Internship Program Report

By

NERUSU VIJAY KUMAR - 18481A0268

GUDLAVALLERU ENGINEERING COLLEGE
(An Autonomous Institute with Permanent Affiliation to JNTUK, Kakinada)
(Sponsored by A. A. N. M & V. V. R. S. R Educational Society, Gudlavalleru)
Approved by AICTE, New Delhi and Permitted by AP State Government
Accredited by NAAC with 'A' Grade
Counselling Code : GDLV

In association with

Smart Internz

Contents

Introduction

Internship program arranged by GUDLAVALLERU ENGINEERING COLLEGE in association withSmart Internz, Hyderabad for the benefit of 3rd year EEE batch 2018-2022 on ElectricalDetaileddesignEngineeringforOil&Gas,PowerandUtilityindustrialsectors.

Programorganiser

SmartBridge,Hyderabad.

PioneerinorganisingInternships,knowledgeworkshops,debates,hackathons,Technical

sessionsandIndustrialAutomationprojects.

Courtesy

Dr.SriB.Dasu–HOD–EEE,GEC

Mr. G. Srinivasa Rao – Internship

coordinatorMr.RameshV-Mentor

Mr.VinayKumar-SystemSupport

Mr.Harikanth–Software/Technical Support

Programdetails

Smart Internz program schedule: 4 weeks starting from 3rd May

2021Daily scheduletime shallbe4PMto6.30PM

ModeofClasses:OnlinethroughZOOMPres

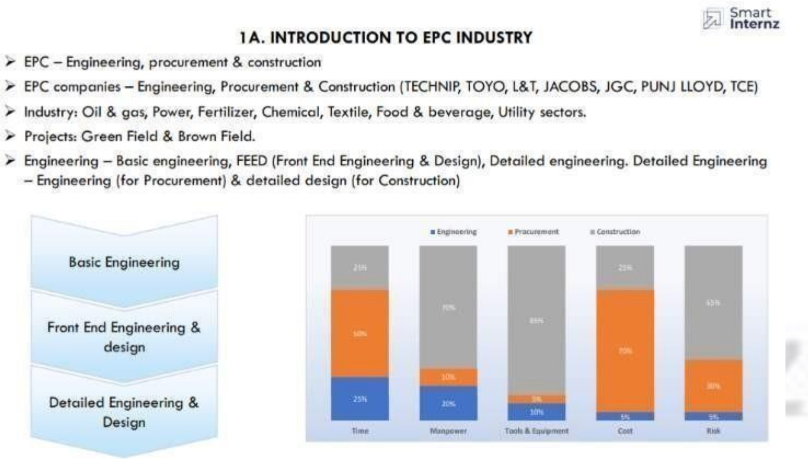
enter:MrRameshV

Internshipprogram

Wehavebeengiventheopportunitytolearnandinteractwithindustryexperiencedengineeringspecialisttolearnthe Electricaldetaileddesignengineeringforvariousindustrialsectors.

3rdMay2021:IntroductiontoEPCIndustry

1	EPC Industry &Electrical DetailedEngineering	EPCIndustry	Introduction
		Engineering	TypesofEngineering
		Procurement	Engineeringroleinprocurement
		Construction	Engineeringroleduringconstruction



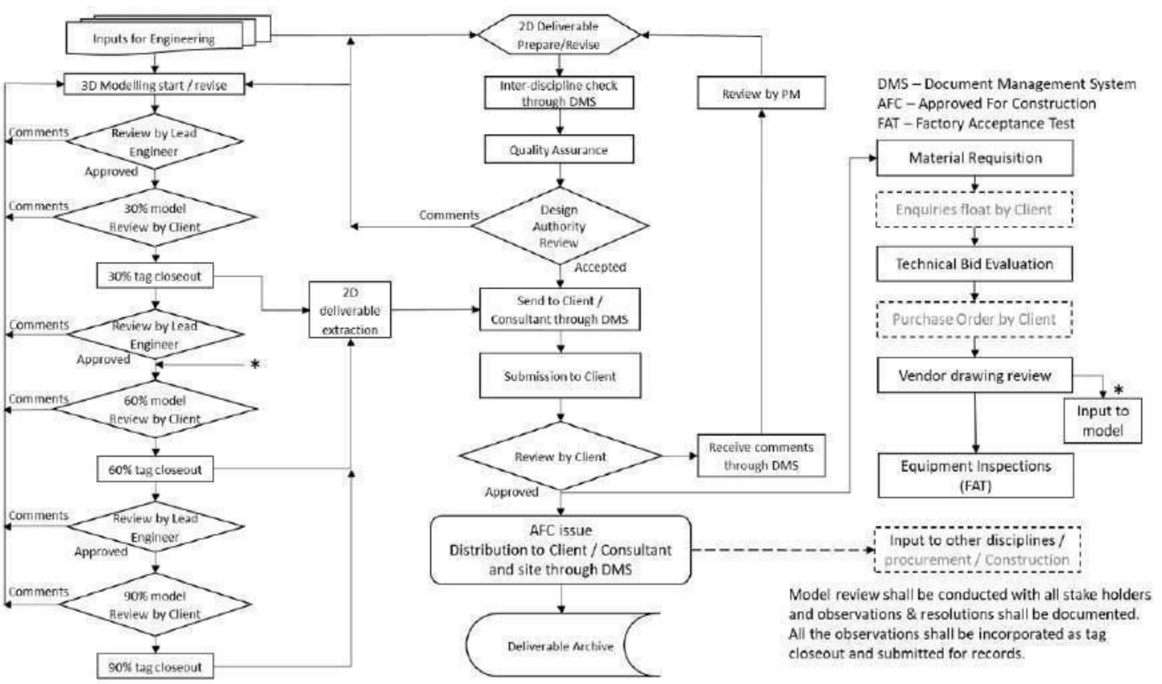
Topicdetails:

Engineeringphases,Engineeringdeliverables(drawings&documents)list,DesignEngineerroleat various phasesofproject.

4^{th}May2021:Engineeringdocumentation forEPCprojects

2	Electrical DesignDocumentation	EngineeringDeliverableslist	Sequenceofdeliverables
		DetailedEngineeringworkflow	Detailedengineeringprocess
		Documenttransmission	Documentsubmissionandinfoexchange
		Deliverablestypes	Differenttypesofdeliverables

3. ELECTRICAL DESIGN & DETAILED ENGINEERING - PROCESS



Topicdetails:

Engineeringdeliverableslist,detailedengineeringflow,engineeringsupportflow,engineering supporttoprocurements.

5thMay2021:Engineeringdocumentationforcommandsandformulae

3	Document & Drawingtools	MSWord	Report/Calculations formats
		MSExcel	Basicexcelcommands
		Autocad	Basic line diagrams and layoutcommends

3C. AUTOCAD BASIC COMMANDS

Smart Internz

AUTOCAD BASIC KEYS							
STANDARD		DRAW		MODIFY		FORMAT	
NEW	Ctrl+N	LINE	L	ERASE	E	PROPERTIES	MO
OPEN	Ctrl+O	RAY	RAY	COPY	CO	SELECT COLOR	COL
SAVE	Ctrl+S	PLINE	PL	MIRROR	MI	LAYER	LA
PLOT	Ctrl+P	3DPOLY	3P	OFFSET	O	LINETYPE	LT
PLOT PREVIEW	PRE	POLIGONE	POL	ARRAY	AR	LINEWEIGHTS	LW
CUT	Ctrl+X	RECTANGLE	REC	MOVE	M	LT SCALE	LTS
COPY	Ctrl+C	ARC	A	ROTATE	RO	LIST	LI
PASTE	Ctrl+V	CIRCLE	C	SCALE	SC	DIMEN. STYLE	D
MATCH PROPE.	MA	SPLINE	SPL	STRECH	S	RENAME	REN
CLOSE	Ctrl+F4	ELLIPSE	EL	TRIM	TR	OPTION	OP
EXIT	Ctrl+Q	BLOCK	B	EXTENED	EX		
		POINT	PO	BRAKE	BR		
		HATCH	H	CHAMFER	CHA		
		GRADIENT	GD	FILLET	F		
		REGION	REG	EXPLODE	X		
		BOUNDARY	BO				
		DONUT	DO				

EXTRA				DRAFTING		PAPER SIZE
UNIT	UN	UCS	UCS	ORTHO	F8, Ctrl+L	A4=210*297
LIMITS	LIMITS	SINGLE TEXT	DT	OSNAP	F3, Ctrl+F	A3=297*420
(0,0; 1000,1000)		MULTILINE TEXT	MT	POLAR	F10, Ctrl+U	A2=420*594
ZOOM	Z	EDIT TEXT	ED	GRID	F7, Ctrl+G	A1=594*841
ALL	A	OBJECT SNAP	OB	OTRACK	F11	A0=841*1189
PAN	P	DIMENTION	DIM	SNAP	F9	
CLEAN SCREEN	Ctrl+0	HORIZONTAL	HOR			
COMMAMD WIN	Ctrl+9	VERTICAL	VER			

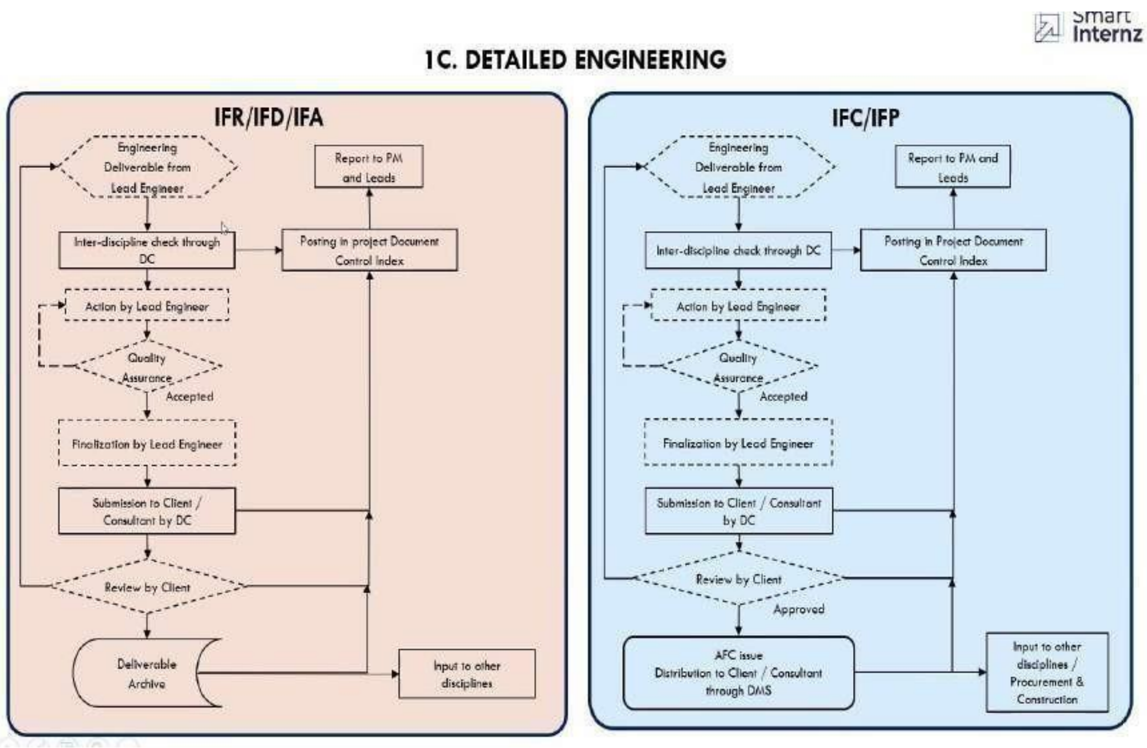
Topicdetails:

Here we need to learn the basis of the autocadbasic keys like standard,modify,draw,format,papersizeetc..

