD QUALITY PLAN स्टैण्डर्ड क्वालिटी प्लान	TO BE FILLED IN BY NTPC		
Item (material, class, grade, rating, range, size etc.) / मद (सामग्री, वर्ग, ग्रेड, रैटिंग, रेंज, आकार आदि): **1.1 PVC Insulated FRLS Control cables**	CONFORMING TO CODE/ कोड के अनुरूप: IS 1554 PART 1 & NTPC TECHNICAL SPECIFICATION)	QP. NO. 0000-999- QOE- S-040 क्यूपी सं..: 0000-999-क्यूओई-एस-040 REV/ संशोधित सं..:01 DATE :/तिथि: 27.08.2021 Page/ पृष्ठ 11 OF/ से 12 VALID UPTO: 26.08.2024	REVIEWED BY AMAN PANDEY AMAN DUBEY S K LAL SUNIL KUMAR LAL NISHITH AGARWAL NISHITH AGRAWAL	APPROVED BY Quality Assurance अनुमोदित Approved N.T.P.C. Noida

SL. NO क्र.सं	COMPONENT & OPERATIONS अवयव व संचालन	Characteristics/ विशेषताएं	Class /वर्ग	Type of check/जांच के प्रकार	Quantum of check		Reference Document/ संदर्भ दस्तावेज#	Acceptance Norms/ स्वीकृत मानदंड	Record Format/ रिकॉर्ड का प्रारूप	Agency / एजेंसी				Remarks/ /टिप्पणियां
					M/ एम	C/ N सी/एन					M/ ए म	C/ सी	N/ एन	
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Notes:	
1)	If the compound manufacturer is carrying out Ageing test, test report of compound manufacturer is to be reviewed. If the compound manufacturer is not carrying out ageing test, then cable manufacturer is to carry out ageing test & test report is to be reviewed (quantum of ageing test sample shall be one sample /batch)
2)	2(a) **In case of manufacturers / supplier who have supplied cables in the past through Corporate Centre**:- Routine Test of manufacturer internal test report are to be verified by NTPC at the time of final inspection. 2(b) **In case of manufacturers / supplier WHO HAVE NOT SUPPLIED cables in the past through Corporate Centre**:- Routine Test are to be witnessed by Main Contractor on 100% basis. This is in addition to manufacturer internal test report to be verified by NTPC at the time of final inspection. Same is to be verified by NTPC
3)	1. **For Smoke Density rating test**: if the test result without conditioning is within (-)10% of the maximum specified value, then, retesting is to be carried out with conditioning of samples as per standard and the test results after conditioning shall be final for acceptance/rejection. 2. **For Acid Gas Generation test**: if the test result without conditioning is within (-)10% of the maximum specified value, then, retesting is to be carried out with conditioning of samples as per standard and the test results after conditioning shall be final for acceptance/rejection.

LEGEND/ संकेतिका: * RECORDS, INDENTIFIED WITH "TICK" (Ö) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION/ * "टिक" (..) के साथ प्रमाणित रिकॉर्ड, क्यूए दस्तावेजीकरण में आपूर्तिकर्ता द्वारा अनिवार्य रूप से शामिल किया जाएगा।

** M: MANUFACTURER / SUB-SUPPLIER /निर्माता / उप-आपूर्तिकर्ता C: MAIN CONTRACTOR / मुख्य संविदाकार, N: NTPC/ एनटीपीसी P: PERFORM/ निष्पादन W: WITNESS/ गवाह AND V: VERIFICATION. AS APPROPRIATE/ सत्यापन (जैसा उपयुक्त हो), CHP/ सीएचपी: NTPC SHALL IDENTIFY IN COLUM "N" AS 'W': एनटीपीसी खंड "N" में "W" के रूप में करेगा ।

