USER'S MANUAL

CABLES

(Release – 3.05)

NETWORK ANALYSIS
CABLE COSTING
&
CABLE SELECTION BY ESTABLISHED METHODS

UNIQUE SOFTWARE FOR ENERGY AUDIT

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PROGRAM ON CABLES

1. INTRODUCTION

i. FEATURES ON THE MAIN INTERFACE

You will observe the following on the main interface:

a. Some menu items on the topmost part (read disclaimer)
b. A selection frame with some program options
c. A frame with 'Important' note at the lower left part
d. An Image view of Cables with some animations
e. An animated 'Status Bar' at the bottom of the interface
f. A circle with animated white text on green background
g. A number label above the circle at f above

Observe the following events:

A. Move your mouse pointer over the selection frame
B. Click the animated *Cables* at cables images
C. Click 'A SofexIndia Product' at cables images
D. Click or Double Click the animated circle mentioned at f.
E. Click the number label above the animated circle
F. Click any part of the 'Status Bar'

ii. PROGRAM OPTIONS

The following options will be found on the main interface of the program:

1. Cable properties and constants at different Temperatures and Frequencies for Copper and Aluminium
2. Cable Selection for feeding a 3-phase Load
3. Single 3-Core Cable's Voltage Regulation, Drop, Line Losses, Efficiency etc. feeding a 3-phase load

4. Multiple 3-Core Cable's Voltage Regulation, Drop, Line Losses, Efficiency etc. feeding a 3-phase load
5. Cable Costing for 1.1kV, 3.3kV, 6.6kV, 11kV and 33kV grade PVC, XLPE and PILC Cables
6. Exit from this program

These program options will now be discussed one by one in the coming sections.

2. CABLE PROPERTIES AND CONSTANTS AT DIFFERENT TEMPERATURES AND FREQUENCIES FOR COPPER AND ALUMINIUM

You can come to this part of the program in the following sequence:

- Open the program
- Click the option as above

Look at this 'Properties' interface. There are some menu items on the topmost part, some command buttons on the left part of the screen with text boxes to change the values of temperature and frequency. On central part of the screen you will find a tabular space for viewing the properties results. Observe that the headers of the table are already filled up.

Copper Cable Properties at a given temp. & frequency – Press the command button 'Copper' and the results will be displayed in the tabular space. Observe the change in grid color.

Aluminium Cable Properties at a given temp. & frequency – Press the command button 'Aluminium' and the results will be displayed in the tabular space. Observe the change in grid color.

Pressing 'Clear' command button will clear the contents of the table.

You can save the results obtained from the 'Save File' menu item in either text format or 'Elect' format. It is important to note that the files saved in 'Elect' format can be opened only in this interface using the 'Open Elect' menu.

Return to main interface by pressing the 'Home' command button or 'Back' menu item.

III. CABLE SELECTION FOR FEEDING A 3-PHASE LOAD

You can come to this part of the program in the following sequence:

- Open the program
- Click the option as above

Look at this 'Cable Selection' interface. There are some menu items on the topmost part. This interface has been divided in two frames. The left frame 'Set Boundary Conditions' is for input data, while the right side frame 'Results of Cable Selection' is for the results obtained on execution of the input data. Below these two frames are two Command Buttons named 'Test Data' and 'Execute' alongwith four labels that will display the various factors of the Cable Selection. We will now discuss these one by one:

i. SET BOUNDARY CONDITIONS (INPUT DATA)

The following input data are required by the program:

- Max. std. size of cable CSA in mm²
- Receiving end voltage in kV(L-L)
- Permissible % voltage regulation (upto 60)
- Load at the receiving end in kW
- Power factor of the load
- Load factor of the cable
- Length of the cable in m
- Mention the type of cable (Al/Cu)
- Symmetrical short circuit current in kA
- Break time of ckt. breaker in sec (0.2 - 1.2)
- Designed Current protection (Upto 2 times)
- Maximum Cable conductor temp. in °C
- Maximum AMBIENT air temp. in °C (40°C)
- DEPTH of cable laying in cm (75...540cm)
- Maximum GROUND temperature in °C (30°)
- SOIL RESISTIVITY (Normal 150°C cm/ W)

Max. std. size of cable CSA in mm²
Only standard cross sectional area between 1.5 and 625 sq.mm. will be accepted as input. The following are standard values as per IS:

1.5, 2.5, 4.0, 6.0, 10.0, 16.0, 25.0, 35.0, 50.0, 70.0, 95.0, 120.0, 150.0, 185.0, 225.0, 240.0, 300.0, 400.0, 500.0 and 625.0 mm²

Receiving end voltage in kV(L-L)
Receiving end voltage of the cable must be a positive value less than and upto 40kV.

