



AL-SHAHEEN REFINERY FEED PROJECT

CALCULATION NOTE FOR ELECTRICAL MEDIUM VOLTAGE CABLE SIZING

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1. SCOPE OF THIS DOCUMENT

This document defines the technical basis, parameters and criteria used for determining the required sizes of electrical Medium Voltage Cables for the Al-Shaheen Refinery Feed Project for the QATAR PETROLEUM.

This cable sizing calculation shall be verified and updated based on actual cable installation details by the EPC Contractor.

2. PURPOSE OF CALCULATION

The purpose of the cable sizing calculation is to determine minimum cable sizes required to satisfy normal operating load currents, ability to withstand excess currents under power system short circuit fault conditions and to ensure maintenance of minimum voltage levels at the equipment under normal operating and motor starting conditions.

3. SPECIFICATIONS, CODE AND STANDARDS

3.1 APPLICABLE PROJECT SPECIFICATION

8942V-00-JSD-16-17-001	Specification for Design Basic Electrical Design
8942V-00-JSS-16-17-002	Specification for cable and wire
8942V-00-DW-16-11-001	General One line diagram
8942V-00-DW-16-31-001	Main cable routing

3.2 CODES AND STANDARDS

The following recommendations are used for different parameters.

IEC 60228	:	Conductors of insulated cables
IEC 60502	:	Power cables with extruded insulation and their accessories for rated voltages from 1 kV ($U_m = 1,2$ kV) up to 30 kV ($U_m = 36$ kV)
IEC 60364 Part 5 - 52	:	Electrical installation of buildings- Selection and erection of electrical equipment wiring system.
BICC Catalogue	:	For typical rating factor

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4. TERMINOLOGY

Abbreviation	Definition
AWA	Aluminium Wire Armoured
DOL	Direct On Line
IEC	International Electro-technical Commission
PVC	Polyvinyl Chloride
VSDS	Variable Speed Drive System
XLPE	Cross Linked Polyethylene
SWA	Steel Wire Armoured

5. ATMOSPHERIC AND GENERAL DESIGN PARAMETERS

The atmosphere and other design parameters applicable for the project are listed below:

Max. ambient temperature	:	50°C
Design ambient temperature for cables in air	:	50°C
Design ambient temperature for cables in concrete trench, sand-filled	:	40°C
Design ambient temperature for cables laid directly buried in the ground	:	40°C
Soil Thermal Resistivity (As per Doc No.8942V-00-JSD-1617-001 titled: "Job Specification for Design Basic Electrical Design")	:	2.5°K.m/W

6. ELECTRICAL SYSTEM DETAILS

1	Electrical MV supply voltage	415V +/- 10 %
2	Frequency	50Hz +/- 5 %
3	Method of earthing at source	Solidly earthed

7. VOLTAGE GRADE OF CABLES

Medium Voltage cables shall be rated for 600/1000 volts.

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8. CABLE INSTALLATION

The methods of cable installations shall be as per "Job specification for Design Basic Electrical Design "8942V-00-JSD-1617-001

9. SIZING CALCULATIONS

Cables shall be sized in accordance with the following criteria and the relevant standards listed in this document.

- ◆ Admissible current ampacity of cables including derating factors.
- ◆ Admissible voltage drop
- ◆ Short circuit ratings of supply system and through fault condition of protective devices

9.1 MAXIMUM ADMISSIBLE CONDUCTOR TEMPERATURE

The maximum conductor operating temperature for XLPE insulated cables is considered as 90°C as per IEC.

9.1.1 REFERENCE CONTINUOUS CURRENT CARRYING AMPACITIES

The current carrying capacities for XLPE cables as shown in Appendix-1 (IEC 60364-5-52) are used for calculation with the following parameters

Ambient air temperature	:	30°C
Ground thermal resistivity	:	2.5°K.m/W
Ground temperature	:	20°C
Depth of laying (MV Cables)	:	Up to 0.8m
Max. Conductor Operating temperature	:	90°C

9.1.2 RESISTANCE AND REACTANCE OF CABLES

The Appendix – 2 gives the resistance and reactances of various sizes of cables.