7thMay2021:EngineeringdocumentationforElectricalsystemdesign

4	Electrical systemdesign for a smallsmallproject	Overallplantdescription
		Sequenceofapproach
		Approachtodetaileddesign

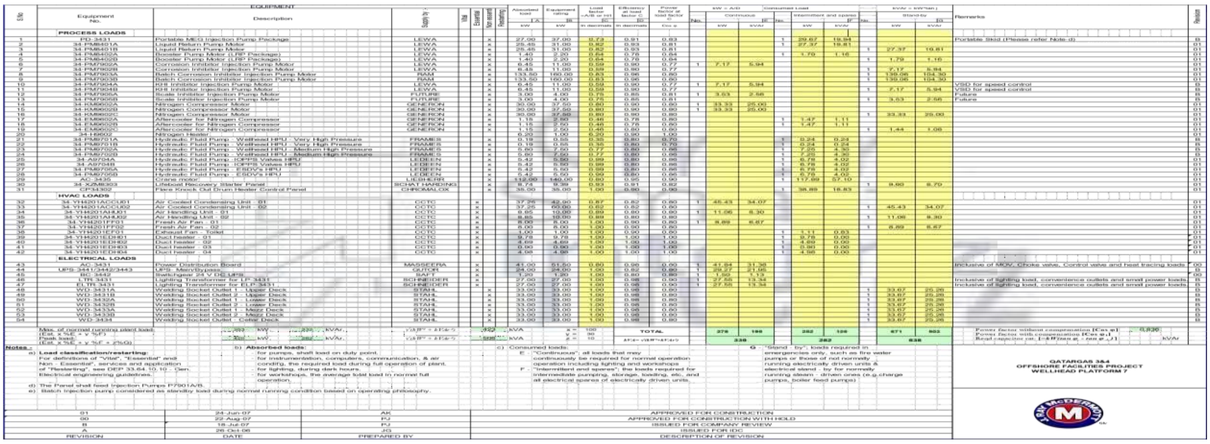
Topicdetails:



Herewe observedthathowtodoaprojectandSequenceofapproach,Approachtodetaildesignan dOverallplantdistributionsystem.

10thMay2021: EngineeringdocumentationforTypicaldiagrams

5	Electrical systemdesignfortypical diagrams		
		Loadlistsshedule	Powerflowdiagram
		Singleline diagram	Typical schematicdiagram



S.No	Equipment No.	Description	Supply by	Absorbed load kW
	PROCESS LOADS			
1	PD-3431	Portable MEG Injection Pump Package	LEWA	27.00
2	34-PM8401A	Liquid Return Pump Motor	LEWA	25.45
3	34-PM8401B	Liquid Return Pump Motor	LEWA	25.45
4	34-PM8402A	Booster Pump Motor (LRP Package)	LEWA	1.40
5	34-PM8402B	Booster Pump Motor (LRP Package)	LEWA	1.40
6	34-PM7902A	Corrosion Inhibitor Injection Pump Motor	LEWA	6.45
7	34-PM7902B	Corrosion Inhibitor Injection Pump Motor	LEWA	6.45
8	34-PM7903A	Batch Corrosion Inhibitor Injection Pump Motor	RAM	133.50
9	34-PM7903B	Batch Corrosion Inhibitor Injection Pump Motor	RAM	133.50
10	34-PM7904A	KHI Inhibitor Injection Pump Motor	LEWA	6.45
11	34-PM7904B	KHI Inhibitor Injection Pump Motor	LEWA	6.45
12	34-PM7905A	Scale Inhibitor Injection Pump Motor	FUTURE	3.00
13	34-PM7905B	Scale Inhibitor Injection Pump Motor	FUTURE	3.00
14	34-KM8602A	Nitrogen Compressor Motor	GENERON	30.00
15	34-KM8602B	Nitrogen Compressor Motor	GENERON	30.00
16	34-KM8602C	Nitrogen Compressor Motor	GENERON	30.00
17	34-EM8602A	Aftercooler for Nitrogen Compressor	GENERON	1.15
18	34-EM8602B	Aftercooler for Nitrogen Compressor	GENERON	1.15
19	34-EM8602C	Aftercooler for Nitrogen Compressor	GENERON	1.15
20	34-H8602	Nitrogen Heater		6.20
21	34-PM9701A	Hydraulic Fluid Pump - Wellhead HPU - Very High Pressure	FRAMES	0.19
22	34-PM9701B	Hydraulic Fluid Pump - Wellhead HPU - Very High Pressure	FRAMES	0.19
23	34-PM9702A	Hydraulic Fluid Pump - Wellhead HPU - Medium High Pressure	FRAMES	5.60
24	34-PM9702B	Hydraulic Fluid Pump - Wellhead HPU - Medium High Pressure	FRAMES	5.60
25	34-A9704A	Hydraulic Fluid Pump -IOPPS Valves HPU	LEDEEN	5.42
26	34-A9704B	Hydraulic Fluid Pump -IOPPS Valves HPU	LEDEEN	5.42
27	34-PM9705A	Hydraulic Fluid Pump - ESDV's HPU	LEDEEN	5.42
28	34-PM9705B	Hydraulic Fluid Pump - ESDV's HPU	LEDEEN	5.42
29	AC-3435	Crane motor	LIEBHERR	112.00
30	34-XZM8303	Lifeboat Recovery Starter Panel	SCHAT HARDING	8.74
31	CP34302	Flare Knock Out Drum Heater Control Panel	CHROMALOX	35.00
	HVAC LOADS			
32	34-YH4201ACCU01	Air Cooled Condensing Unit - 01	CCTC	37.25
33	34-YH4201ACCU02	Air Cooled Condensing Unit - 02	CCTC	37.25
34	34-YH4201AHU01	Air Handling Unit - 01	CCTC	8.85
35	34-YH4201AHU02	Air Handling Unit - 02	CCTC	8.85
36	34-YH4201FF01	Fresh Air Fan - 01	CCTC	8.00
37	34-YH4201FF02	Fresh Air Fan - 02	CCTC	8.00
38	34-YH4201EF01	Exhaust Fan - Toilet	CCTC	1.00
39	34-YH4201EDH01	Duct heater - 01	CCTC	9.78
40	34-YH4201EDH02	Duct heater - 02	CCTC	4.69
41	34-YH4201EDH03	Duct heater - 03	CCTC	0.90
42	34-YH4201EDH04	Duct heater - 04	CCTC	4.98
	ELECTRICAL LOADS			
43	AC-3431	Power Distribution Board	MASSEERA	41.00
44	UPS-3441/3442/3443	UPS- Main/Bypass	GUTOR	24.00
45	BC-3442	Switchgear 24 V DC UPS	SAFT	1.20
46	LTR-3431	Lighting Transformer for LP-3431	SCHNEIDER	27.00
47	ELTR-3431	Lighting Transformer for ELP-3431	SCHNEIDER	27.00
48	WD-3431A	Welding Socket Outlet 1 - Upper Deck	STAHL	33.00
49	WD-3431B	Welding Socket Outlet 2 - Upper Deck	STAHL	33.00
50	WD-3432A	Welding Socket Outlet 1 - Lower Deck	STAHL	33.00
51	WD-3432B	Welding Socket Outlet 2 - Lower Deck	STAHL	33.00
52	WD-3433A	Welding Socket Outlet 1 - Mezz Deck	STAHL	33.00
53	WD-3433B	Welding Socket Outlet 2 - Mezz Deck	STAHL	33.00
54	WD-3434	Welding Socket Outlet - Cellar Deck	STAHL	33.00

Notes -
a) Load classification/restarting: For definitions of "Vital", "Essential" and Non - Essential", services and application of "Restarting", see DEP 33.64.10.10 - Gen. Electrical engineering guidelines.
b) Absorbed loads: - for pumps, shaft load on duty point. - for instrumentation, computers, communication, & air condit'g, the required load during full operation of plant. - for lighting, during dark hours. - for workshops, the average total load in normal full operation.
d) The Panel shall feed Injection Pumps P7901A/B.
e) Batch injection pump considered as standby load during normal running condition based on operating philosophy.

REVISION	DATE	PREPARED BY
01	24-Jun-07	AK
00	22-Aug-07	PJ
B	18-Jul-07	PJ
A	26-Oct-06	JG

QATARGAS 3&4 OFFSHORE FACILITIES PROJECT WELLHEAD PLATFORM 7

Topicdetails:

WeconcludeherehowtodoloadcalculationsandTypicaldiagramsandinernalstructureandalsoaboutthepowerflowdiagram.

11thMay2021:ClassificationofTransformersandGenerators

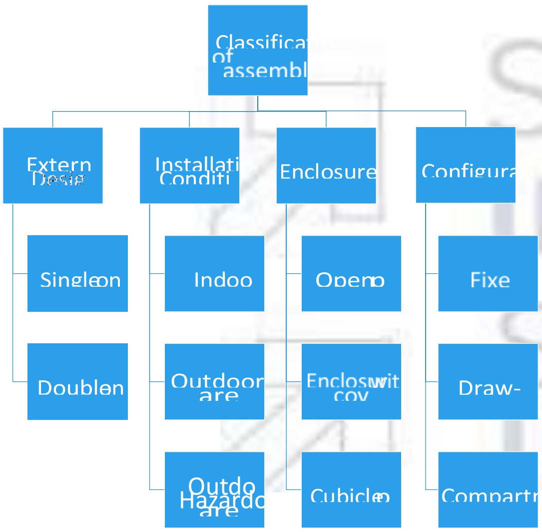
6	Classificationof Transformers andGenerators	Different types ofTransformers	DifferenttypesofGenerators

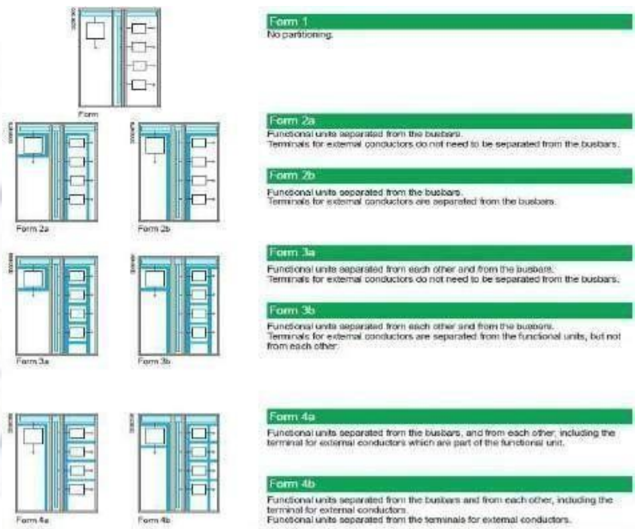
Topicdetails:

ClassificationofTransformersandGenerators

12thMay2021:ClassificationofSwitchgareconstructionandpowerfactorimprovement

7	Classificationof Switchgare constructionand power factor improvement	DifferenttypesofSwitchgare assembles	Powerfactorimprovement



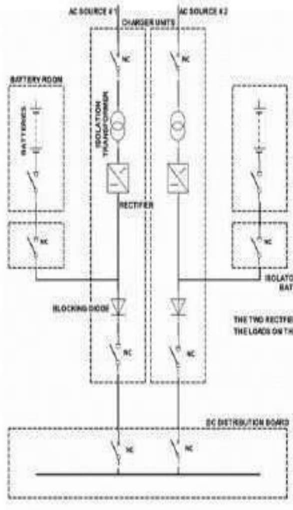


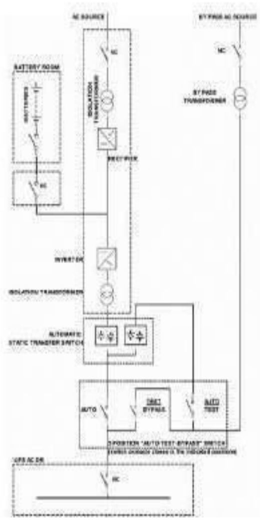
Topicdetails:

ClassificationofSwitchgarecontructionandPowerFactorImprovement

17thMay2021:DetailingaboutUPSsystemandBusducts.