	STANDARD QUALITY PLAN स्टैण्डर्ड क्वालिटी प्लान	TO BE FILLED IN BY NTPC		
Item (material, class, grade, rating, range, size etc.) / मद (सामग्री, वर्ग, ग्रेड, रैटिंग, रेंज, आकार आदि): **1.1 PVC Insulated FRLS Control cables**	CONFORMING TO CODE/ कोड के अनुरूप: IS 1554 PART 1 & NTPC TECHNICAL SPECIFICATION)	QP. NO. 0000-999- QOE- S-040 क्यूपी सं..: 0000-999-~~क्यूओई~~ -एस-040 REV/ संशोधित सं..:01 DATE :/तिथि: 27.08.2021 Page/ पृष्ठ12 OF/ से 12 VALID UPTO: 26.08.2024	REVIEWED BY AMAN PANDEY AMAN DUBEY S K LAL SUNIL KUMAR LAL NISHITH AGARWAL NISHITH AGRAWAL	APPROVED BY Quality Assurance अनुमोदित Approved N.T.P.C. Ltd.

SL. NO क्र.सं	COMPONENT & OPERATIONS अवयव व संचालन	Characteristics/ विशेषताएं	Class /वर्ग	Type of check/जांच के प्रकार	Quantum of check		Reference Document/ संदर्भ दस्तावेज#	Acceptance Norms/ स्वीकृत मानदंड	Record Format/ रिकॉर्ड का प्रारूप	Agency / एजेंसी				Remarks/ /टिप्पणियां
					M/ एम	C/ N सी/एन					M/ ए म	C/ सी	N/ एन	
1	2	3	4	5	6		7	8	9	D*	**	10		11

	3. **For Oxygen Index test:** if the test result without conditioning is within (+)7% of the minimum specified value, then, retesting is to be carried out with conditioning of samples as per standard and the test results after conditioning shall be final for acceptance/rejection.
	4. In case the test results without conditioning do not meet the maximum/minimum specified value, the manufacturer may exercise the option of retesting the samples after conditioning as per standard.
4)	This test will be carried out using composite sampling i.e. irrespective of size; cables of one particular type (i.e. armoured, unarmoured) will be bunched together, as per calculations in line with the IEC. All sizes of armoured & unarmoured cables shall be covered.
LEGEND:	**NTPC ADS: NTPC approved data sheet, QCR: quality control records of cable manufacturer, CABLE MANUF STD- cable manufacturer's internal plant standard, MI: minor, MA: major, CR: critical, COC- certificate of conformance**

LEGEND:/ संकेतिका: * RECORDS, INDENTIFIED WITH "TICK" (Ö) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION/ * "टिक" (..) के साथ प्रमाणित रिकॉर्ड, क्यूए दस्तावेजीकरण में आपूर्तिकर्ता द्वारा अनिवार्य रूप से शामिल किया जाएगा।

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TYPE/ ACCEPTANCE/ ROUTINE TEST REQUIREMENTS

A. Type Test Conduction (For applicability, please refer clause no. 4.2 of Technical Data Part-A):

1. Tests for which "T" is indicated in the 'Test Conduction Required As' column below shall be conducted as Type Test.

2. Sampling:
   a) Type test to be conducted on one size for each type (Al/Cu conductor) of cable.
   b) FRLS & Flammability Test to be conducted only on one sample.

3. Repeat type test(s) are not required, in case the requirements of note no. 2, clause no. 2.2 of IS 1554-1 (as per amendment no. 5 of 2012) are met.

B. **Acceptance Test Conduction:**

1. Tests for which "A" is indicated in the 'Test Conduction Required As' column below shall be conducted as Acceptance tests.

2. Sampling:
   Sampling for acceptance tests shall be as per Appendix-B of IS: 1554 Part-I.

3. Flammability Test to be conducted only on one sample.

C. Routine Test Conduction:

1. Tests for which "R" is indicated in the 'Test Conduction Required As' column below shall be conducted as Routine tests.