9.2 SHORT CIRCUIT CALCULATION**FEEDER MINIMUM CROSS SECTION BASED ON SHORT CIRCUIT LEVEL**

The cable short circuit current capacity is evaluated as

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$$I_{sc}^2 = \frac{K^2 S^2}{T} \log_e \left(\frac{\phi_1 + \beta}{\phi_0 + \beta} \right)$$

Where :

- I_{sc} = symmetrical short circuit current (r.m.s) in Amp
- T = duration of short-circuit in second
- K = Constant for the material of conductor
- S = area of conductor in mm²
- ϕ_1 = final temperature in °C
- ϕ_0 = initial temperature in °C
- β = reciprocal of the temperature coefficient of resistance of conductor in °C at 0°C

The constant K and β for copper cables and ϕ_1 and ϕ_0 for Copper / XLPE cables are:

K = 226
 β = 234.5
 ϕ_1 = 250°C (for XLPE cable)
 ϕ_0 = 90°C (for XLPE cable)

The short circuit currents for Copper /XLPE cables based on above are given as:

$$I_{sc} = \frac{143 \times S}{\sqrt{T}}$$

Minimum XLPE insulated cable size to satisfy short circuit withstand is determined by the following formulae:

$$S = \frac{I_{sc} \times \sqrt{T}}{143}$$

Based on above, the short-circuit withstand of cables shall be calculated based on switchboard short circuit rating and fault clearing time.

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Item Description	Short Circuit Current level (kA)	Short Circuit Duration (sec)	Minimum Cable Size (sq.mm)
415V Incomer feeder (From transformer)	50 / 65	0.627	300 / 400

Notes:

- (1) Short circuit current level means rated interrupted current of each switchgear
- (2) Determination of fault duration for any given circuit conductor will be based on 110% of the clearing time of the upstream protection that is considered to be the "backup" protection for that circuit conductor.
- (3) Short circuit duration is determined as follows:
 - 415V ACB:
 - = Relay (50) operation time + CB interrupting time + allowance
 - = 0.04 sec. (2 cyc.) + 0.06 sec (3 cyc.) + 0.12 sec. (6 cyc.) + 0.35 backup
 - = 0.57 X 1.1 = 0.627 sec

The Copper/XLPE cable size required for various short circuit current and clearance times are as given in Appendix -3.

9.3 CORRECTION FACTORS

Tables A.52-14, A.52-15, A.52-16 & A.52-18 in IEC 60364 Part 5-52 give the various Correction Factors under different conditions like variation of Ground temperature, Soil thermal resistivity, grouping of cables and Variation in Ambient temperature.

Based on the installation conditions, the following derating factors have been considered.

For MV cables (laid in ground) as per Appendix -1

- a) Rating factor for ground temperature of 40°C = Kt = 0.85
- b) Rating factor for soil thermal resistivity of 2.5 °K.m/W = Ks = 1.00
- c) Rating factor for direct burial at a depth of 0.8 metre = K1 = 0.96
- d) Rating factor for grouping of cables (6 circuit with 1 D spacing) = Kg = 0.55
- e) Overall admissible ampacity correction factor Df = Kt X Ks X K1 X Kg = 0.45

All calculation shall be based on the derating factor for cable laid in the ground as the worst condition.

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Note: As per the Electrical design basic "Cable shall be installed underground throughout the plant facility." Therefore 0.45 correction factor is used in this document.