8	Detailing aboutUPS system andBusducts	Uninterruptiblepowersupplys ystem	Busdutsofthesystem





110Vor220VDC
UPSSystem

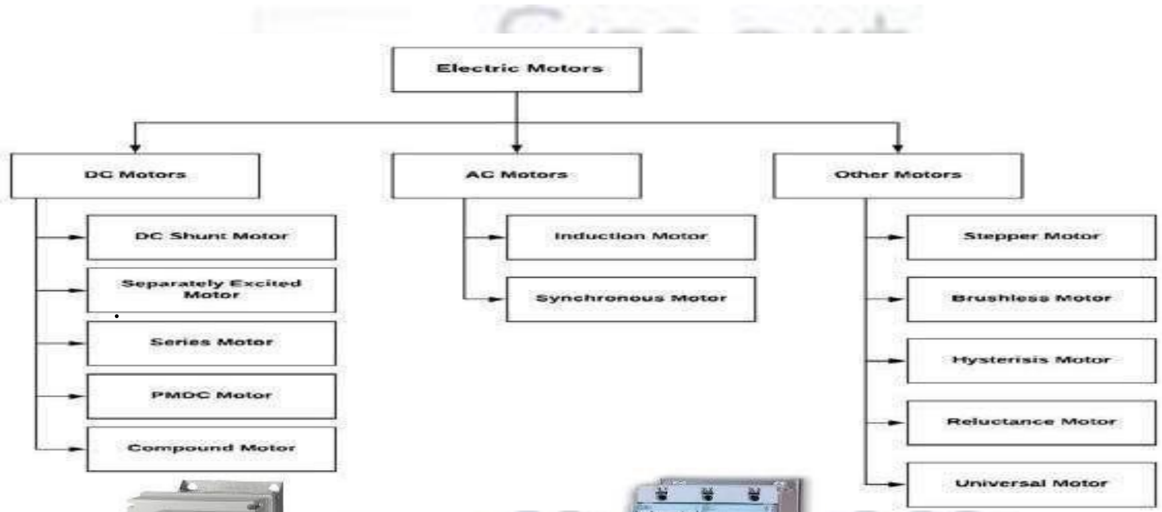
110Vor230V
ACUPSSystem

Topic details:PowerdistributionofUPSsystemandBusducts.

UPS systems are designed to provide continuous power to a load, even withan interruption or loss of utility supply power. UPS generally involves a balance ofcostVs need.

18thMay2021:DetailingaboutMotorStarters andSizingofmotors.

9	Detailing about MotorStarters and Sizing ofmotors	Motor startersanddrives	Sizingandselectionof motors



Topicdetails:DetailingaboutMotorStarterandSizingofmotorsand theirselection.

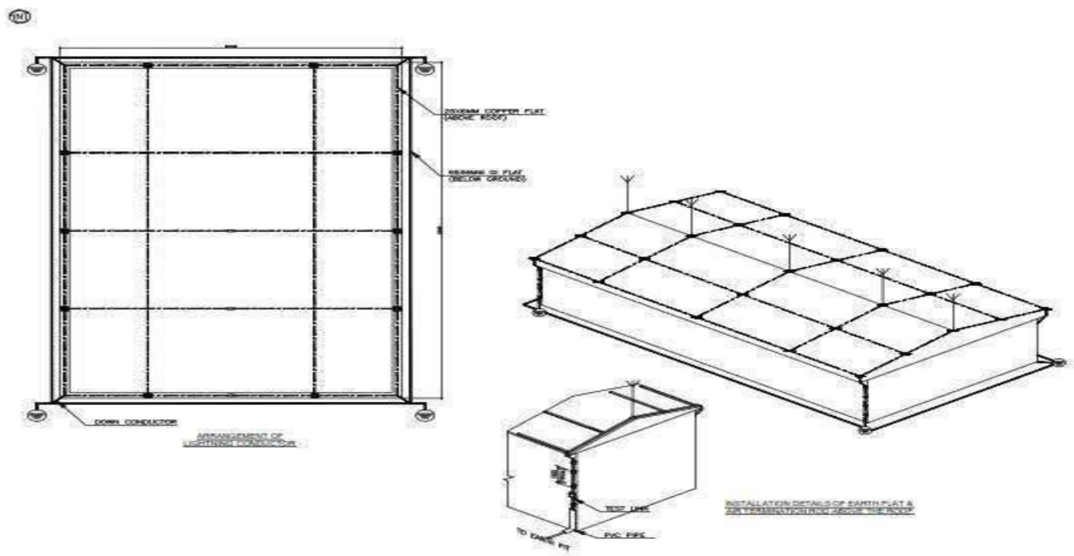
The principal function of a motor starter is to start and stop the respectivemotor connected with specially designed electromechanical switches which aresimilar in some ways to relays. The main difference between a relay and a starteristhatastarterhasoverloadprotectionforthemotorthatismissinginarelay.

Differenttypesofmotorstartersareasfollows:

- Direct-On-LineStarter
- RotorResistanceStarter
- StatorResistanceStarter
- AutoTransformerStarter

19thMay2021:DiscribingaboutEarthingsystemandLightingProtection.

10	Discribingabo utEarthingsyst em and LightingPr otection.	PlantEarthingsystem	LightingProtectionmaterials



Topicdetails:DiscribingaboutEarthingsystemandLightingProtection.

Lightningprotectionrequiredforhighrisestructuresandimportantbuildingsagainstlightningcurrentsduringthunderstorms.PrimarilyLightningprotectionsystemcalculations are done based on soil resistivity, conductor material, coverage structure /Buildingtodetermine whetherlightningprotectionisrequiredornot.

20thMay2021:Lightingorilluminationsystemsandcalculations.

11	Lightingor Illumination systemsand Calculations	Lightingorilluminationsystems	Lightingcalculations

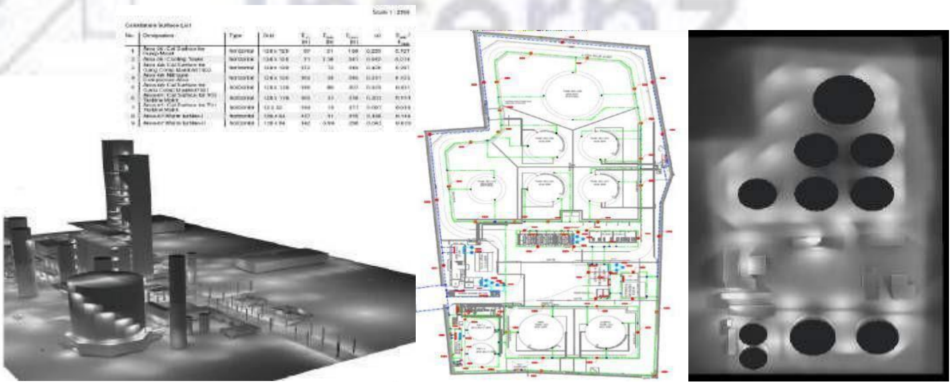
Topicdetails: LightingorIlluminationsystemsandCalculations.

All outdoor lighting fittings shall be connected with armoured PVC cable ofsuitable no. of cores and size. Necessary type and no. of junction boxes shall beprovided forbranchconnections.Indoorlightfittingsshall beconnectedwithFRLSPVCwireslaidincable trunks or conduits.

Inputsrequired:Equipmentandcableroutinglayouts,lightingcalculations,Designbasisfortypeoflightfittingstobeused,requiredlux levels

Lightingcalculationssoftware:Dialux,Chalmlite,Calculux,Relux,Luxicon,CG

LuxApplicableStandards:IS6665: Codeofpracticeforindustrial



lighting,IS3646:Code ofpracticeforinteriorillumination,IEC60598:Luminaires, IEC62493:Assessmentoflightingequipmentrelatedtohumanexposuretoelectromagneticfield

Deliverables:IndoorLightinglayouts,socketoutletlayouts,Streetlightingandarealightinglayouts.BOQ.

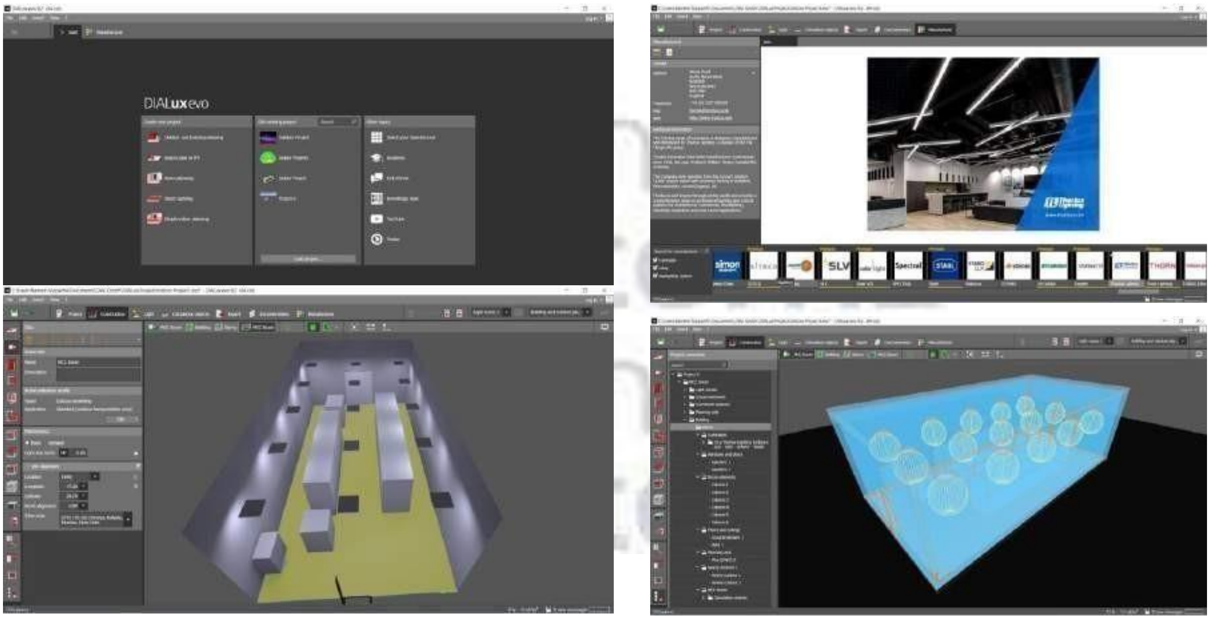
Typesoflightfittings:Industrial,flameprooftype(EXd),increasedsafetytype(Exe).