Permissible % voltage regulation (upto 60)
Value of percentage voltage regulation must be a positive upto 60.

Load at the receiving end in kW
Load at receiving in kW must be a positive value.

Power factor of the load
Power factor, value must be between -1 and +1.

Load factor of the cable
Load factor, value must be positive upto 1.

Length of the cable in m
Cable length, value must be positive upto 20000m.

Mention the type of cable (Al/Cu)
Type of Cable should be either copper (cu) or Aluminium (al).

Symmetrical short circuit current in kA
Symmetrical short circuit current should be positive upto 70kA.

Break time of ckt. breaker in sec (0.2 - 1.2)
Break time should lie between 0.2 and 1.2 in sec.

Designed Current protection (Upto 2 times)
Designed current protection should lie between 1.00 and 2.00. This input value has been disabled in this program. However, it can be taken into consideration only at the choice of the user on demand.

Maximum Cable conductor temp. in °C
Cable temperature should lie between -30°C and 120°C.

Maximum AMBIENT air temp. in °C (40°C)
Ambient air temperature should lie between -30°C and 120°C.

DEPTH of cable laying in cm (75...540cm)
Depth of cable laying in cm must not exceed 600.

Maximum GROUND temperature in °C (30°)
Ground temperature should lie between 0°C and 90°C. This will be enabled and effective only when the depth of cable laying has some value.

SOIL RESISTIVITY (Normal 150°C cm/ W)
Soil Resistivity should lie between 10 and 900. This will be enabled and effective only when the depth of cable laying has some value.

ii. EXECUTION OF CABLE SELECTION PROGRAM

Now, once you filled up all the required and necessary data, it is time to execute these data. For this you have a command button below this input frame. Before you press this 'Execute' button, see and check the contents of the right side frame 'Results of Cable Selection'.

NOW, press the 'Execute' command button.

iii. VIEWING RECOMMENDED RESULTS

Observe that the right side frame is filled up with resulting data. You will find that the Cable Selection has been done on the following three methods:

- Cable Selected on the basis of Fault Current
- Cable Selected on the basis of RMS Current
- Cable Selected on the basis of Volt. Regulation.

The program recommends the highest size of the selected cables and only the related results of the recommended cable are displayed in the tabular form. The following are *recommended* sampled resulting data after execution of the 'Test Data' of the program:

S.N.	D e s c r i p t i o n	Value
1	Required number of the cable lengths in parallel	1
2	Cross Sectional Area of the selected cable sq.mm.	150
3	Percentage voltage regulation (%)	0.914
4	Voltage drop in the cable/phase in Volts	17.6
5	Annual energy loss in the selected cable in kWh	39320
6	Percentage line efficiency of the cable (%)	99.1
7	Resistance of the cable/phase/conductor in ohms	0.0796
8	Ind. reactance of the cable/phase/conductor in ohms	0.0386
9	Capacitance of each cable/phase in MFD	0.3332
10	Total losses in the cable (Average)- kW component	4.489
11	Total losses in the cable (Maximum)- kW component	9.538
12	Total dielectric losses in the cable- Watt component	8
13	Total sheath loss in the cable- Watt component	88
14	Sending end power factor	0.88
15	Sending end voltage (L-L) in kV	3.33
16	Calculated RMS current based on LF & FF in Amperes	135.6
17	Maximum load current in Amperes	198.8
18	Derating factor due to ambient temperature	0.953
19	Derating factor due to ground temperature	1
20	Derating factor due to depth of cable laying	0.994
21	Derating factor due to soil resistivity	1.03

iv. VIEWING OTHER RESULTS

To view the results in the manner the above tabular results are displayed then do the following:

Suppose you want to view the results of 'Cable Selected on the basis of Fault Current' the simply Click once the label and your related results will be displayed at once. This will be indicated by changed color of the table texts.

v. SAVING THE RESULTS

Results thus obtained can be saved in the following two formats:

Text Format with extension .txt
Elect Format with extension .cbs

It should be noted that the text format results can be displayed in any text editor while the 'Elect Format' results can only be opened in this program through 'Open Elect' menu.

vi. EXPORTING RESULTS TO 'EXCEL' OR 'LOTUS'

You can export these results to either 'Excel' or 'Lotus' spreadsheets if desired. To do this *Right Click* the mouse over the result table. Choose the option 'Select All'. Again *Right Click* the mouse and choose 'Copy Selection'. Now, open 'Excel' or 'Lotus' environment and 'Paste' the clipboard contents there. Observe that the entire resulting table is shifted to 'Excel' or 'Lotus'.