9.4 VOLTAGE DROP CALCULATION

9.4.1 GENERAL MAXIMUM ALLOWABLE VOLTAGE DROP

The following break down to be considered as per Doc No. 8942V-00-JSD-1617-001, sec 6.4

- a) Incoming feeders (cable between transformer : 1%
and switchgear fed by transformer)
- b) Incoming feeders (cable between generator : 1%
and switchgear fed by generator)
- c) Cable between switchgear and local : 2%
distribution panels
- d) Cable between MV switchgear and MV Load : 4%
- e) MV Motor normal run (Cable between MV : 4%
switchgear and MV motor)
- f) MV Motor during starting : 20% of rated equipment
voltage at motor terminal
- g) MV Switchgear during MV motor starting : 10% of rated equipment
voltage at switchgear bus bar
- h) Cable between switchboard and lighting : 1%
panel fed by the switchboard
- i) Cable between lighting panel and farthest : 3%
lighting fitting fed by the lighting panel

9.4.2 FORMULA FOR CALCULATING FEEDER VOLTAGE DROP

$$\Delta V = \frac{\sqrt{3}}{n \times 1000 \times V} (R \cdot \cos \phi + X \cdot \sin \phi) \cdot I \cdot L \times 100 \quad (\text{For 3 ph loads})$$

Where : ΔV = Voltage drop in %

L = Length of cable route in metres

n = Number of cables running in parallel per phase

R = Resistance in Ohm/km @50Hz

X = Reactance in Ohm/km @ 50Hz

I = Carried current in Amps

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$\cos\phi$ = Load Power factor

V = Nominal Voltage (volts)

10. CABLE SIZE SELECTION

The cable sizing shall be based on selection of the largest cable size meeting the following requirement

- Short circuit capacity requirements as discussed in section 9.2 and Appendix -3.
- Correction factor as discussed in sections 9.3
- Voltage drop and current carrying capacity requirements as discussed in sections 9.4.
- Cable specification

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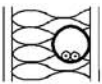
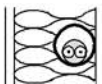
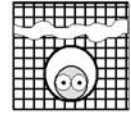
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APPENDIX - 1

APPLICABLE TABLES FROM IEC 60364 -5- 52

(6 PAGES)

**Table A.52-3 (52-C2) – Current-carrying capacities in amperes
for methods of installation in table A.52-1 (52-B1) –
XLPE or EPR insulation/two loaded conductors/copper or aluminium –
Conductor temperature: 90 °C/Ambient temperature: 30 °C in air, 20 °C in ground**

Nominal cross-sectional area of conductor mm ²	Installation methods of table A.52-1					
	A1	A2	B1	B2	C	D
						
1	2	3	4	5	6	7
Copper						
1,5	19	18,5	23	22	24	26
2,5	26	25	31	30	33	34
4	35	33	42	40	45	44
6	45	42	54	51	58	56
10	61	57	75	69	80	73
16	81	76	100	91	107	95
25	106	99	133	119	138	121
35	131	121	164	146	171	146
50	158	145	198	175	209	173
70	200	183	253	221	269	213
95	241	220	306	265	328	252
120	278	253	354	305	382	287
150	318	290	–	–	441	324
185	362	329	–	–	506	363
240	424	386	–	–	599	419
300	486	442	–	–	693	474
Aluminium						
2,5	20	19,5	25	23	26	26
4	27	26	33	31	35	34
6	35	33	43	40	45	42
10	48	45	59	54	62	56
16	64	60	79	72	84	73
25	84	78	105	94	101	93
35	103	96	130	115	126	112
50	125	115	157	138	154	132
70	158	145	200	175	198	163
95	191	175	242	210	241	193
120	220	201	281	242	280	220
150	253	230	–	–	324	249
185	288	262	–	–	371	279
240	338	307	–	–	439	322
300	387	352	–	–	508	364
NOTE In columns 3, 5, 6 and 7, circular conductors are assumed for sizes up to and including 16 mm ² . Values for larger sizes relate to shaped conductors and may safely be applied to circular conductors.						