21thMay2021:LightingorilluminationsystemsusingDIALUXsoftware.

12	LightingorIllu minationusing DIALUX software	Lightingorilluminationsystems	Operation of dialuxsoftwa re

Topicdetails:LightingorIlluminationCalculations using DIALUXsoftware.

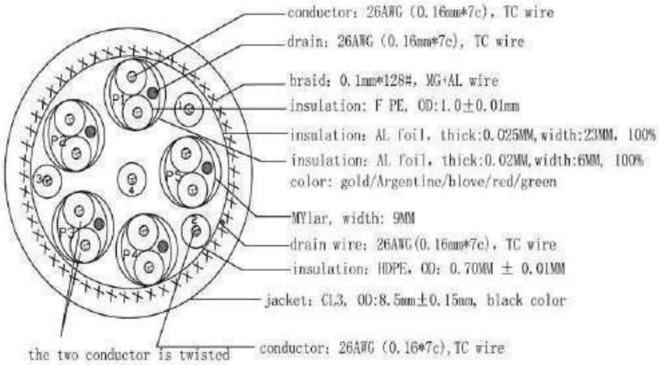
HereweareusingthisDialuxevo5.9.2softwarewindowstoconstructthe powerplantandwecanperformtheoperationfromthis software.

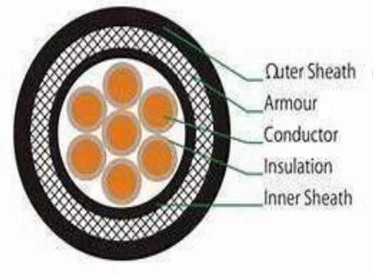


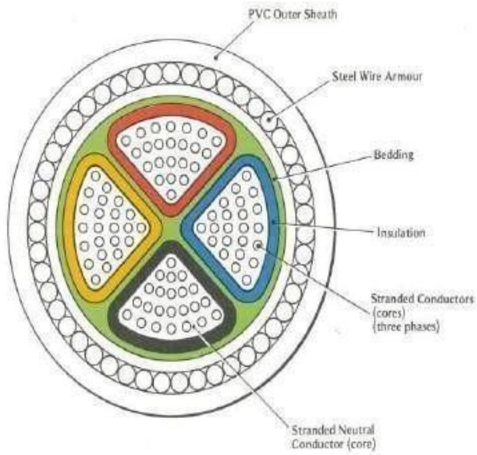
24thMay2021:Cablingandtheircalculationsandtypes.

13	Cablingandtheirtypes and claculations	Cablingcalculations	Types of cablingmaterials

Topicdetails:Cablingandtheirtypesandclaculations.







Electricalcablesmustbeproperlysupportedtorelievemechanicalstresses onthe conductors, and protected from harsh conditions such as abrasion which mightdegradetheinsulation.

Cables generally laid in the cable trays above ground, direct buriedundergroundandinmetallicorPVCconduits.Deratingfactorsmaybeapplicable for eachtypeofcablelayingconditions.

25thMay2021:CablingcalculationsandCableglandselection.

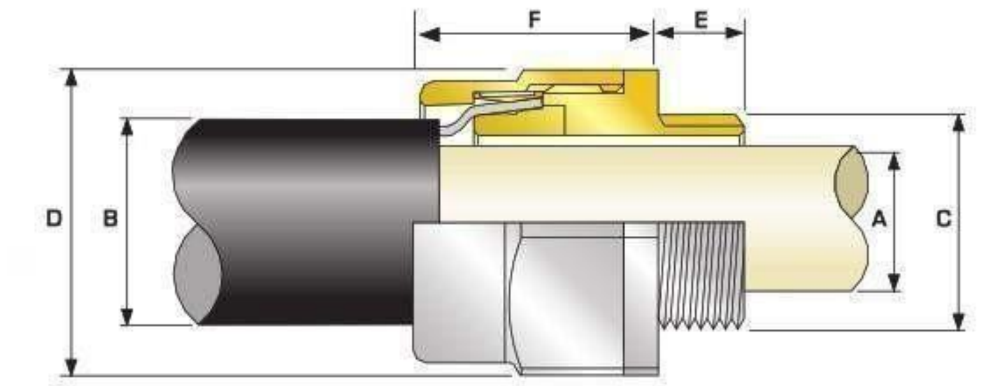
14	Cablingclaculat ionsand cable glandselect ion	Cablingcalculations	Cableglandselection

Topicdetails:Cablesizingcalculationandcableglandselection.

Inputsrequired: LoadList, Design basis, Electricalequipmentlayout,cableschedule,vendorcataloguesforcabletray.

Cable tray sizing shall be performed for each branch of cable tray routing upto the load point. Results shall be checked with specified limits mentioned indesignbasis.

Cablegland:



Cable Gland Selection Table
Refer to illustration at the top of the page.

Cable Gland Size	Available Entry Threads "C" (Alternate Metric Thread Lengths Available)		Cable Bedding Diameter "A"	Overall Cable Diameter "B"	Armour Range		Across Flats "D"	Across Corners "D"	Protrusion Length "F"
	Metric	Thread Length (Metric) "E"	Max	Max	Min	Max	Max	Max	
20S16	M20	10.0	8.7	13.2	0.8	1.25	24.0	26.4	35.2
20S	M20	10.0	11.7	15.9	0.8	1.25	24.0	26.4	32.2
20	M20	10.0	14.0	20.9	0.8	1.25	30.5	33.6	30.6
25	M25	10.0	20.0	26.2	1.25	1.6	36.0	39.6	36.4
32	M32	10.0	26.3	33.9	1.6	2.0	46.0	50.6	32.6
40	M40	15.0	32.2	40.4	1.6	2.0	55.0	60.5	36.6
50S	M50	15.0	38.2	46.7	2.0	2.5	60.0	66.0	39.6
50	M50	15.0	44.1	53.1	2.0	2.5	70.1	77.1	39.1
63S	M63	15.0	50.0	59.4	2.0	2.5	75.0	82.5	52.0
63	M63	15.0	56.0	65.9	2.0	2.5	80.0	88.0	49.8
75S	M75	15.0	62.0	72.1	2.0	2.5	90.0	99.0	63.7
75	M75	15.0	68.0	78.5	2.5	3.0	100.0	110.0	57.3
90	M90	24.0	80.0	90.4	3.15	4.0	114.3	125.7	66.6

28thMay2021:LoadcalculationsandTransformersizingcalculations

15	Load calculationsand TR calculations	Loadcalculations	TRcalculations

Topicdetails:

Listofelectricalloadcalculations.

ELECTRICAL LOAD CALCULATIONS LV MCC

Sl. No.	Equipment No.	Equipment Description	Breaker Rating A	Breaker Type	Breaker No. of Poles	ELCB Rating mA	Absorbed Load [A] kW	Motor / Load Rating [B] kW	Load Factor [A] / [B] [C] decimal	Efficiency at Load Factor [C] [D] decimal	Power Factor at Load Factor [C] cos φ	Consumed Load (kW = [A] / [D]; kVAR = kW x tan φ) Continuous kW	Continuous kVAR	Intermittent kW	Intermittent kVAR	Stand-by kW	Stand-by kVAR	Remarks
1	PU2315	Silica filter feed pump					14.34	15.00	0.96	0.85	0.73	16.87	15.79					
2	PU 2314-A	Absorbesnt/Neutral oil pump (W)					4.16	4.70	0.89	0.85	0.73	4.9	4.6					
3	PU 2314 -B	Absorbesnt/Neutral oil pump (S)					3.58	3.70	0.97	0.85	0.73					4.2	3.9	
4	PU2305	Feed Pump (Seperator)					14.47	15.00	0.96	0.85	0.73	17.0	15.9					
5	MX2305	MIXER (W)					14.58	15.00	0.97	0.85	0.73	17.2	16.1					
6	MX 2308	MIXER (S)					14.58	15.00	0.97	0.85	0.73					17.2	16.1	
7	BW2313	Blower					6.27	7.50	0.84	0.85	0.73	7.4	6.9					
8	Rotary valve	TK 2313B (I)					0.61	0.75	0.81	0.85	0.73			0.7	0.7			
9	SC2314	Screw conveyor (I)					1.41	1.50	0.94	0.85	0.73			1.66	1.55			
10	AG 2324A	Citric acid tan agitator (W)					1.05	1.10	0.95	0.85	0.73	1.24	1.16					
11	AG 2324B	Citric acid tank agitator (S)					1.05	1.10	0.95	0.85	0.73					1.2	1.2	
12	AG 2305	Citric oil rection vessol agitator					3.84	4.70	0.82	0.85	0.73	4.52	4.23					
13	AG 2309	Lye oil reaction vessel agitator					1.39	1.50	0.93	0.85	0.73	1.64	1.53					
14	AG 2310	Lye oil reaction vessel agitator					1.39	1.50	0.93	0.85	0.73	1.64	1.53					
15	AG 2314	Soap Adsorbant Tank Agitator					2.44	3.00	0.81	0.85	0.73	2.87	2.69					
	Maximum of normal running plant load : (Est. x%E + y%F)	75.9 kW		71.1 kVAR			sqrt (kW² +kVAR²) =	104.0 kVA			TOTAL	75.21	70.42	2.38	2.22	22.60	21.16	
	Peak Load : (Est. x%E + y%F + z%G)	78.2 kW		73.2 kVAR			sqrt (kW² +kVAR²) =	107.1 kVA			kVA	103.03		3.26		30.96		

Assumptions

1) Load factor, Efficiency and Power factor.

Load Rating (kW)	Efficiency	Power factor
<= 20	0.85	0.73
> 20 - <= 45	0.91	0.78
> 45 - < 150	0.93	0.82
>= 150	0.94	0.91

2) Coincidence factors x= 1.0, y= 0.3, and z=0.1 considered for contrinous, intermittent and standby load.