D. Tests listed in S. No-7.0 & 8.0 shall be conducted only on one sample.

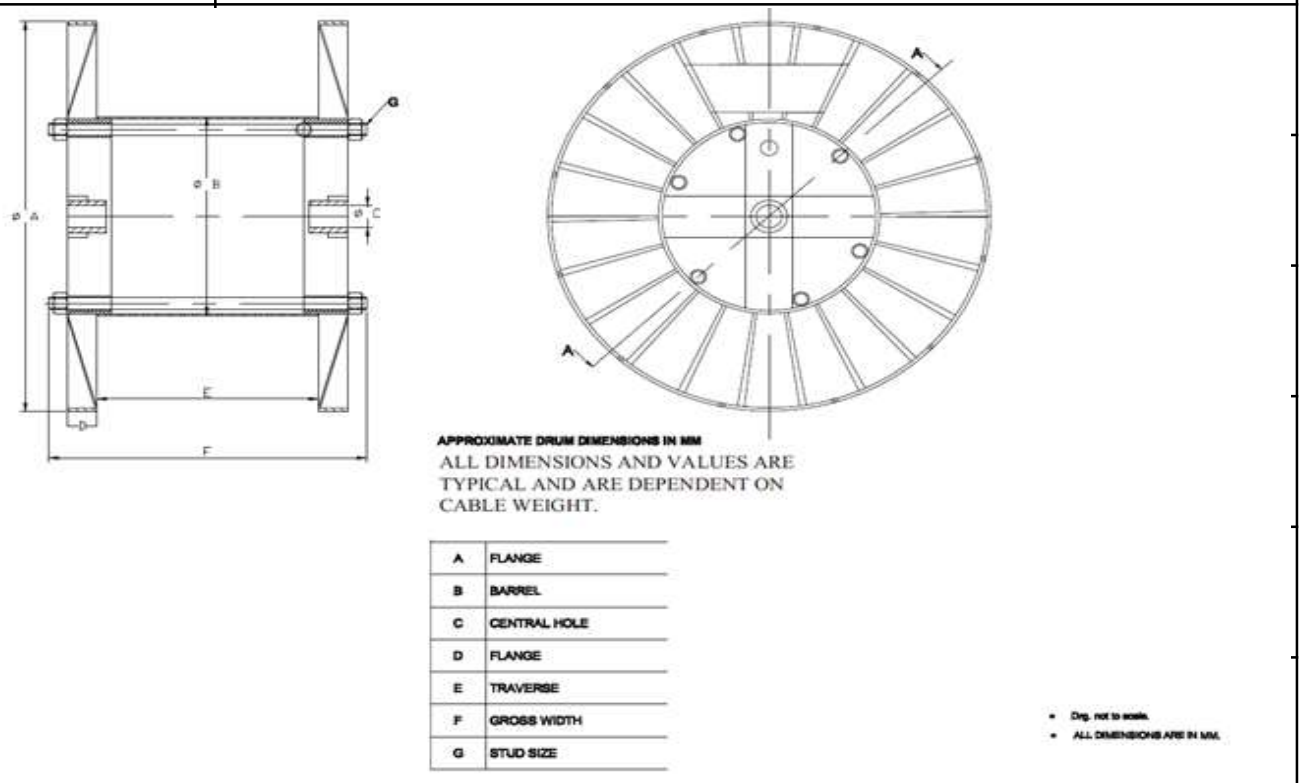
S. No.	TEST	APPLICABLE FOR	TEST CONDUCTION REQUIRED AS	REFERENCE STANDARD	REMARKS
1.0	**Tests for Conductor**				
I.	Annealing test	For copper conductor only	**T, A**	IS 10810 Pt 1	Internal in process Test Report to be furnished for to inspector at the time of inspection
II.	Tensile test	For aluminium conductor only (Not applicable for compacted circular or shaped conductor)	**T, A**	IS 10810 Pt 2	
III.	Wrapping test	For aluminium conductor only (Not applicable for compacted circular or shaped conductor)	**T, A**	IS 10810 Pt 3	
IV.	Resistance test	For Al/Cu	**T, A, R**	IS 10810 Pt 5	
2.0	**Tests for Armour Wires/Strips**				