LEGEND SHEET FOR INSTALLATION METHODS OF CABLE

Table 52-3 (continued)

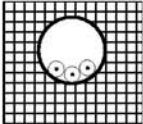
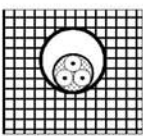
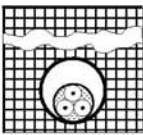
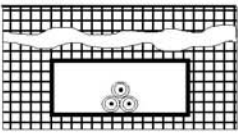
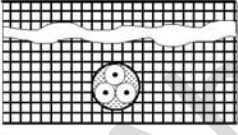
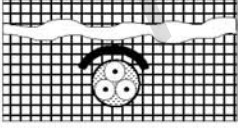
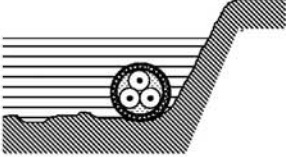
Item No.	Methods of installation	Description	Reference method of installation to be used to obtain current-carrying capacity (see annex A)
59		Insulated conductors or single-core Cables in conduit in masonry ^a	B1
60		Multi-core cables in conduit in masonry ^a	B2
70		Multi-core cable in conduit or in cable ducting in the ground	D
71		Single-core cable in conduit or in cable ducting in the ground	D
72		Sheathed single-core or multi-core cables direct in the ground – without added mechanical protection (see note)	D
73		Sheathed single-core or multi-core cables direct in the ground – with added mechanical protection (see note)	D
80		Sheathed single-core or multi-core cables immersed in water	Under consideration
NOTE The inclusion of directly buried cables in this item is satisfactory when the soil thermal resistivity is of the order of 2,5 K·m/W. For lower soil resistivities, the current-carrying capacity for directly buried cables is appreciably higher than for cables in ducts.			
^a Thermal resistivity of masonry is not greater than 2 K·m/W.			

Table A.52-14 (52-D1) – Correction factor for ambient air temperatures other than 30 °C to be applied to the current-carrying capacities for cables in the air

Ambient temperature ^a °C	Insulation			
	PVC	XLPE and EPR	Mineral ^a	
			PVC covered or bare and exposed to touch 70 °C	Bare not exposed to touch 105 °C
10	1,22	1,15	1,26	1,14
15	1,17	1,12	1,20	1,11
20	1,12	1,08	1,14	1,07
25	1,06	1,04	1,07	1,04
35	0,94	0,96	0,93	0,96
40	0,87	0,91	0,85	0,92
45	0,79	0,87	0,87	0,88
50	0,71	0,82	0,67	0,84
55	0,61	0,76	0,57	0,80
60	0,50	0,71	0,45	0,75
65	–	0,65	–	0,70
70	–	0,58	–	0,65
75	–	0,50	–	0,60
80	–	0,41	–	0,54
85	–	–	–	0,47
90	–	–	–	0,40
95	–	–	–	0,32

^a For higher ambient temperatures, consult manufacturer.

Table A.52-15 (52-D2) – Correction factors for ambient ground temperatures other than 20 °C to be applied to the current-carrying capacities for cables in ducts in the ground

Ground temperature °C	Insulation	
	PVC	XLPE and EPR
10	1,10	1,07
15	1,05	1,04
25	0,95	0,96
30	0,89	0,93
35	0,84	0,89
40	0,77	0,85
45	0,71	0,80
50	0,63	0,76
55	0,55	0,71
60	0,45	0,65
65	–	0,60
70	–	0,53
75	–	0,46
80	–	0,38

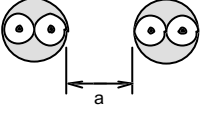
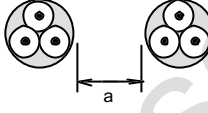
Table A.52-16 (52-D3) – Correction factors for cables in buried ducts for soil thermal resistivities other than 2,5 K·m/W to be applied to the current-carrying capacities for reference method D

Thermal resistivity, K·m/W	1	1,5	2	2,5	3
Correction factor	1,18	1,1	1,05	1	0,96
NOTE 1 The correction factors given have been averaged over the range of conductor sizes and types of installation included in tables A.52-2 to A.52-5. The overall accuracy of correction factors is within ±5 %. NOTE 2 The correction factors are applicable to cables drawn into buried ducts; for cables laid direct in the ground the correction factors for thermal resistivities less than 2,5 K·m/W will be higher. Where more precise values are required they may be calculated by methods given in IEC 60287. NOTE 3 The correction factors are applicable to ducts buried at depths of up to 0,8 m.					