T/Fcalculation:

Calculation for Transformer Capacity

1.0 **Example of calculation for Transformer Capacity**

1.1 **Calculation for consumed load**

Consumed loads used for this example are as follows :

	kW	kVar	kVA	
a. Continuous load	247.5	189.4	311.64	(i)
b. Intermittent load / Diversity Factor	8.37	7.8	11.45	(ii)
c. Stand-by load required as consumed load	74.36	56.5	93.37	(iii)
Max. Consumed load = ((i) + 30% (ii) + 10% (iii)) =	257.4	197.4	324.39	
Future expansion load (20% capacity)	51.5	39.5	64.88	
Total Load =	308.9	236.8	389.27	

1.2 **Calculation for 3.3kV / 0.433 kV transformer capacity**

Max. Consumed load = 324.4 kVA
Spare capacity = 64.9 kVA
Required capacity = 389.3 kVA
Transformer rated capacity = 120 kVA

1.3 **Voltage regulation check**

During starting or reacceleration of max. capacity motor (3400 kW), while all the other loads running , the voltage regulation is as follows :

P_T = 315.1 KVA (%Z)= 4 & Ratio X/R = 3.3

Hence , %R = 1.176%

%X = 3.82%

P_M = 55 KW having (K = 6 & C = 1 & Cos θ = 0.76 & Eff.η = 0.88 & Cos θs = 0.25

P_S = 193.42105 KVA

Cos $θ_S$ = 0.25 ,Corresponding to Angle $θ_s$ = 75.522488 Degrees for which Sin $θ_s$ = 0.97

P_B = 324.4 KVA & PB in KW is = 275.74 & P_B in Kvar = 197.4 ∴ Cos $θ_B$ = 0.850

Cos $θ_B$ = 0.85 ,Corresponding to Angle $θ_s$ = 31.788331 Degrees, for which Sin $θ_s$ = 0.53

P_{CP} = 399.09526 KW

P_{CQ} = 575.15288 KVAR

P_C = 784.28849 KVA

Cos $θ_C$ = 1.5088628 , where as Sin $θ_C$ = 0.861

Voltage Regulation = 9.7 %

29thMay2021:DGsetcalculations

16	DG setcalculati

Topicdetails:

TransformerandDGsetcalculations,types,sizingorselections

DG SIZING CALCULATIONS

	Design Data		
	Rated Volatge	415	KV
	Power factor (CosØ)	0.76	Avg
	Efficiency	0.88	Avg
	Total operating load on DG set in kVA at 0.76 power factor	315.1	
	Largest motor to start in the sequence - load in KW	55	KW
	Running kVA of last motor (CosØ= 0.91)	82	KVA
	Starting current ratio of motor	6	(Considering starting method as Soft starter)
	Starting KVA of the largest motor (Running kVA of last motor X Starting current ratio of motor)	493	KVA
	Base load of DG set in KVA (Total operating load in kVA – Running kVA of last motor)	233	KVA
A	**Continous operation under load -P1**		
	Capacity of DG set based on continuous operation under load P1	233	**KVA**
B	**Transient Voltage dip during starting of Last motor P2**		
	Total momentary load in KVA (Starting KVA of the last motor+Base load of DG set in KVA	726	KVA
	Subtransient Reactance of Generator (Xd")	7.91%	(Assumed)
	Transient Reactance of Generator (Xd')	10.065%	(Assumed)
	Xd'" =(Xd"+Xd')/2	0.089875	
	Transient Voltage Dip	15%	(Max)
	Transient Voltage dip during Soft starter starting of Last motor P2 = Total momentary load in KVA x Xd'" x (1-Transient Voltage Dip) / (Transient Voltage Dip)	370	**KVA**
C	**Overload capacity P3**		
	Capacity of DG set required considering overload capacity		
	Total momentary load in KVA	726	KVA
	overcurrent capacity of DG (K) (Ref: IS/IEC 60034-1, Clause 9.3.2)	150%	
	Capacity of DG set required considering overload capacity (P3) = Total momentary load in KVA / overcurrent capacity of DG (K)	484	**KVA**
	Considering the last value amongst P1, P2 and P3		
	Continous operation under load -P1	233	KVA
	Transient Voltage dip during Soft starter starting of Last motor P2	370	KVA
	Overload capacity P3	484	KVA
	Considering the last value amongst P1, P2 and P3	**484**	**KVA**

Hence, Existing Generator 484 KVA is adequate to cater the loads as per re-scheduled loads

NOTE:VOLTAGE DIP CONSIDERED - 15%

2ndjune2021:CaluculationsofEarthingandLightingprotection.

17	Calculation of Earthingand Lighting protection calculations	Earthingcalculations	Lightingprotection Calculation

Topicdetails:

CalculationofEarthingandLightingprotectioncalculations

Earthingcalculation

	10	
Maximum line-to-ground fault in kA for 1 sec	14	
Earthing material (Earth rod & earth strip)	GI	
Depth of earth flat burrial in meter	0.5	
Average depth / length of Earth rod in meters	4	
Soil resistivity Ω-meter	17	
Ambient temperature in deg C	50	
Plot dimensions (earth grid) L x B in meters	65	125
Number of earth rods in nos.	6	

Earth electrode sizing:

Ac - Required conductor cross section in sq.mm

$$I_{lg} = A_c x \sqrt{\left[\frac{TCAPx10^{-4}}{t_c X\alpha_r X\rho_r}\right] x I_a \left[\frac{K_0 + T_m}{K_0 + T_a}\right]}$$

αr - Thermal co-efficient of resistivity, at 20 oC	0.0032
ρr - Resistivity of ground conductor at 20 oC	20.10
Ta - Ambient Temperature is °C	50
I_{lg} - RMS fault current in kA = 50 KA	14
tc - Short circuit current duration sec	1
Thermal capacity factor, TCAP J/(cm3.oC)	3.93
Tm - Maximum allowable temperature for copper conductor, in oC	419
K0 - Factor at oC	293
The data taken from IEEE 80-2000, Clause 11.3, Table-1 for clad steel rod:	
14 = Ac *	0.123
Ac - Required conductor cross section in sq.mm	114
Earth rod dia in mm	12
Earth rod dia (including 25% corrosion allowance) in mm	15

Earth flat sizing:

Ac - Required conductor cross section in sq.mm

$$I_{lg} = A_c x \sqrt{\left[\frac{TCAPx10^{-4}}{t_c X\alpha_r X\rho_r}\right] x I_a \left[\frac{K_0 + T_m}{K_0 + T_a}\right]}$$

αr - Thermal co-efficient of resistivity, at 20 oC	0.0032
ρr - Resistivity of ground conductor at 20 oC	20.10
Ta - Ambient Temperature is °C	50
I_{lg} - RMS fault current in kA = 50 KA	14
tc - Short circuit current duration sec	1
Thermal capacity factor, TCAP J/(cm3.oC)	3.93
Tm - Maximum allowable temperature for copper conductor, in oC	419
K0 - Factor at oC	293
The data taken from IEEE 80-2000, Clause 11.3, Table-1 for clad steel rod:	

Lightningcalculation

		1				
	Location	Bellari				
	Building	Concrete, School				
	Type of Building	Triangle Roofs (c)				
	Building Length (L)	21				
	Building breadth (W)	8				
	Building Height (H)	8				
	Risk Factor Calculation					
1	**Collection Area (A_c)**					
	A_c			=	3.14*H*H+2(H*L)	
					536.96	
2	**Probability of Being Struck (P)**					
	P			=	$A_c * N_g * 10^{-6}$	
					0.00080544	
3	**Overall weighing factor**					
	a) Use of structure (A)			=	1.7	
	b) Type of construction (B)			=	0.4	
	c) Contents or consequential effects (C)			=	1.7	
	d) Degree of isolation (D)			=	1.0	
	e) Type of country (E)			=	0.3	
	Wo - Overall weighing factor			=	A * B * C * D * E	
				=	0.347	
4	**Overall Risk Factor**		Po	=	P * Wo	
			Po	=	0.000279327	
			Pa		10^{-5}	
	As per clause no. 9.7 of BS- 6651, suggested acceptable risk factor (Po) has been taken as 10^{-5}					
	Since Po > Pa lightning protection required.					
5	**Air Terminations**					
	Perimeter of the building			=	2(L+W)	
				=	58	Mts.
6	**Down Conductors**					
	Perimeter of building			=	58	Mts.
	No. of down conductors based on perimeter			=	3	Nos.
	Hence 3 nos. of Down conductors have been selected.					
	Size of Down conductor			=	20 X 2.5 mm Galvanized Steel Strip	
	(As per BS6651, lightning currents have very short duration, therefore thermal factors are of little consequence in deciding the cross-section of the conductor. The minimum size of Down conductors - 20mm X 2.5 mm Galvanized Steel Strip)					

5thjune2021:Cablesizingandcabletraysizingcalculations.

18	Cablesizingand cable traysizing calculations	Cablesizingcalculations	Cabletraycalculation

Topicdetails:

CablesizingandcabletraysizingcalculationsforLV cablesandMV/HVcables.

S.NO.	Description	Equipment No.	Description	Consumed Load KW	Load Rating KW	Voltage (V)	No. of ph	Full Load Current (A)	Motor Starting Current (A)	Load P.F. Running	SIN Φ Running	Motor P.F Staring	SIN Φ Staring	Type	No. of Runs	No. of Cores	Size (mm2)	Current Rating (A)	Derating factor k1	Derating factor k2	Derating factor k3	Derating factor k4	Overall Derating factor k	Derated Current (A)	Cable Length (M)	Cable Resistance (Ohms/KM)	Cable Reactance (Ohms/KM)	Voltage drop Running (V)	Voltage drop (Running) (%)	Voltage drop (Starting) (V)	Voltage drop (starting) (%)	Cable size result	OD of Cable (mm)	Gland size
3	LV MCC	[illegible]	[illegible]	50.42	55.00	415	3	87.7	526.10	0.8	0.6	0.8	0.5	2	1	4.0	70	230	0.96	0.9	1	1	0.882	202.9	95	0.3430	0.0752	4.61	1.11	27.01	6.51	OK	29	20s
4	LV MCC	[illegible]	[illegible]	14.64	15.00	415	3	25.5	152.76	0.8	0.6	0.8	0.5	2	1	4.0	16	85	0.96	0.9	1	1	0.882	75.0	80	1.4700	0.0815	5.12	1.24	30.98	7.57	OK	21	20s
5	LV MCC	[illegible]	[illegible]	12.60	15.00	415	3	21.9	131.47	0.8	0.6	0.8	0.5	2	1	4.0	16	85	0.96	0.9	1	1	0.882	75.0	60	1.4700	0.0815	2.79	0.67	16.62	4.01	OK	21	20s
6	LV MCC	[illegible]	[illegible]	50.92	55.00	415	3	88.6	531.32	0.8	0.6	0.8	0.5	2	1	4.0	70	230	0.96	0.9	1	1	0.882	202.9	85	0.3430	0.0752	4.17	1.00	24.40	5.88	OK	29	20s
7	LV MCC	[illegible]	[illegible]	51.31	55.00	415	3	89.2	535.39	0.8	0.6	0.8	0.5	2	1	4.0	70	230	0.96	0.9	1	1	0.882	202.9	75	0.3430	0.0752	3.70	0.89	21.70	5.23	OK	29	20s
8	LV MCC	[illegible]	[illegible]	51.31	55.00	415	3	89.2	535.39	0.8	0.6	0.8	0.5	2	1	4.0	70	230	0.96	0.9	1	1	0.882	202.9	105	0.3430	0.0752	5.18	1.25	30.38	7.32	OK	29	20s
9	LV MCC	[illegible]	[illegible]	22.03	30.00	415	3	38.3	229.87	0.8	0.6	0.8	0.5	2	1	4.0	25	122	0.96	0.9	1	1	0.882	107.6	100	0.9300	0.0815	5.26	1.27	31.25	7.53	OK	23	20s
10	LV MCC	[illegible]	[illegible]	2.14	3.00	415	3	3.7	22.33	0.8	0.6	0.8	0.5	2	1	4.0	2.5	28	0.96	0.9	1	1	0.882	24.7	100	8.4800	0.1007	4.93	1.19	29.53	7.11	OK	16	20s
11	LV MCC	[illegible]	[illegible]	4.95	5.50	415	3	8.6	51.65	0.8	0.6	0.8	0.5	2	1	4.0	6	51	0.96	0.9	1	1	0.882	45.0	75	3.9400	0.0902	3.56	0.86	21.45	5.17	OK	18	20
12	LV MCC	[illegible]	[illegible]	3.71	4.70	415	3	6.5	38.71	0.8	0.6	0.8	0.5	2	1	4.0	4	38	0.96	0.9	1	1	0.882	33.5	110	5.9000	0.0947	5.87	1.41	35.16	8.47	OK	17	20s
13	LV MCC	[illegible]	[illegible]	3.71	4.70	415	3	6.5	38.71	0.8	0.6	0.8	0.5	2	1	4.0	4	38	0.96	0.9	1	1	0.882	33.5	75	5.9000	0.0947	4.00	0.96	23.97	5.78	OK	17	20
14	LV MCC	[illegible]	[illegible]	13.51	15.00	415	3	23.5	140.97	0.8	0.6	0.8	0.5	2	1	4.0	16	85	0.96	0.9	1	1	0.882	75.0	100	1.4700	0.0815	5.23	1.26	31.19	7.52	OK	21	20s
15	LV MCC	[illegible]	[illegible]	4.91	5.50	415	3	8.5	51.23	0.8	0.6	0.8	0.5	2	1	4.0	6	51	0.96	0.9	1	1	0.882	45.0	85	3.9400	0.0902	4.03	0.97	24.11	5.81	OK	18	32
16	LV MCC	[illegible]	[illegible]	4.91	5.50	415	3	8.5	51.23	0.8	0.6	0.8	0.5	2	1	4.0	6	51	0.96	0.9	1	1	0.882	45.0	95	3.9400	0.0902	4.50	1.09	26.95	6.49	OK	18	20s
17	LV MCC	[illegible]	[illegible]	8.60	9.20	415	3	15.0	89.74	0.8	0.6	0.8	0.5	2	1	4.0	10	66	0.96	0.9	1	1	0.882	58.2	85	2.3400	0.0902	3.20	0.78	19.34	4.66	OK	18	20s
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Basis:

1. Overall derating factor k = k1 x k2 x k3 x k4
   K1=Rating factor for variation in air/ground temperature
   K2=Rating factor for depth of laying
   K3=Rating factor for spacing between two circuits
   K4=Rating factor for variation in thermal resistivity of the soil
2. LT Motors : Running Voltage Drop = 3%, Starting Voltage Drop = 15%
3. Cable type:
   TYPE 1: Al Conductor, XLPE Insulated, Armoured, PVC outer sheathed
   TYPE 2: Cu Conductor, XLPE Insulated, Armoured, PVC outer sheathed
4. Effect of Frequency Variation ±5%
5. Combined Effect of Voltage & Frequency Variation ±10%

LT CABLES

CABLE TRAY: FROM		LT-4		TO	LT-5				
Sr. No.	Cable Route (From-To)	Type & Cable Size	Size of Cable (mm2)	No. of Cable	Overall Diameter of each Cable (mm)	Sum of Cable OD (mm)	Self Weight of Cable (Kg/Mt)	Total Weight of Cable (Kg/Mt)	Remarks
1	PMCC-2 TO NEW COOLING WATER CIRCULATION PUMP- MP-3003A	3C x 185 Sq. mm, XLPE, FRLS AL Cable	185	1	46	46	3.95	3.95	
2	PMCC-2 TO SPACE HEATER FOR NEW COOLING WATER CIRCULATION PUMP- MP-3003A	2C x 4 Sq. mm, XLPE, FRLS CU Cable	4	1	14	14	0.37	0.37	
3	PMCC-2 TO NEW COOLING WATER CIRCULATION PUMP- MP-3003B	3C x 185 Sq. mm, XLPE, FRLS AL Cable	185	1	46	46	3.95	3.95	
4	PMCC-2 TO SPACE HEATER FOR NEW COOLING WATER CIRCULATION PUMP- MP-3003A	2C x 4 Sq. mm, XLPE, FRLS CU Cable	4	1	14	14	0.37	0.37	
5	PMCC-2 TO NEW COOLING WATER CIRCULATION PUMP- MP-3003C	3C x 185 Sq. mm, XLPE, FRLS AL Cable	185	1	46	46	3.95	3.95	
6	PMCC-2 TO SPACE HEATER FOR NEW COOLING WATER CIRCULATION PUMP- MP-3003A	2C x 4 Sq. mm, XLPE, FRLS CU Cable	4	1	14	14	0.37	0.37	
7	PMCC-2 TO BLOW DOWN PIT PUMP- MP-3111A	3C x 25 Sq. mm, XLPE, FRLS AL Cable	25	1	22	22	0.9	0.9	
8	PMCC-2 TO BLOW DOWN PIT PUMP- MP-3111B	3C x 25 Sq. mm, XLPE, FRLS AL Cable	25	1	22	22	0.9	0.9	
9	PMCC-2 TO ETP PANEL- MP-3009A	3.5C x 120 Sq. mm, XLPE, FRLS AL Cable	120	1	40	40	2.9	2.9	
10	PMCC-2 TO 110V AC UPS-1	3.5C x 35 Sq. mm, XLPE, FRLS AL Cable	35	1	26	26	1.2	1.2	
11	PMCC-2 TO 110V AC UPS-2	3.5C x 35 Sq. mm, XLPE, FRLS AL Cable	35	1	26	26	1.2	1.2	
12	PMCC-2 TO 110V AC UPS-3	3.5C x 35 Sq. mm, XLPE, FRLS AL Cable	35	1	26	26	1.2	1.2	
13	PMCC-2 TO AUXILIARY PANEL-1	3.5C x 50 Sq. mm, XLPE, FRLS AL Cable	50	1	28	28	1.45	1.45	
14	PMCC-2 TO AUXILIARY PANEL-2(A/C)	3.5C x 70 Sq. mm, XLPE, FRLS AL Cable	70	1	33	33	2	2	
15	PMCC-2 TO COOLING TOWER DOSING SYSTEM PACKAGE	3.5C x 95 Sq. mm, XLPE, FRLS AL Cable	95	1	36	36	2.4	2.4	
16	PMCC-2 TO WELDING RECEPTACLE-1 & 2	3.5C x 95 Sq. mm, XLPE, FRLS AL Cable	95	1	36	36	2.4	2.4	
17	MLDB TO LDB(COOLING TOWER AREA)	4C x 16 Sq. mm, XLPE, FRLS AL Cable	16	1	21	21	0.85	0.85	
18	MLDB TO LDB(ETP AREA)	4C x 16 Sq. mm, XLPE, FRLS AL Cable	16	1	21	21	0.85	0.85	
19	MLDB TO LDB(DG AREA)	4C x 16 Sq. mm, XLPE, FRLS AL Cable	16	1	21	21	0.85	0.85	
20	MLDB TO LDB(SWITCHYARD)	3.5C x 25 Sq. mm, XLPE, FRLS AL Cable	25	1	23	23	1	1	
21	MLDB TO LDB(CONTROL ROOM)	4C x 16 Sq. mm, XLPE, FRLS AL Cable	16	1	21	21	0.85	0.85	
	Total			21		582	33.91	33.91	

Calculation		
Maximum Cable Diameter:	46	mm
Consider Spare Capacity of Cable Tray:	30%	
Distance between each Cable:	0	mm
Calculated Width of Cable Tray:	757	mm
Calculated Area of Cable Tray:	34804	Sq.mm
No of Layer of Cables in Cable Tray:	1	
Selected No of Cable Tray:	1	Nos.
Selected Cable Tray Width:	600	mm
Selected Cable Tray Depth:	100	mm
Selected Cable Tray Weight Capacity:	90	Kg/Meter
Type of Cable Tray:	Ladder	
Total Area of Cable Tray:	60000	Sq.mm

Result		
Selected Cable Tray width:	Not adequate	
Selected Cable Tray Depth:	O.K	
Selected Cable Tray Weight:	O.K	Including Spare Capacity
Selected Cable Tray Size:	Not adequate	Including Spare Capacity
crease No of Cable Tray or width of C		
Required Cable Tray Size:		mm
Required Nos of Cable Tray:		No
Required Cable Tray Weight:		Kg/Meter/Tray
Type of Cable Tray:	Ladder	
Cable Tray Width Area Remaning	-26%	
Cable Tray Area Remaning:	42%	

Conclusion

WehavebeentaughtmanyaspectsofengineeringactivitiesduringtheEPCstagesforallelectricalandrelatedotherdisciplinesalso.

Feedback

SmartBridge

Theyconductsummerinternships,workshops,debates,hackthons,technicalsessions.

Methodofconductingprogram

Onlinevirtualprogramwithpresentationslidesandexplanationonthetopicandpracticalusageoftopicandwithsomeexamples.

Programhighlights

Itisforthedetaileddesignofanyindustrialsectors.

Material

Thematerialwas good.

Benefits

Ithasbeengiventheopportunitytolearnandinteractwithindustryexperiencedengineering specialist to learn the Electrical detailed design engineering for variousindustrialsectors.

ASSIGNMENT1

ELECTRICALLOADCALCULATIONSLVMCC

Sl. No.	EquipmentNo.	EquipmentDescription	Breaker Rating	Breaker Type	Breaker No.ofPoles	ELCB Rating	Absorbed Load [A]	Motor / LoadRating [B]	LoadFactor[A]/[B] [C]	Eff ciency at Loadtor Fa r[C] [D]	PowerFactorat LoadFactor[C]	kW=[A]/[D] Continuous		ConsumedLoad Intermittent		kVAR=kWxtanφ Stand-by		Remarks
			A			mA	Kw	kW	decimal	decimal	cosφ	kW	kVAR	kW	kVAR	kW	kVAR	
1	PU2315	Silicafilterfeedpump					14.34	15.00	0.96	0.85	0.73	16.87	15.79					
2	PU2314-A	Absorbesnt/Neutraloilpump(W)					4.16	4.70	0.89	0.85	0.73	4.9	4.0					
3	PU2314 -B	Absorbesnt/Neutraloilpump(S)					3.58	3.70	0.97	0.85	0.73					4.2	3.	
4	PU2305	FeedPump(Seperator)					14.47	15.00	0.96	0.85	0.73	17.0	15.9					
5	MX2305	MIXER(W)					14.58	15.00	0.97	0.85	0.73	17.2	16.					
6	MX2308	MIXER(S)					14.58	15.00	0.97	0.85	0.73					17.2	16.	
7	BW2313	Blower					6.27	7.50	0.84	0.85	0.73	7.4	6.9					
8	Rotaryvalve	TK2313B(I)					0.61	0.75	0.81	0.85	0.73			0.7	0.			
9	SC2314	Screwconveyor(I)					1.41	1.50	0.94	0.85	0.73			1.66	1.5			
10	AG2324A	Citricacidtanagitator(W)					1.05	1.10	0.95	0.85	0.73	1.24	1.10					
11	AG2324B	Citricacidtankagitator(S)					1.05	1.10	0.95	0.85	0.73					1.2	1.	
12	AG2305	Citricoilrectionvessolagitator					3.84	4.70	0.82	0.85	0.73	4.52	4.23					
13	AG2309	Lyeoilreactionvesselagitator					1.39	1.50	0.93	0.85	0.73	1.64	1.53					
14	AG2310	Lyeoilreactionvesselagitator					1.39	1.50	0.93	0.85	0.73	1.64	1.53					
15	AG2314	SoapAdsorbantTankAgitator					2.44	3.00	0.81	0.85	0.73	2.87	2.69					

Maximumofnormalrunningplantload:(Est.x% E + y%F)	75.9kW	71.1 kVAR	sqrt(kW²+kVAR²)=	104.0kVA	TOTAL	75.21	70.42	2.38	2.22	22.60	21.16
PeakLoad: (Est.x%E+y%F+ z%G)	78.2kW	73.2 kVAR	sqrt(kW²+kVAR²)=	107.1kVA	kVA	103.03		3.26		30.96	

Assumptions

1)Loadfactor,EfficiencyandPowerfactor.