S. No.	TEST	APPLICABLE FOR	TEST CONDUCTION REQUIRED AS	REFERENCE STANDARD	REMARKS
I.	Measurement of dimensions	Applicable for Aluminium wire & GS wire/Strip	**T, A**	IS 10810 Pt 36	
II.	Tensile test	Applicable for Aluminium wire & GS wire/Strip	**T, A**	IS 10810 Pt 37	
III.	Elongation at break test	Applicable for GS wire/Strip only	**T, A**	IS 10810 Pt 37	
IV.	Torsion test	For GS round wire only	**T, A**	IS 10810 Pt 38	
V.	Winding / Adhesion Test	For GS strip only	**T, A**	IS 10810 Pt 39	
VI.	Resistivity test	Applicable for Aluminium wire & GS wire	**T, A**	IS 10810 Pt 42	
VII.	Uniformity of Zinc coating test	For G. S. wires/Strip only	**T, A**	IS 10810 Pt 40	
VIII.	Mass of Zinc coating test	For G. S. wires/Strip only	**T, A**	IS 10810 Pt 41	
IX.	Wrapping Test	Applicable for Aluminium wire & GS wire	**A**	IS 10810 Pt 3	
3.0	**Physical Tests for PVC Insulation & PVC sheath**				
I.	Test for thickness	Applicable for PVC insulation, PVC inner sheath & PVC outer sheath	**T, A**	IS 10810 Pt 6	
II.	Tensile strength and elongation test at break	Applicable for PVC insulation & PVC outer sheath			
(a)	Before ageing		**T, A**	IS 10810 Pt 7	
(b)	After ageing		**T, A**	IS 10810 Pt 7	
III.	Ageing in air oven	Applicable for PVC insulation & PVC outer sheath	**T**	IS 10810 Pt 11	
IV.	Loss of mass in air oven test	For PVC outer sheath only	**T**	IS 10810 Pt 10	
V.	Hot deformation test	For PVC outer sheath only	**T, A**	IS 10810 Pt 15	
VI.	Heat shock test	For PVC outer sheath only	**T**	IS 10810 Pt 14	
VII.	Shrinkage test	For PVC insulation & PVC outer sheath only	**T**	IS 10810 Pt 12	
VIII.	Thermal stability test	For PVC insulation & PVC outer sheath only	**T, A**	IS 10810 Pt 60	
4.0	**Improved Fire performance (FR-LSH) Tests**				
I.	Oxygen index test	*For outer sheath only*	**T, A**	IS 10810 Pt 58 / ASTMD 2863/	
II.	Smoke density test	*For outer sheath only*	**T, A**	IS 10810 Pt 63 / ASTMD 2843	
III.	Acid gas generation test	*For outer sheath only*	**T, A**	IS 10810 Pt 59 / IEC-754-1	
IV.	Temperature Index Test	*For outer sheath only*	**T**	IS 10810 Pt 64 / ASTMD 2863	

S. No.	TEST	APPLICABLE FOR	TEST CONDUCTION REQUIRED AS	REFERENCE STANDARD	REMARKS
5.0	**Flammability Tests**				
I.	Flammability test for bunched cables	For complete cable	**T, A**	IS 10810 Pt 62/ IEC-60332 (Part-3-23-Cat-B	
II.	Flammability test for single cable	For complete cable	**T, A**	IS: 10810 Pt 61 / IEC:60332 Part-1	
III.	Swedish chimney test	For complete cable	**A**	SEN SS 424 1475 (Class F3)	
IV.	Flammability test	For complete cable	**A**	IEEE: 60383	
6.0	**Electrical Tests**				
I.	High Voltage Test (Water immersion test)	On cores	**T, A, R**	IS 10810 Pt 45	
II.	High Voltage Test at room temperature	For complete cable	**T, A, R**	IS 10810 Pt 45	
III.	Insulation Resistance Test (Volume resistivity method)	For complete cable	**T, A**	IS 10810 Pt 43	

PACKING REQUIREMENT

Sl.no	DESCRIPTION
	Steel Drums:
1.1	Item shall be fully covered with multi layered cross laminated colourless polyethylene sheet of at least 100 GSM and shall be packed inside steel drum as per below typical drawing.
1.2	Both the end of cables shall be properly sealed with heat shrinkable seal secured by 'U' nails so as to eliminate ingress of water during transportation, storage & erection.
1.3	A tag containing same information shall be attached to the leading end of the cable.