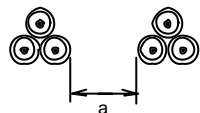
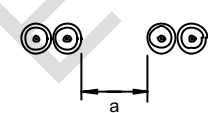
**Table A.52-18 (52-E2) – Reduction factors for more than one circuit,
cables laid directly in the ground –
Installation method D in tables A.52-2 (52-C1) to A.52-5 (52-C4) –
Single-core or multi-core cables**

Number of circuits	Cable to cable clearance (a) ^a				
	Nil (cables touching)	One cable diameter	0,125 m	0,25 m	0,5 m
2	0,75	0,80	0,85	0,90	0,90
3	0,65	0,70	0,75	0,80	0,85
4	0,60	0,60	0,70	0,75	0,80
5	0,55	0,55	0,65	0,70	0,80
6	0,50	0,55	0,60	0,70	0,80

^a Multi-core cables

^a Single-core cables

NOTE Values given apply to an installation depth of 0,7 m and a soil thermal resistivity of 2,5 K·m/W. They are average values for the range of cable sizes and types quoted for tables A.52-2 to A.52-5. The process of averaging, together with rounding off, can result in some cases in errors up to ±10 %. (Where more precise values are required they may be calculated by methods given in IEC 60287-2-1).

Rating Factor for Depth Of Laying

Depth of laying (Metre)	(From BICC Cat.)	
	Up to 50 mm ²	70 mm ² to 300 mm ²
0.5	1.00	1.00
0.6	0.99	0.98
0.8	0.97	0.96
1.0	0.95	0.94
1.25	0.94	0.92
1.5	0.93	0.89

Ahmed Essa

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APPENDIX - 2

RESISTANCE AND REACTANCE OF CABLES

(1 PAGE)

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TABLE - 2 RESISTANCE AND REACTANCE OF MV CABLE:

Nominal area of Conductor (mm ²)	Resistance (Ref. Table II, column-8 of IEC 60228)		Reactance at 50Hz (Ref. Cable manufacturer catalogue)	
	R in ohm/km		Single core X in Ohm/km	Multi core X in Ohm/km
	20°C	90°C (ref. Note 1)		
2.5	7.41	9.50	-	0.105
4	4.61	5.91	-	0.098
6	3.08	3.95	-	0.094
10	1.83	2.35	-	0.088
16	1.15	1.47	0.118	0.084
25	0.727	0.93	0.112	0.083
35	0.524	0.67	0.107	0.081
50	0.387	0.50	0.104	0.080
70	0.268	0.34	0.101	0.079
95	0.193	0.25	0.098	0.077
120	0.153	0.20	0.096	0.077
150	0.124	0.16	0.096	0.077
185	0.0991	0.13	0.096	0.077
240	0.0754	0.10	0.094	0.077
300	0.0601	0.08	0.093	0.077
400	0.0470	0.06	0.093	0.076
500	0.0366	0.047	0.093	-
630	0.0283	0.036	0.090	-
800	0.0221	0.0283	0.092	-

Notes: 1) The temperature correction factor for copper conductor

$$= \frac{254.5}{234.5 + t} \quad (\text{Ref. IEC 60 228, cl. 6})$$

$$= 0.78 \quad (t = \text{for } 90^{\circ}\text{C})$$

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APPENDIX - 3

SHORT CIRCUIT RATING OF CABLES

(1 PAGE)