IV. VOLTAGE REGULATION, DROP, CABLE LOSSES, CABLE EFFICIENCY ETC. OF SINGLE/ BUNCH OF CABLE(S) FEEDING A SINGLE LOAD.

i. DATA INPUT SECTION

You can come to this part of the program in the following sequence:

- Open the program
- Click the option/s as above

Look at this 'Voltage Regulation' interface. There are some menu items on the topmost part. This interface has been divided in two frames. The left frame 'Set Boundary Conditions' is for input data, while the right side frame 'After Execution of Input Data' is for the results obtained on execution of the input data. There is a Command Buttons named 'Execute'.

The following two options are discussed under this head:

- *Single 3-Core Cable's Voltage Regulation, Drop, Line Losses, Efficiency etc. feeding a 3-phase load*

- *Multiple 3-Core Cable's Voltage Regulation, Drop, Line Losses, Efficiency etc. feeding a 3-phase load*

Further, to above both the options may be dealt with for the following two conditions:

1. When receiving end voltage known - With Capacitance.
2. When sending end voltage known - No Capacitance.

All the above four categories/ divisions require the following input data:

- No. of cables in parallel
- Cable(s) code (1..20)
- Receiving end voltage in kV(L-L)
- Load at the receiving end in kW
- Power factor of the load
- Load factor of the cable
- Length of the cable in m
- Mention the type of cable (Al/Cu)
- Maximum cable conductor temp. in °C (75°C)

No. of cables in parallel
Obviously, number of cables in parallel will be two or more for 'Bundled' case and it will be one for single 3-core cable.

Cable(s) code (1..20)
Thestandard size cables have been coded as will be shown on pressing the command button besides the input box. The value must lie between 1 and 20.

Receiving/ Sending end voltage in kV(L-L)
Receiving/ Sending voltage of cable must be positive a value upto 40kV.

Load at the receiving end in kW
Must be a positive value.

Power factor of the load
Power factor value must be between -1 and +1.

Load factor of the cable
Load factor value must be positive from 0.1 to less than 1.0

Length of the cable in m
Cable length value must be positive upto 20000m.

Mention the type of cable (Al/Cu)
Type of Cable should be either copper (cu) or Aluminium (al).

Maximum cable conductor temp. in °C (75°C)
Cable temperature should lie between -30°C and 120°C.

ii. EXECUTION OF VOLTAGE REGULATION PROGRAM

Now, once you filled up all the required and necessary data, it is time to execute these data. For this you have a command button below this input frame. Before you press this 'Execute' button, see and check the contents of the right side frame 'After Execution of Input Data'.

NOW, press the 'Execute' command button.

iii. VIEWING THE ANALYSIS RESULTS

Observe that the right side frame is filled up with resulting data. You will find the following tabular results of cable analysis due to default data:

Calculated Results of various cable parameters
Receiving end voltage known - With Capacitance

S. N.	Description	Unit	OUT-PUT
1	Receiving end load shared by cable path	kW	150
2	Sending end voltage of the cable (L-L)	kV	3.302
3	Sending end current/ phase of the system	Amps.	30.36
4	Sending end power factor of the system	Factor	0.8644
5	Percentage voltage regulation of the system	%	0.05
6	Annual energy losses in the cable(s)	kWh	335
7	Total losses (max. in eq. kW) in the system	kW	0.08
8	Total line losses (rms eq. kW) in the system	kW	0.04
9	Resist./phase/cond. of the cable at 75°C	Ohms	0.0295
10	Inductive react./phase/cond. of the cable	Ohms	0.0074
11	Line efficiency of the cable feeding system.	%	99.95
12	Receiving end current/ phase in cable(s)	Amps.	30.52
13	Form factor of the system.	Factor	1.22
14	Total Capacitance/ phase of the cable(s)	MFD	0.5
15	Receiving end capacitor current	Amps.	0.05
16	Cable line mid point capacitor current	Amps.	0.2
17	Sending end capacitor current	Amps.	0.05
18	Capacitive react./phase/cond. of the cable	k.Ohms	6.4
19	Equivalent impedance/ phase of cable(s)	Ohms	0.0305
20	Type of conductor material of the cable	Type	cu
21	Cross sectional area of cable(s)	sq.mm.	70
22	Current carrying capacity of cable(s)	Amps.	165
23	Voltage DROP per phase in the cable(s)	Volts	0.9

iv. SAVING THE RESULTS

Results thus obtained can be saved in the following two formats:

Text Format with extension .txt
Elect Format with extension .erd

It should be noted that the text format results can be displayed in any text editor while the 'Elect Format' results can only be opened in this program through 'Open Elect' menu.

v. EXPORTING RESULTS TO 'EXCEL' OR 'LOTUS'

You can export these results to either 'Excel' or 'Lotus' spreadsheets if desired. To do this *Right Click* the mouse over the result table. Choose the option 'Select All'. Again *Right Click* the mouse and choose 'Copy Selection'. Now, open 'Excel' or 'Lotus' environment and 'Paste' the clipboard contents there. Observe that the entire resulting table is shifted to 'Excel' or 'Lotus'.

V. CABLE COSTING FOR 1.1kV, 3.3kV, 6.6kV, 11kV AND 33kV GRADE PVC, XLPE AND PILC CABLES

i. INTRODUCTION AND BASIS

Cable cost is a subject that is generally required by every user. It is required before a purchase, for comparisons, for replacing cables and at several other occasions. The cost of cable is a function of the following major variables:

- Time
- Place
- Voltage grade
- Type of Conductor Material
- Number of Cores
- Armouring
- Insulation type
- Size of cable i.e. csa

The program has introduced a base price as on 1st September 2003. All the default rates refer to the said date. The base price of different types and category of cables were collected from various sources and agencies. A series of curves were than drawn and trend for different types and categories of cables were established. The resulting values are based on the above analysis. These values can be further updated or downdated to any date.

The following constants have been considered for the costing of cables:

- Specific gravity of Aluminium 2.703
- Specific gravity of Copper 8.930
- Cost of 1 kg Al as on 1.9.2003 in Rs. 120.00
- Cost of 1 kg Cu as on 1.9.2003 in Rs. 200.00
- Inflation rate % for cable materials/month 0.11

ii. FINDING COST OF A POWER CABLE

THE INTERFACE
You can come to this part of the program in the following sequence:

- Open the program
- Click the option/s as above

Look at this 'Cable Costing' interface. There are some menu items on the topmost part. This interface has been divided in seven frames.

The top five frames have been arranged to set the following five cable variables:

- Voltage in kV (1.1/ 3.3/ 6.6/ 11 or 33)
- Conductor (Aluminium or Copper)
- Core (3 or 3½ or 4)
- Armouring (Unarmoured or Armoured)
- Insulation (PVC/ XLPE or PILC)

The sixth frame is for selection of cable size in sq.mm.. Open the drop down box and select the standard size of cable for which you want the price in Rs. Per km. The default date is displayed as 01.09.2003. If you want the inflated value of the cable cost on some other date then write down the date in the prescribed format in the date box.

The seventh frame is for RESULTS. The following results will be displayed in the seventh frame:

1. Cable cost/km as on 01.09.2003 in Rs. '000
2. Cost inflation as on 'Your date' in Rs. '000
3. Net cost of Cable/km as on your date in Rs. '000

Below these frames is a command button with the caption 'Find Cable Cost'.

These constants and rates mentioned above in the 'Introduction and Basis' Section can be changed from the 'Options' menu of the program.

EXECUTION
Once you set the values of Voltage, Conductor, Cores, Armouring, insulation, size and date, it is time to execute the data. Press the command button 'Find Cable Cost' and get your results in the result section of the interface.

iii. ACCESSING RATES OF ALL SIZE OF CABLES

If you wish to find unit rates of all the standard size cables of a given category and type then open the text format file 'RcntExec.txt' in any text editor. You will find a series of twenty values. These values are cost of twenty standard size cables. The standard size has already been defined above and are between 1.5 sq.mm. and 625 sq.mm.

iv. VIEWING ALUMINIUM TO COPPER COST DIFFERENCE

To view the cost difference for each size of cables due to the change of conductor from aluminium to copper, go to the menu item 'Options'. Select the item 'Al to Cu Cost Difference'. Results will be displayed showing csa in sq.mm., Cost of Cu, Cost of Al and Cost difference in a message box.

v. TECHNOLOGY AND BASIS BEHIND THE CABLE COSTING

A complete discussion on different curves and methodology of arriving at the empirical formulae for different types and category of cables has been discussed separately in 'Technology behind Cables'.

