Internship Program Report

By

BAYIREDDY VARAPRASAD 18481A0210



In association with



Contents

Introduction	3
Program organiser	3
Courtesy	3
Program details	3
Internship program	3
3 rd May2021: Introduction to EPC Industry	4
4 th May2021: Engineering documentation for EPC projects	5
5 th May2021: Engineering documentation for commands and formulae	6
7 th May2021: Engineering documentation for Electrical system design	7
10 th May2021: Engineering documentation for Typical diagrams	8
11th May2021: Classification of Transformers and Generators	9
12th May2021: Classification of Switchgare construction and power factor improvement	10
17th May2021: Detailing about UPS system and Busducts	11
18th May2021: Detailing about Motor Starters and Sizing of motors.	12
19th May2021: Discribing about Earthing system and Lighting Protection	
20th May2021: Lighting or illumination systems and calculations.	14
21 th May2021: Lighting or illumination systems using DIALUX software	15
24th May2021: Cabling and their calculations and types	
25 th May2021: Cabling calculations and Cable gland selection	17
28 th May2021: Load calculations and Transformer sizing calculations	18
29th May2021: DG set calculations.	19
2nd june2021: Caluculations of Earthing and Lighting protection	20
5 th june 2021: Cable sizing and cable tray sizing calculations.	21
Conclusion	22
Foodback:	22

Introduction

Internship program arranged by GUDLAVALLERU ENGINEERING COLLEGE in association with Smart Internz, Hyderabad for the benefit of 3rd year EEE batch 2018-2022 on Electrical Detailed design Engineering for Oil& Gas, Power and Utility industrial sectors.

Program organiser

Smart Bridge, Hyderabad.

Pioneer in organising Internships, knowledge workshops, debates, hackathons, Technical sessions and Industrial Automation projects.



Courtesy

Dr. Sri B. Dasu – HOD – EEE, GEC

Dr.G.Srinivasa Rao-Coordinator

Mr. Ramesh V - Mentor

Mr. Vinay Kumar - System Support

Mr. Harikanth – Softwar/Technical Support

Program details

Smart Internz program schedule: 4 weeks starting from 3rd May 2021

Daily schedule time shall be 4PM to 6.30PM

Mode of Classes: Online through ZOOM

Presenter: Mr Ramesh V

Internship program

We have been given the opportunity to learn and interact with industry experienced engineering specialist to learn the Electrical detailed design engineering for various industrial sectors.

3rd May2021: Introduction to EPC Industry

1	EPC Industry &	EPC Industry	Introduction
	Electrical Detailed	Engineering	Types of Engineering
	Engineering	Procurement	Engineering role in procurement
		Construction	Engineering role during construction

Topic details:

1A. INTRODUCTION TO EPC INDUSTRY



- ➤ EPC Engineering, procurement & construction
- ➤ EPC companies Engineering, Procurement & Construction (TECHNIP, TOYO, L&T, JACOBS, JGC, PUNJ LLOYD, TCE)
- > Industry: Oil & gas, Power, Fertilizer, Chemical, Textile, Food & beverage, Utility sectors.
- Projects: Green Field & Brown Field.
- Engineering Basic engineering, FEED (Front End Engineering & Design), Detailed engineering. Detailed Engineering
 Engineering (for Procurement) & detailed design (for Construction)



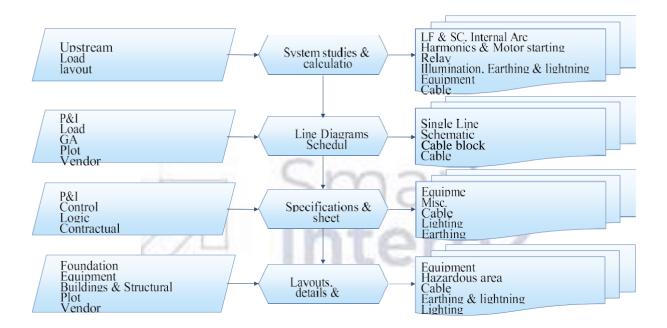
Engineering phases, Engineering deliverables (drawings & documents) list, Design Engineer role at various phases of project.