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CALCULATION NOTE FOR ELECTRICAL MEDIUM VOLTAGE CABLE SIZING

TABLE – 3 SHORT CIRCUIT RATING OF CABLES

short circuit current in ampere	Cu / XLPE cable Size in sq.mm for durations							
	0.01 sec.	0.025 sec.	0.050 sec.	0.100 sec.	0.200 sec.	0.250 sec.	0.500 sec.	1.000 sec.
65000	50	95	120	150	240	240	400	500
52500	50	70	95	120	185	185	300	400
50000	50	70	95	120	185	185	300	400
40000	35	50	70	95	150	150	240	300
31500	25	35	50	70	120	120	185	240
25000	25	35	50	70	95	95	150	185
15000	16	16	25	35	50	70	95	120
10000	10	16	16	25	35	35	50	70
5000	6	6	10	16	16	25	25	35
2500	2.5	4	4	6	10	10	16	25

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CALCULATION NOTE FOR ELECTRICAL MEDIUM VOLTAGE CABLE SIZING

APPENDIX - 4

415V CABLE SELECTION CHART (MOTOR FEEDER [LAID IN GROUND](#))

(1 PAGE)

APPENDIX - 4 : CABLE SELECTION CHART FOR 415 V MOTOR FEEDERS (LAID BURIED IN GROUND)

System voltage (Line to Line) =	0.415 kV	Rating factor for ground temperature of 40 deg C	=	0.85
Running voltage drop limit=	4% At Motor FLC	Rating factor for soil thermal resistivity of 2.5 Km/W	=	1.00
Starting volt.drop limit =	20% At Motor LRC	Rating factor for direct burial at a depth of 0.6m	=	0.96
DERATING FACTOR =	0.45	Rating factor for grouping of cables (12 nos group, 0.15m)	=	0.55
CABLES HAVING COPPER CONDUCTORS		Overall admissible ampacity correction factor = 0.85X1X0.96X0.55=		0.45
COS Øs= 0.2 IS ASSUMED AS THE STANDARD STARTING P.F. FOR L.V. MOTORS				
Design Margin =	10%			

CABLE SIZE IN mm ²	4	6	10	16	25	35	50	70	95	120	150	185	240	95	120	150	185	240
No. of Cable cores	3C	3C	3C	3C	3C	3C	3C	3C	3C	3C	3C	3C	3C	3C	3C	3C	3C	3C
No. of Runs per phase	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2
STANDARD CABLE RATING	44	56	73	95	121	146	173	213	252	287	324	363	419	504	574	648	726	838
SITE CABLE RATING	19.7	25.1	32.8	42.6	54.3	65.5	77.6	95.6	113.1	128.8	145.4	162.9	188.0	226.2	257.6	290.8	325.8	376.1
CABLE RESISTANCE IN OHM / km	5.91	3.95	2.35	1.47	0.93	0.67	0.50	0.34	0.25	0.20	0.16	0.13	0.10	0.13	0.10	0.08	0.07	0.05
CABLE REACTANCE IN OHM / km	0.098	0.094	0.088	0.084	0.083	0.081	0.080	0.079	0.077	0.077	0.077	0.077	0.077	0.039	0.039	0.039	0.039	0.039