COSTING OF 3-PHASE POWER CABLES

A series of cost of different voltage grades, insulations, conductors etc. are collected from various reliable sources and the prevailing market

on a base date of September 2003. The following categories are then constituted for group generalization:

1. Voltage (650/1100, 3300, 6600, 11000 and 33000V)
2. Conductor (Copper and Aluminium)
3. Armouring (Armoured and Unarmoured)
4. Number of Cores (3, 3½ and 4)
5. Insulation (PVC, XLPE and PILC)

Based on the data collected the following graphs were drawn between cross sectional area (csa) in sq.mm. and unit cost of cable in Rs. '000.

A. 1100V, Al, Unarmoured, 3-Core and PVC insulation cables
B. 1100V, Al, Armoured, 3-Core and PVC insulation cables
C. 3300V, Al, Armoured, 3-Core and PVC insulation cables
D. 3300V, Al, Armoured, 3-Core and XLPE insulation cables
E. 3300V, Cu, Armoured, 3-Core and PVC insulation cables
F. 3300V, Al, Armoured, 3-Core and PILC insulation cables
G. 6600V, Al, Armoured, 3-Core and XLPE insulation cables
H. 6600V, Al, Armoured, 3-Core and PILC insulation cables
I. 6600V, Cu, Armoured, 3-Core and PVC insulation cables
J. 11000V, Al, Armoured, 3-Core and PVC insulation cables
K. 11000V, Al, Armoured, 3-Core and XLPE insulation cables
L. 11000V, Al, Armoured, 3-Core and PILC insulation cables
M. 11000V, Cu, Armoured, 3-Core and PVC insulation cables
N. 33000V, Al, Armoured, 3-Core and XLPE insulation cables

The trends of variation of costs with the cross sectional areas, csa, of cable/km are then obtained and are shown in the following table:

Sl. No.	Voltage Grade	Core	Arm-ouring	Cond-uctor	Insulation	Trend Equation	Basis
A	1100	3	U	Al	PVC	$cpkm = 1.42 \times a + 22$	PMP

B	1100	3	A	Al	PVC	$cpkm = 1.45 \times a + 35$	PMP
C	3300	3	A	Al	PVC	$cpkm = 2.95 \times a + 75$	PMP
D	3300	3	A	Al	XLPE	$cpkm = 3.82 \times a + 315$	PMP
E	3300	3	A	Cu	PVC	$cpkm = 5.54 \times a + 80$	PMP
F	3300	3	A	Cu	PILC	Abnormal curve	PMP
G	6600	3	A	Al	XLPE	$cpkm = 4.14 \times a + 338$	PMP
H	6600	3	A	Al	PILC	$cpkm = 4.64 \times a + 338$	PMP
I	6600	3	A	Cu	PVC	$cpkm = 7.36 \times a + 320$	PMP
J	11000	3	A	Al	PVC	$cpkm = 4.32 \times a + 524$	PMP
K	11000	3	A	Al	XLPE	$cpkm = 4.91 \times a + 524$	PMP
L	11000	3	A	Al	PILC	$cpkm = 7.92 \times a + 594$	PMP
M	11000	3	A	Cu	PVC	Much deviated figures are obtained	PMP
N	33000	3	A	Al	XLPE	$cpkm = 5.3875 \times a + 10$	PMP

PMP – Prevailing Market Price A- Armoured U- Unarmoured Al- Aluminium Cu- Copper

On the basis of the above equations derived on the basis of the trend of prevailing market price as on 1st September 2003, the following equations are set for the different types and category of power cables:

Sl. No.	Voltage Grade	Core	Arm-ouring	Cond-uctor	Insulation	Trend Equation	Basis
1	1100	3	U	Al	XLPE	$cpkm = 1.42 \times a + 22$	
2				Cu	PVC	$cpkm = 1.42 \times a + 22$	
3					XLPE	$cpkm = 1.42 \times a + 22$	
4			A	Al	XLPE	$cpkm = 1.42 \times a + 22$	
5				Cu	PVC	$cpkm = 1.42 \times a + 22$	
					XLPE	$cpkm = 1.42 \times a + 22$	
		3 ½	U	Al	PVC	$cpkm = 1.42 \times a + 22$	
					XLPE	$cpkm = 1.42 \times a + 22$	
				Cu	PVC	$cpkm = 1.42 \times a + 22$	

					XLPE	$cpkm = 1.42 \times a + 22$	PMP
			A	Al	PVC	$cpkm = 1.42 \times a + 22$	
					XLPE	$cpkm = 1.42 \times a + 22$	PMP
				Cu	PVC	$cpkm = 1.42 \times a + 22$	PMP
					XLPE	$cpkm = 1.42 \times a + 22$	PMP
		4	U	Al	PVC	$cpkm = 1.42 \times a + 22$	
					XLPE	$cpkm = 1.42 \times a + 22$	
				Cu	PVC	$cpkm = 1.42 \times a + 22$	
					XLPE	$cpkm = 1.42 \times a + 22$	PMP
			A	Al	PVC	$cpkm = 1.42 \times a + 22$	
4					XLPE	$cpkm = 1.42 \times a + 22$	PMP
E				Cu	PVC	$cpkm = 1.42 \times a + 22$	PMP
F					XLPE	$cpkm = 1.42 \times a + 22$	PMP
G	6600	3	A	Al	XLPE	$cpkm = 4.14 \times a + 338$	PMP
H	6600	3	A	Al	PILC	$cpkm = 4.64 \times a + 338$	PMP

I	6600	3	A	Cu	PVC	$cpkm = 7.36 \times a + 320$	PMP
J	11000	3	A	Al	PVC	$cpkm = 4.32 \times a + 524$	PMP
K	11000	3	A	Al	XLPE	$cpkm = 4.91 \times a + 524$	PMP
L	11000	3	A	Al	PILC	$cpkm = 7.92 \times a + 594$	PMP
M	11000	3	A	Cu	PVC	Much deviated figures are obtained	PMP
N	33000	3	A	Al	XLPE	$cpkm = 5.3875 \times a + 1$	PMP

To start with, we find the difference of cost between copper and aluminium conductors for a three phase cable with different cross sections. The method by which this difference in cost cd is obtained is given hereunder in the table:

COST DIFFERENCE BETWEEN Cu & Al

Sl. No.	Cable CS Area sq.mm.	VOLUME in litre	Wt. of Al in kg **2.703**	Wt. of Cu in kg **8.93**	Cost of Al in Rs. '000	Cost of Cu in Rs. '000	Cost Diff. in Rs. '000
1	1.5	4.5	12	40	1.5	8.0	6.6
2	2.5	7.5	20	67	2	13	11.0
3	4	12	32	107	4	21	18
4	6	18	49	161	6	32	26
5	10	30	81	268	10	54	44
6	16	48	130	429	16	86	70

7	25	75	203	670	24	134	110
8	35	105	284	938	34	188	153
9	50	150	405	1340	49	268	219
10	70	210	568	1875	68	375	307
11	95	285	770	2545	92	509	417
12	120	360	973	3215	117	643	526
13	150	450	1216	4019	146	804	658
14	185	555	1500	4956	180	991	811
15	225	675	1825	6028	219	1206	987
16	240	720	1946	6430	234	1286	1052
17	300	900	2433	8037	292	1607	1315
18	400	1200	3244	10716	389	2143	1754
19	500	1500	4055	13395	487	2679	2192
20	625	1875	5068	16744	608	3349	2741

Voltage	Armo-uoring	Cores	Cond-uctor	Insula-tion	Empirical Equation
1100	U	3	Al	PVC	$cpkm = 1.42 \times a + 22$
				XLPE	$cpkm = 1.37 \times (1.42 \times a + 22)$
			Cu	PVC	$cpkm = 1.42 \times a + 22 + cd$
				XLPE	$cpkm = 1.37 \times (1.42 \times a + 22 + cd)$
		3 ½	Al	PVC	$cpkm = 1.1 \times (1.42 \times a + 22)$
				XLPE	$cpkm = 1.1 \times 1.37 \times (1.42 \times a + 22)$