4th May2021: Engineering documentation for EPC projects

2	Electrical Design	Engineering Deliverables list	Sequence of deliverables
	Documentation	Detailed Engineering work flow	Detailed engineering process
		Document transmission	Document submission and info exchange
		Deliverables types	Different types of deliverables

Topic details:

SEQUENCE OF DELIVERABLES



On this day I have learned the Deliverable list of details and work flow in electrical design. And after sequence of deliverables, Detailed engineering process, Document submission and exchange process, and at last I learned about different types of delivarables.

5th May2021: Engineering documentation for commands and formulae

3 Electrical Design Ms word commands Documentation Ms excel formulae

Auto cad basic commands

Topic details:

MS Word, Excel and Auto cad COMMANDS.

Word Shortcut Keys

Command Name	Keys
All Caps	Ctrl+Shift+A
Apply List Bullet	Ctrl+Shift+L
Auto Format	Alt+Ctrl+K
Auto Text	F3
Bold	Ctrl+B
Cancel	ESC
Center Para	Ctrl+E
Change Case	Shift+F3
Clear	Del
Close or Exit	Alt+F4
Copy	Ctrl+C
Create Auto Text	Alt+F3
Cut	Ctrl+X
Double Underline	Ctrl+Shift+D
Find	Ctrl+F
Help	F1
Hyperlink	Ctrl+K
Indent	Ctrl+M
Italic	Ctrl+I
Justify Para	Ctrl+J
Merge Field	Alt+Shift+F
New Document	Ctrl+N
Open	Ctrl+O
Outline	Alt+Ctrl+O
Overtype	Insert
Page	Alt+Ctrl+P
Page Break	Ctrl+Return
Paste	Ctrl+V
Paste Format	Ctrl+Shift+V
Print	Ctrl+P
Print Preview	Ctrl+F2
Redo	Alt+Shift+Backspace
Redo or Repeat	Ctrl+Y
Save	Ctrl+S
Select All	Ctrl+A
Small Caps	Ctrl+Shift+K
Style	Ctrl+Shift+S
Subscript	Ctrl+=
Superscript	Ctrl+Shift+=
Task Pane	Ctrl+F1
Time Field	Alt+Shift+T

Underline	Ctrl+U	
Undo	Ctrl+Z	
Update Fields	F9	
Word Count List	Ctrl+Shift+G	

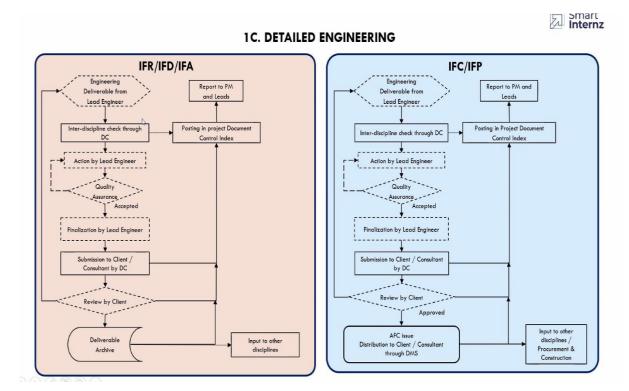
Function Keys	
F1	Get Help or visit Microsoft Office Online.
F2	Move text or graphics.
F3	Insert an AutoText (AutoText: A storage location for text or graphics you want to use again, such as a standard contract clause or a long distribution list. Each selection of text or graphics is recorded as an AutoText entry and is assigned a unique name.) entry (after Microsoft Word displays the entry).
F4	Repeat the last action.
F5	Choose the Go To command (Edit menu).
F6	Go to the next pane or frame.
F7	Choose the Spelling command (Tools menu).
F8	Extend a selection.
F9	Update selected fields.
F10	Activate the menu bar.
F11	Go to the next field.
F12	Choose the Save As command (File menu).