MOTOR RATING kW	Eff	cos ør	MOTOR F.L.C AMPS	MOTOR L.R.C AMPS	cos øs	MAXIMUM PERMISSIBLE ROUTE LENGTH IN METRE (3000 m)																	
0.75	0.75	0.75	1.85	18.36	0.20	1044	1553	2580															
1.10	0.77	0.73	2.72	26.95	0.20	730	1086	1802	2831														
1.50	0.79	0.76	3.48	34.41	0.20	550	818	1360	2139														
2.20	0.81	0.78	4.84	47.96	0.20	385	573	953	1500	2314													
3.00	0.82	0.80	6.36	48.99	0.20	286	426	709	1117	1725	2343												
3.70	0.83	0.80	7.75	59.69	0.20	235	349	581	916	1416	1923	2509											
4.00	0.85	0.81	8.08	62.24	0.20	223	331	551	869	1344	1826	2385											
5.50	0.86	0.82	10.85	83.55	0.20	164	244	406	641	991	1348	1762	2478										
7.50	0.87	0.83	14.45	111.26	0.20	122	181	302	476	737	1003	1312	1848	2408	2886								
11.00	0.89	0.83	20.72	159.52	0.20	0	126	210	332	514	699	915	1289	1679	2013	2393	2788						
15.00	0.90	0.84	27.60	212.55	0.20	0	0	156	247	382	520	681	961	1254	1505	1792	2091	2362	2507				
18.50	0.91	0.84	33.67	259.26	0.20	0	0	0	202	313	426	558	788	1028	1234	1469	1714	1937	2056	2467	2938		
22.00	0.91	0.82	41.02	315.83	0.20	0	0	0	0	262	357	466	656	853	1021	1212	1410	1590	1706	2042	2424	2820	
30.00	0.92	0.82	55.32	425.99	0.20	0	0	0	0	0	264	346	486	632	757	899	1045	1179	1265	1514	1797	2090	2357
37.00	0.93	0.82	67.50	519.74	0.20	0	0	0	0	0	0	283	398	518	620	736	857	966	1036	1241	1473	1713	1932
45.00	0.94	0.82	81.65	628.74	0.20	0	0	0	0	0	0	0	329	428	513	609	708	799	857	1026	1218	1416	1597
55.00	0.94	0.84	96.91	692.87	0.20	0	0	0	0	0	0	0	0	357	429	510	596	715	714	857	1021	1191	1430
75.00	0.94	0.84	131.72	941.82	0.20	0	0	0	0	0	0	0	0	0	0	375	438	526	525	631	751	876	1052
90.00	0.95	0.84	157.40	1125.41	0.20	0	0	0	0	0	0	0	0	0	0	0	0	440	440	528	628	733	880
110.00	0.95	0.84	191.77	1371.16	0.20	0	0	0	0	0	0	0	0	0	0	0	0	0	361	433	516	602	722

AL-SHAHEEN REFINERY FEED PROJECT

CALCULATION NOTE FOR ELECTRICAL MEDIUM VOLTAGE CABLE SIZING

APPENDIX - 5

415V CABLE SELECTION CHART (POWER FEEDER IN GROUND)

(1 PAGE)

Note: Appendix-5 is applicable for the 415V cable with maximum allowable voltage drop of 4%, while the other power feeders with different voltage drop as indicated in section 9.4.1 shall be sized individually during the EPC stage of engineering.

APPENDIX - 5 : CABLE SELECTION CHART FOR 415 V POWER FEEDERS (LAID IN GROUND)

		Rating factor for ground temperature of 40 deg C	=	0.85
System voltage (Line to Line) =	0.415 kV	Rating factor for soil thermal resistivity of 2.5 Km/W	=	1.00
Voltage drop limit=	4%	Rating factor for direct burial at a depth of 0.8m	=	0.96
DERATING FACTOR =	0.45	Rating factor for grouping of cables (6 circuits, 1D spacing)	=	0.55
CABLES HAVING COPPER CONDUCTORS		Overall admissible ampacity correction factor = 0.85X1X0.96X0.55 =		0.45
Design Margin =	10%			

CABLE SIZE IN mm ²	4	6	10	16	25	35	50	70	95	120	150	185	240	120	150	185	240
No. of Cable cores	4C	4C	4C	4C	4C	4C	4C	4C	4C	4C	4C	4C	4C	4C	4C	4C	4C
No. of Runs per phase	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2
STANDARD CABLE RATING	44	56	73	95	121	146	173	213	252	287	324	363	419	574	648	726	838
SITE CABLE RATING	19.7	25.1	32.8	42.6	54.3	65.5	77.6	95.6	113.1	128.8	145.4	162.9	188.0	257.6	290.8	325.8	376.1
CABLE RESISTANCE IN OHM / km	5.91	3.95	2.35	1.47	0.93	0.67	0.50	0.34	0.25	0.20	0.16	0.13	0.10	0.10	0.08	0.07	0.05
CABLE REACTANCE IN OHM / km	0.098	0.094	0.088	0.084	0.083	0.081	0.080	0.079	0.077	0.077	0.077	0.077	0.077	0.039	0.039	0.039	0.039

[illegible]