			Cu	PVC	$cpkm = 1.1 \times (1.42 \times a + 22 + cd)$
				XLPE	$cpkm = 1.1 \times 1.37 \times (1.42 \times a + 22 + cd)$
		4	Al	PVC	$cpkm = 1.2 \times (1.42 \times a + 22)$
				XLPE	$cpkm = 1.2 \times 1.37 \times (1.42 \times a + 22)$
			Cu	PVC	$cpkm = 1.2 \times (1.42 \times a + 22 + cd)$
				XLPE	$cpkm = 1.2 \times 1.37 \times (1.42 \times a + 22 + cd)$
	A	3	Al	PVC	$cpkm = 1.45 \times a + 35$
				XLPE	$cpkm = 1.37 \times (1.45 \times a + 35)$
			Cu	PVC	$cpkm = 1.45 \times a + 35 + cd$
				XLPE	$cpkm = 1.37 \times (1.45 \times a + 35 + cd)$
		3 ½	Al	PVC	$cpkm = 1.1 \times (1.45 \times a + 35)$
				XLPE	$cpkm = 1.1 \times 1.37 \times (1.45 \times a + 35)$
			Cu	PVC	$cpkm = 1.1 \times (1.45 \times a + 35 + cd)$
				XLPE	$cpkm = 1.1 \times 1.37 \times (1.45 \times a + 35 + cd)$
		4	Al	PVC	$cpkm = 1.2 \times (1.45 \times a + 35)$
				XLPE	$cpkm = 1.2 \times 1.37 \times (1.45 \times a + 35)$
			Cu	PVC	$cpkm = 1.2 \times (1.45 \times a + 35 + cd)$

				XLPE	$cpkm = 1.2 \times 1.37 \times (1.45 \times a + 35 + cd)$
3300	A	3	Al	PVC	$cpkm = 2.95 \times a + 75$
				XLPE	$cpkm = 3.82 \times a + 315$
				PILC	$cpkm = 4.32 \times a + 315$
			Cu	PVC	$cpkm = 5.54 \times a + 80$
				XLPE	$cpkm = 3.82 \times a + 315 + cd$
				PILC	$cpkm = 4.32 \times a + 315 + cd$
		3 ½	Al	PVC	$cpkm = 1.1 \times (2.95 \times a + 75)$
				XLPE	$cpkm = 1.1 \times (3.82 \times a + 315)$
				PILC	$cpkm = 1.1 \times (4.32 \times a + 315)$
			Cu	PVC	$cpkm = 1.1 \times (5.54 \times a + 80)$
				XLPE	$cpkm = 1.1 \times (3.82 \times a + 315 + cd)$
				PILC	$cpkm = 1.1 \times (4.32 \times a + 315 + cd)$
		4	Al	PVC	$cpkm = 1.2 \times (2.95 \times a + 75)$
				XLPE	$cpkm = 1.2 \times (3.82 \times a + 315)$
				PILC	$cpkm = 1.2 \times (4.32 \times a + 315)$
			Cu	PVC	$cpkm = 1.2 \times (5.54 \times a + 80)$

				XLPE	$cpkm = 1.2 \times (3.82 \times a + 315 + cd)$
				PILC	$cpkm = 1.2 \times (4.32 \times a + 315 + cd)$
6600	A	3	Al	PVC	$cpkm = 7.36 \times a + 320 - cd$
				XLPE	$cpkm = 4.14 \times a + 338$
				PILC	$cpkm = 4.64 \times a + 338$
			Cu	PVC	$cpkm = 7.36 \times a + 320$
				XLPE	$cpkm = 4.14 \times a + 338 + cd$
				PILC	$cpkm = 4.64 \times a + 338 + cd$
		3 ½	Al	PVC	$cpkm = 1.1 \times (7.36 \times a + 320 - cd)$
				XLPE	$cpkm = 1.1 \times (4.14 \times a + 338)$
				PILC	$cpkm = 1.1 \times (4.64 \times a + 338)$
			Cu	PVC	$cpkm = 1.1 \times (7.36 \times a + 320)$
				XLPE	$cpkm = 1.1 \times (4.14 \times a + 338 + cd)$
				PILC	$cpkm = 1.1 \times (4.64 \times a + 338 + cd)$
		4	Al	PVC	$cpkm = 1.2 \times (7.36 \times a + 320 - cd)$
				XLPE	$cpkm = 1.2 \times (4.14 \times a + 338)$
				PILC	$cpkm = 1.2 \times (4.64 \times a + 338)$