LoadRating(kW)	Efficiency	Power factor
<= 20	0.85	0.73
>20-<=45	0.91	0.78
>45-<150	0.93	0.82
>=150	0.94	0.91

2)Coincidencefactorsx=1.0,y=0.3,andz=0.1consideredfor contnious, intermittent andstandbyload.

Calculation for Transformer Capacity

1.0 Example of calculation for Transformer Capacity

1.1 Calculation for consumed load

Consumed loads used for this example are as follows :

	kW	kVar	kVA	
a. Continuous load	247.5	189.4	311.64	--- (i)
b. Intermittent load / Diversity Factor	8.37	7.8	11.45	--- (ii)
c. Stand-by load required as consumed load	74.36	56.5	93.37	--- (iii)
Max. Consumed load = ((i) + 30% (ii) + 10% (iii)) =	257.4	197.4	324.39	
Future expansion load (20% capacity)	51.5	39.5	64.88	
Total Load =	308.9	236.8	389.27	

1.2 Calculation for 3.3kV / 0.433 kV transformer capacity

Max. Consumed load	=	324.4 kVA
Spare capacity	=	64.9 kVA
Required capacity	=	389.3 kVA
Transformer rated capacity	=	120 kVA

1.3 Voltage regulation check

During starting or reacceleration of max. capacity motor (3400 kW) , while all the other loads running , the voltage regulation is as follow

P_T = 315.1 KVA (%Z)= 4 & Ratio X/R = 3.3

Hence , **%R =** = 1.176 %

%X = = 3.82 %

P_M = 55 KW having (K = 6 & C = 1 & Cos θ = 0.76 & Eff.η = 0.88 & Cos Θs = 0.25

P_S = = 493.421 KVA

Cos θ_S = 0.25 ,Corresponding to Angle θ_s = 75.5225 Degrees for which Sin θ_s = 0.97

P_B = 324.4 KVA & PB in KW is = 275.74 & P_B in Kvar = 197.4 ∴ Cos θ_B = 0.850

Cos θ_B = 0.85 ,Corresponding to Angle θ_s = 31.7883 Degrees, for which Sin θ_s = 0.53

P_{CP} = = 399.095 KW

P_{CQ} = = 675.153 KVAR

P_C = = 784.288 KVA

Cos θ_C = = 0.50886 , where as Sin θ_C = 0.861

Voltage Regulation ε = 9.7 %

Result: During starting of max. capacity motor, while all other loads are running , the voltage regulation at Transformer secondary terminals is approx. 5.3% , which meets the criteria to maintain less than 15% voltage regulation.

1.4 Selection of rated capacity

120 kVA transformer selected.

ASSIGNMENT 3

	DG SIZING CALCULATIONS		
	Design Data		
	Rated Volatge	415	KV
	Power factor (CosØ)	0.76	Avg
	Efficiency	0.88	Avg
	Total operating load on DG set in kVA at 0.76 power factor	**315.1**	
	Largest motor to start in the sequence - load in KW	55	KW
	Running kVA of last motor (CosØ= 0.91)	82	KVA
	Starting current ratio of motor	6	(Considering starting method as Soft starter)
	Starting KVA of the largest motor (Running kVA of last motor X Starting current ratio of motor)	**493**	KVA
	Base load of DG set in KVA (Total operating load in kVA – Running kVA of last motor)	**233**	KVA
A	**Continous operation under load -P1**		
	Capacity of DG set based on continuous operation under load P1	**233**	**KVA**
B	**Transient Voltage dip during starting of Last motor P2**		
	Total momentary load in KVA (Starting KVA of the last motor+Base load of DG set in KVA	726	KVA
	Subtransient Reactance of Generator (Xd'')	7.91%	(Assumed)
	Transient Reactance of Generator (Xd')	10.065%	(Assumed)
	Xd''' =(Xd"+Xd')/2	0.089875	
	Transient Voltage Dip	15%	(Max)
	Transient Voltage dip during Soft starter starting of Last motor P2 = Total momentary load in KVA x Xd''' x (1-Transient Voltage Dip) / (Transient Voltage Dip)	**370**	**KVA**
C	**Overload capacity P3**		
	Capacity of DG set required considering overload capacity		
	Total momentary load in KVA	726	KVA
	overcurrent capacity of DG (K) (Ref: IS/IEC 60034-1, Clause 9.3.2)	150%	
	Capacity of DG set required considering overload capacity (P3) = Total momentary load in KVA / overcurrent capacity of DG (K)	**484**	**KVA**
	Considering the last value amongst P1, P2 and P3		
	Continous operation under load -P1	233	KVA
	Transient Voltage dip during Soft starter starting of Last motor P2	370	KVA
	Overload capacity P3	484	KVA
	Considering the last value amongst P1, P2 and P3	**484**	**KVA**
	Hence, Existing Generator 484 KVA is adequate to cater the loads as per re-scheduled loads		
	NOTE:VOLTAGE DIP CONSIDERED - 15%		

ASSIGNMENT
4EARTHINGCALCULATION

	10	
Maximumline-to-groundfaultinkAfor1sec	14	
Earthingmaterial(Earthrod&earthstrip)	GI	
Depthofearth flatburrial inmeter	0.5	
Averagedepth/lengthofEarthrodinmeters	4	
SoilresistivityΩ-meter	17	
AmbienttemperatureindegC	50	
Plotdimensions(earthgrid)LxBinmeters	65	125
Numberofearthrodsinnos.	6	

Earthelectrodesizing:
Ac-Requiredconductorcrosssectioninsq.mm

$$I_{lg} = A_c x \sqrt{\left[\frac{TCAP x 10^{-4}}{t_c x \alpha_r x \rho_r}\right] x l_n \left[\frac{K_0 + T_m}{K_0 + T_a}\right]}$$

αr-Thermalco-efficientofresistivity,at20Oc	0.0032
ρr-Resistivityofgroundconductorat20Oc	20.10
Ta-Ambient Temperatureis°C	50
I_{l-g}-RMSfaultcurrent inkA =50KA	14
tc-Shortcircuitcurrent durationsec	1
Thermalcapacityfactor,TCAPJ/(cm3.oC)	3.93
Tm-Maximumallowabletemperatureforcopperconductor,inOc	419
K0-FactoratOc	293
ThedatatakenfromIEEE80-2000,Clause11.3,Table-1forcladsteelrod:	
14=Ac*	0.123
Ac-Requiredconductor crosssectioninsq.mm	114
Earthroddiainmm	12
Earthroddia(including25%corrosionallowance)inmm	15

Earthflatsizing:
Ac-Requiredconductorcrosssectioninsq.mm

$$I_{lg} = A_c x \sqrt{\left[\frac{TCAP x 10^{-4}}{t_c x \alpha_r x \rho_r}\right] x l_n \left[\frac{K_0 + T_m}{K_0 + T_a}\right]}$$

αr-Thermalco-efficientofresistivity,at20oC	0.0032
ρr-Resistivityofgroundconductorat20oC	20.10
Ta-Ambient Temperatureis°C	50
I_{l-g}-RMSfaultcurrent inkA =50KA	14
tc-Shortcircuitcurrent durationsec	1

Thermalcapacityfactor,TCAPJ/(cm3.oC)	3.93
Tm-Maximumallowabletemperatureforcopperconductor, inoC	419
K0-Factor atoC	293

ThedatatakenfromIEEE80-2000,Clause11.3,Table-1forcladsteelrod:

ASSIGNMNT 5LIGHTNINGCALCULATION

	1			
Location	Bellari			
Building	Concrete, School			
Type of Building	Triangle Roofs (c)			
Building Length (L)	21			
Building breadth (W)	8			
Building Height (H)	8			

Risk Factor Calculation

1 Collection Area (A_c)

A_c		=	3.14*H*H+2(H*L)	
			536.96	

2 Probability of Being Struck (P)

P		=	$A_c * N_g * 10^{-6}$	
			0.00080544	

3 Overall weighing factor

a) Use of structure (A)		=	1.7	
b) Type of construction (B)		=	0.4	
c) Contents or consequential effects (C)		=	1.7	
d) Degree of isolation (D)		=	1.0	
e) Type of country (E)		=	0.3	
Wo - Overall weighing factor		=	A * B * C * D * E	
		=	0.347	

4 Overall Risk Factor

	Po	=	P * Wo	
	Po	=	0.000279327	
	Pa		10^{-5}	

As per clause no. 9.7 of BS- 6651, suggested acceptable risk factor (Po) has been taken as 10^{-5}
Since Po > Pa lightning protection required.

5 Air Terminations

Perimeter of the building		=	2(L+W)	
		=	58	Mts.

6 Down Conductors

Perimeter of building		=	58	Mts.
No. of down conductors based on perimeter		=	3	Nos.

Hence 3 nos. of Down conductors have been selected.