2	**Packing slip & holder:**
2.1	Packing slip kept in polyethylene bag shall be placed inside the cable drum at appropriate place.
2.2	One copy of packing slip wrapped in polyethylene bag covered in galvanized iron tin sheet/ aluminium packing slip holder shall be fixed on the external surface the cable drum.

DOCUMENTATION REQUIREMENT

DRAWINGS & DOCUMENTS TO BE SUBMITTED BY ALL THE BIDDERS ALONG WITH THE BID

Sl. No.	DOCUMENT TITLE
1	PQR CREDENTIALS
2	COMPLIANCE SHEET

DRAWINGS & DOCUMENTS TO BE SUBMITTED BY SUCCESSFUL BIDDER AFTER AWARD OF CONTRACT ALONG WITH SUBMISSION SCHEDULE

Sl. No.	DOCUMENT TITLE	SUBMISSION SCHEDULE		
		Vendor submission (Days) *	BHEL Comment (Days)	Vendor re-submission (Days)#
I	**Primary documents**			
1	Datasheet and Cross Section Drawings for Control Cable	14	18	10
2	QAP for Control cables	14	18	10
II	**Secondary documents**			
1	Type Test Report for Control cable	7$	3	2
NOTES:				
a) * 1st submission within indicated days from date of purchase order.				
b) # Submission (within indicated days) after incorporating all BHEL comments.				
c) Primary documents shall be considered for Delay analysis				
d) $: 1st submission within indicated days from date of purchase order (in case Type test report is available)/ from the date of conduction tests.				

DRAWINGS & DOCUMENTS TO BE SUBMITTED AS FINAL/AS-BUILT DOCUMENT

Sl. No.	DOCUMENT TITLE
1	APPROVED DOCUMENTS
2	APPROVED QUALITY PLAN.
3	ALL TEST CERTIFICATES

COMPLIANCE CERTIFICATE	
1	It is hereby confirm that the technical specification (sheet 1 to) has been read, understood. We confirm compliance to the tender specification including any clarification and amendments without any deviation.
2	It is hereby declared that any technical submittals which was not specifically asked for in NIT shall stand withdrawn.

Signature of authorised Representative

Name and Designation :

Name & Address of the Bidder

Date

ITEMS: LT PVC CONTROL CABLE SCOPE: Supply: YES; Erection & Commissioning: NO;	
1	Vendor should be a manufacturer of LT Control Cables.
2	Availability of test reports of tests of LT PVC FRLS Control Cable to establish in-house capability to carry out all routine, type & acceptance tests as per relevant IS/International Standards.
3	Capacity of manufacturing 200 km of LT Control Cables per month.
4	Manufactured and supplied at least one (1) km of FRLS cables.
5	Manufactured and supplied LT Control Cables upto 12 cores.
6	Manufactured & supplied at least 500 km of LT Control Cables of min. 1.5 sq. mm in one or more orders and at least 100 km of LT Control cables of min. 1.5 sq. mm in one single order.
7	Minimum two (2) nos. purchase orders for LT PVC Control Cables shall be submitted which should not be more than five (5) years old from date of techno-commercial bid opening.

Notes (General points of PQR):

1. Consideration of offer shall be subject to customer's approval of bidder, if applicable.
2. Bidder to submit all supporting documents in English. If documents submitted by bidder are in language other than English, a self-attested English translated document should also be submitted.
3. Notwithstanding anything stated above, BHEL reserves the right to assess the capabilities & capacity of the bidder to perform the contract, should the circumstance warrant such assessment in the overall interest of BHEL.
4. After satisfactory fulfilment of all the above criteria/requirement, offer shall be considered for further evaluation as per NIT and all the other terms of the tender.

PREPARED BY	CHECKED BY	REVIEWED BY	APPROVED BY
28/01/2025	28.1.25	28/01/25	29/1/25
ANKUR ARORA Sr. MANAGER	AYAN SAHA DGM	SANDEEP LODH AGM	DEBASISA RATH GM (ELECT)