			Cu	PVC	$cpkm = 1.2 \times (7.36 \times a + 320)$
				XLPE	$cpkm = 1.2 \times (4.14 \times a + 338 + cd)$
				PILC	$cpkm = 1.2 \times (4.64 \times a + 338 + cd)$
11000	A	3	Al	PVC	$cpkm = 4.32 \times a + 524$
				XLPE	$cpkm = 4.91 \times a + 524$
				PILC	$cpkm = 7.92 \times a + 594$
			Cu	PVC	$cpkm = 4.32 \times a + 524 + cd$
				XLPE	$cpkm = 4.91 \times a + 524 + cd$
				PILC	$cpkm = 7.92 \times a + 594 + cd$
		3 ½	Al	PVC	$cpkm = 1.1 \times (4.32 \times a + 524)$
				XLPE	$cpkm = 1.1 \times (4.91 \times a + 524)$
				PILC	$cpkm = 1.1 \times (7.92 \times a + 594)$
			Cu	PVC	$cpkm = 1.1 \times (4.32 \times a + 524 + cd)$
				XLPE	$cpkm = 1.1 \times (4.91 \times a + 524 + cd)$
				PILC	$cpkm = 1.1 \times (7.92 \times a + 594 + cd)$
		4	Al	PVC	$cpkm = 1.2 \times (4.32 \times a + 524)$
				XLPE	$cpkm = 1.2 \times (4.91 \times a + 524)$

				PILC	$cpkm = 1.2 \times (7.92 \times a + 594)$
			Cu	PVC	$cpkm = 1.2 \times (4.32 \times a + 524 + cd)$
				XLPE	$cpkm = 1.2 \times (4.91 \times a + 524 + cd)$
				PILC	$cpkm = 1.2 \times (7.92 \times a + 594 + cd)$
33000	A	3	Al	XLPE	$cpkm = 5.3875 \times a + 1040$
			Cu	XLPE	$cpkm = 5.3875 \times a + 1040 + cd$
		3½	Al	XLPE	$cpkm = 1.1 \times (5.3875 \times a + 1040)$
			Cu	XLPE	$cpkm = 1.1 \times (5.3875 \times a + 1040 + cd)$
		4	Al	XLPE	$cpkm = 1.2 \times (5.3875 \times a + 1040)$
			Cu	XLPE	$cpkm = 1.2 \times (5.3875 \times a + 1040 + cd)$

cd- Cost Difference (Cu-Al) cpkm– Cost/km in Rs. '000 a- csa in sq.mm.

POWER CABLES OF 3½ and 4 CORES

The cost per km of cables of 3½ and 4 core cables of different voltages, conductors and insulations have been directly derived on the basis as under:

Cost of 3½ Core Cable = 1.10 x Cost of 3 Core Cable
Cost of 4 Core Cable = 1.20 x Cost of 3 Core Cable

VI. HELP POINT

For any further query/ enquiry the user may contact SofexIndia at any of the following points:

sofexindia@yahoo.com
sofexindia@gmail.com

User may like to our web-pages at the following addresses:

http://www.sofexindia.com

S A V E E N E R G Y

MAKE YOUR SYSTEM MORE ENERGY EFFICIENT

SOME OF OUR SOFTWARES

Elect 7.05 Software deals with Electrical Engg. of Overhead Transmission lines and Selection of Most Economical Conductor. Unique software for Energy Audit.

AliView is useful for viewing all types of images, creating animations, obtaining image information etc. etc.

Multimedia player, useful for playing sound files of any format, video files like dat and avi etc., Shockwave files etc. etc

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Address Book 'Pataa Saaz' is a database, useful for family persons with individual Address Book for each with password facility, FIND facility etc. etc.

Calendar: 200 years HIJRI and Gregorian Calendar from 1900-2100.

Happy Birthday program. If installed, will wish respective persons on their Birthday.

Happy Wedding Anniversary program. If installed, will wish respective couples on their Wedding Anniversaries.

Cable Selection Software deals with selection of most suitable cable for a specific purpose. Unique software for Energy Audit.

File Navigator, useful for music lovers, video and audio editors, business personnel etc. Database of Songs and other information can be created and located afterwards at ease.

Loan Calculator. Small program for your day to day use for finding interest, EMI, duration etc. of a loan.