Size of Down conductor		=	20 X 2.5 mm Galvanized Ste	

(As per BS6651, lightning currents have very short duration, therefore thermal factors are of little consequence in deciding the cross-section of the conductor. The minimum size of Down conductors - 20mm X 2.5 mm Galvanized Steel Strip)

ASSIGNMENT

6CABLESIZING

S.NO.	Description	Equipment No.	Description	Consumed LoadKW	LoadRatingKW	Voltage (V)	No. ofph	FullLoadCurrent(A)	MotorStartingCurrent(A)	Load P.F.Running	SINΦ Running	Motor P.FStaring	SINΦ Staring	Type	No. ofRuns	No. ofCores	Size(mm2)	Current Rating(A)	Derating factork1	Derating factork2	Derating factork3	Derating factork4	Overall Derating factor k	Derated Current (A)	CableLength(M)	CableResistance(Ohms/kM)	CableReactance(Ohms/kM)	Voltagedrop(Running) (V)	Voltagedrop(Running)(%)	Voltage drop (Starting) (V)	Voltagedrop(starting)(%)	Cable sizeresult	OD ofCable(mm)	Gland size
3	LVMCC	PU2315	Silicafilter feedpump	50.42	55.00	415	3	87.7	526.10	0.8	0.6	0.8	0.5	2	1	4.0	70	230	0.98	0.9	1	1	0.882	202.9	95	0.3430	0.0752	4.61	1.11	27.01	6.51	OK	29	20
4	LVMCC	PU2314-A	Absorbesnt/Neutraloilpump(W)	14.64	15.00	415	3	25.5	152.76	0.8	0.6	0.8	0.5	2	1	4.0	16	85	0.98	0.9	1	1	0.882	75.0	95	1.4700	0.0815	5.13	1.24	30.58	7.37	OK	21	20s
5	LVMCC	PU2314-B	Absorbesnt/Neutraloil pump(S)	12.60	15.00	415	3	21.9	131.47	0.8	0.6	0.8	0.5	2	1	4.0	16	85	0.98	0.9	1	1	0.882	75.0	60	1.4700	0.0815	2.79	0.67	16.62	4.01	OK	21	20s
6	LVMCC	PU2305	FeedPump(Seperator)	50.92	55.00	415	3	88.6	531.32	0.8	0.6	0.8	0.5	2	1	4.0	70	230	0.98	0.9	1	1	0.882	202.9	85	0.3430	0.0752	4.17	1.00	24.40	5.88	OK	29	20s
7	LVMCC	MX2305	MIXER (W)	51.31	55.00	415	3	89.2	535.39	0.8	0.6	0.8	0.5	2	1	4.0	70	230	0.98	0.9	1	1	0.882	202.9	75	0.3430	0.0752	3.70	0.89	21.70	5.23	OK	29	20s
8	LVMCC	MX2308	MIXER(S)	51.31	55.00	415	3	89.2	535.39	0.8	0.6	0.8	0.5	2	1	4.0	70	230	0.98	0.9	1	1	0.882	202.9	105	0.3430	0.0752	5.19	1.25	30.38	7.32	OK	29	20s
9	LVMCC	BW2313	Blower	22.03	30.00	415	3	38.3	229.87	0.8	0.6	0.8	0.5	2	1	4.0	25	122	0.98	0.9	1	1	0.882	107.6	100	0.9300	0.0816	5.26	1.27	31.25	7.53	OK	22	20s
10	LVMCC	Rotaryvalve	TK2313B(I)	2.14	3.00	415	3	3.7	22.33	0.8	0.6	0.8	0.5	2	1	4.0	2.5	28	0.98	0.9	1	1	0.882	24.7	100	9.4800	0.1007	4.93	1.19	29.53	7.11	OK	16	20s
11	LVMCC	SC2314	Scre wconveyor(I)	4.95	5.50	415	3	8.6	51.65	0.8	0.6	0.8	0.5	2	1	4.0	6	51	0.98	0.9	1	1	0.882	45.0	75	3.9400	0.0902	3.59	0.86	21.45	5.17	OK	18	20
12	LVMCC	AG2324A	Citricacidtanagitator(W)	3.71	4.70	415	3	6.5	38.71	0.8	0.6	0.8	0.5	2	1	4.0	4	38	0.98	0.9	1	1	0.882	33.5	110	5.9000	0.0947	5.87	1.41	35.16	8.47	OK	17	20s
13	LVMCC	AG2324B	Citricacidtankagitator(S)	3.71	4.70	415	3	6.5	38.71	0.8	0.6	0.8	0.5	2	1	4.0	4	38	0.98	0.9	1	1	0.882	33.5	75	5.9000	0.0947	4.00	0.96	23.97	5.78	OK	17	20
14	LVMCC	AG2305	Ci tricoilrectionvessolagitator	13.51	15.00	415	3	23.5	140.97	0.8	0.6	0.8	0.5	2	1	4.0	16	85	0.98	0.9	1	1	0.882	75.0	105	1.4700	0.0815	5.23	1.26	31.19	7.52	OK	21	20
15	LVMCC	AG2309	Lyeoilreactionvesselagitator	4.91	5.50	415	3	8.5	51.23	0.8	0.6	0.8	0.5	2	1	4.0	6	51	0.98	0.9	1	1	0.882	45.0	85	3.9400	0.0902	4.03	0.97	24.11	5.81	OK	18	32
16	LVMCC	AG2310	Lyeoilreactionvesselagitator	4.91	5.50	415	3	8.5	51.23	0.8	0.6	0.8	0.5	2	1	4.0	6	51	0.98	0.9	1	1	0.882	45.0	95	3.9400	0.0902	4.50	1.09	26.95	6.49	OK	18	20s
17	LVMCC	AG2314	SoapAdsorbantT ankAgitator	8.60	9.20	415	3	15.0	89.74	0.8	0.6	0.8	0.5	2	1	4.0	10	66	0.98	0.9	1	1	0.882	58.2	65	2.3400	0.0852	3.24	0.78	19.34	4.66	OK	18	20s
18																																		
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Basis:

1. Overallderatingfactork=k1xk2xk3x k4

K1=Ratingfactorforvariationin air/groundtemperature

K2=Ratingfactorfordepthoflaying

K3=Ratingfactorforspacingbetweentwocircuits

K4=Ratingfactorforvariationin thermalresistivityofthesoil

2. LTMotors:RunningVoltageDrop=3%,StartingVoltageDrop=15%

3. Cable type:

TYPE 1: Al Conductor, XLPE Insulated, Armoured, PVC outer sheathedTYPE2:CuConductor,XLPEInsulated,Armoured,PVCoutersheathed

4. EffectofFrequencyVariation±5%

5. CombinedEffectofVoltage&FrequencyVariation±10%

ASSIGNMENT 7CABLETRYSIZIN G

LTCABLES

CABLETRAY:FROM		LT-4		TO	LT-5				
Sr. No.	**CableRoute(From-To)**	**Type&CableSize**	**Size ofCable(mm2)**	**No. ofCable**	**OverallDiameter ofeach Cable(mm)**	**Sum of CableOD (mm)**	**Self Weight ofCable(Kg/Mt)**	**Total WeightofCable(Kg/Mt)**	**Remarks**
1	PMCC-2 TO NEW COOLING W ATERCIRCULATIONPUMP-MP-3003A	3Cx185Sq.mm,XLPE,FRLSALCable	185	1	46	**46**	3.95	**3.95**	
2	PMCC-2TOSPACEHEATERFORNEW COOLING W ATER CIRCULATION PUMP- MP-3003A	2C x 4 Sq.mm,XLPE,FRLSCUCable	4	1	14	**14**	0.37	**0.37**	
3	PMCC-2 TO NEW COOLING W ATERCIRCULATIONPUMP-MP-3003B	3Cx185Sq.mm,XLPE,FRLSALCable	185	1	46	**46**	3.95	**3.95**	
4	PMCC-2TOSPACEHEATERFORNEW COOLING W ATER CIRCULATION PUMP- MP-3003A	2C x 4 Sq.mm,XLPE,FRLSCUCable	4	1	14	**14**	0.37	**0.37**	
5	PMCC-2 TO NEW COOLING W ATERCIRCULATIONPUMP-MP-3003C	3Cx185Sq.mm,XLPE,FRLSALCable	185	1	46	**46**	3.95	**3.95**	
6	PMCC-2TOSPACEHEATERFORNEW COOLING W ATER CIRCULATION PUMP- MP-3003A	2C x 4 Sq.mm,XLPE,FRLSCUCable	4	1	14	**14**	0.37	**0.37**	
7	PMCC-2TOBLOWDOWNPITPUMP-MP-3111A	3Cx25Sq.mm,XLPE,FRLSALCable	25	1	22	**22**	0.9	**0.9**	
8	PMCC-2TOBLOWDOWNPITPUMP-MP-3111B	3Cx25Sq.mm,XLPE, FRLSALCable	25	1	22	**22**	0.9	**0.9**	
9	PMCC-2TOETPPANEL-MP-3009A	3.5C x 120Sq.mm, XLPE,FRLSALCable	120	1	40	**40**	2.9	**2.9**	
10	PMCC-2TO110VACUPS-1	3.5Cx 35 Sq.mm, XLPE,FRLSALCable	35	1	26	**26**	1.2	**1.2**	
11	PMCC-2TO110VACUPS-2	3.5Cx 35 Sq.mm, XLPE,FRLSALCable	35	1	26	**26**	1.2	**1.2**	
12	PMCC-2TO110VACUPS-3	3.5Cx35Sq.mm,XLPE, FRLSALCable	35	1	26	**26**	1.2	**1.2**	
13	PMCC-2TOAUXILIARYPANEL-1	3.5Cx50Sq.mm,XLPE, FRLSALCable	50	1	28	**28**	1.45	**1.45**	
14	PMCC-2TOAUXILIARYPANEL-2(A/C)	3.5Cx70Sq.mm,XLPE, FRLSALCable	70	1	33	**33**	2	**2**	
15	PMCC-2TOCOOLINGTOWERDOSING SYSTEMPACKAGE	3.5Cx95Sq.mm,XLPE, FRLSALCable	95	1	36	**36**	2.4	**2.4**	
16	PMCC-2TOWELDINGRECEPTACLE-1 &2	3.5Cx95Sq.mm,XLPE, FRLSALCable	95	1	36	**36**	2.4	**2.4**	
17	MLDB TO LDB(COOLINGTOWERAREA)	4Cx16Sq.mm,XLPE,FRLSALCable	16	1	21	**21**	0.85	**0.85**	
18	MLDBTOLDB(ETPAREA)	4Cx16Sq.mm,XLPE, FRLSALCable	16	1	21	**21**	0.85	**0.85**	
19	MLDBTOLDB(DGAREA)	4Cx16Sq.mm,XLPE,FRLSALCable	16	1	21	**21**	0.85	**0.85**	
20	MLDBTOLDB(SWITCHYARD)	3.5Cx 25 Sq.mm, XLPE,FRLSALCable	25	1	23	**23**	1	**1**	
21	MLDBTOLDB(CONTROLROOM)	4Cx16Sq.mm,XLPE, FRLSALCable	16	1	21	**21**	0.85	**0.85**	
Total				**21**		**582**	**33.91**	**33.91**	

1

Calculation

MaximumCableDiameter:	**46**	**mm**
ConsiderSpareCapacityofCableTray:	**30%**	
DistancebetweeneachCable:	**0**	**mm**
CalculatedWidthofCableTray:	**757**	**mm**
CalculatedAreaofCableTray:	**34804**	**Sq.mm**
NoofLayerofCablesinCableTray:	**1**	
SelectedNoofCableTray:	**1**	**Nos.**
SelectedCableTrayWidth:	**600**	**mm**
SelectedCableTrayDepth:	**100**	**mm**
SelectedCableTrayWeightCapacity:	**90**	**Kg/Meter**

Result

SelectedCableTraywidth:	**Notadequate**	
SelectedCableTrayDepth:	**O.K**	
SelectrdCableTrayWeight:	**O.K**	**IncludingSpareCapacity**
SelectedCableTraySize:	**Notadequate**	**IncludingSpareCapacity**
reaseNoofCableTrayorwidthofC		
RequiredCableTraySize:		**mm**
RequiredNosofCableTray:		**No**
RequiredCableTray Weight:		**Kg/Meter/Tray**
TypeofCableTray:	**Ladder**	