Here we need to check the Page setup, spelling, Grammer, Punctuation, Paragraphs, Overall prasentations, Tables & pictures to be numbered and titled at last we check the Document name & date of versions.

7th May2021: Engineering documentation for Electrical system design

4 Electrical system Overall plant description design for a small small project Sequence of approach Approach to detailed design

Topic details: Overall plant description ,approach to detailed design.



Here we observed that how to do a project and Sequence of approach, Approach to detail design and Overall plant distribution system.

10th May2021: Engineering documentation for Typical diagrams

5 Electrical system
design for typical Load lists shedule
diagrams Single line diagram

Power flow diagram
Typical schematic diagram

Topic details: Typical diagrams and Load calculations.

_		EQUIPMENT	1 2	70	12 5	Absorbe load		Load factor	Efficiency at load	Power factor at	KW =		onsume				kVAr =	offitan j	
S.S	Equipment	Description	ly by	la li	artic		rating	=A/B or H		load factor	_ c	ontinuous		Intermitten	and spares	Н	Star	dby	Remarks
9	No.	Descriptori	Supply	> 88	On 6	kW	kW B	In decimat	s in decima		io.	kVAr	No.	kW	KVAr	No.	kW	RVAr	
			- 00	-	2 "		1.00	III ORCHIGA	s in decina	10 COS V	K.07	AVAI		***	Ken		1.11	AVAI	
_	PROCESS LOADS			╙	-		1 497		1	1		_				Ш			
2	PD-3431 34-PM8401A	Portable MEG Injection Pump Package	LEWA	₩	X	27.00		0.73	0.91	0.83	_	+	1	29.67	19.94 19.81	\vdash			Portable Skid (Please refer Note-d)
3	34-PM8401A 34-PM8401B	Liquid Return Pump Motor Liquid Return Pump Motor	LEWA	-	×	25.45		0.82	0.93	0.81		_	<u>'</u>	27.37	19.01	4	27.37	19,81	
4	34-PM8402A	Booster Pump Motor (LRP Package)	LEWA	-	Ŷ	1.40	2.20	0.64		0.84		_	1	1.79	1.16	•	21.31	10.01	
5	34-PM8402B	Booster Pump Motor (LRP Package)	LEWA	+	x	1.40	2.20	0.64	0.78	0.84		_	<u> </u>	1110	1.10	1	1.79	1.16	
6	34-PM7902A	Corrosion Inhibitor Injection Pump Motor	LEWA	\vdash	x	6.45	11,00	0.59	0.90	0.77	1 7,17	5.94							
7	34-PM7902B	Corrosion Inhibitor Injection Pump Motor	LEWA		x	6.45	11.00	0.59	0.90	0.77						1	7.17	5.94	
8	34-PM7903A	Batch Corrosion Inhibitor Injection Pump Motor	RAM		X	133.50		0.83	0.96	0.80						1	139.06	104.30	
9	34-PM7903B	Batch Corrosion Inhibitor Injection Pump Motor	RAM	ш.	X	133.50		0.83	0.96	0.80						1	139.06	104.30	
10	34-PM7904A 34-PM7904B	KHI Inhibitor Injection Pump Motor	LEWA	₩	X	6.45	11.00		0.90	0.77	1 7.17	5.94				1	7.17	5.94	VSD for speed control
12	34-PM7905A	KHI Inhibitor Injection Pump Motor Scale Inhibitor Injection Pump Motor	FUTURE	-	×	3.00	4.00	0.59	0.90	0.77	1 3.53	2.56		_		'	7.17	0.94	VSD for speed control Future
13	34-PM7905B	Scale Inhibitor Injection Pump Motor	FUTURE	++	×	3.00	4.00	0.75	0.85	0.81	3.03	2.00				1	3.53	2.56	Future
4	34-KM9602A	Nitrogen Compressor Motor	GENERON	\vdash	x	30.00		0.80	0.90	0.80	1 33.33	25.00					0.00	2	
5	34-KM9602B	Nitrogen Compressor Motor	GENERON		х	30.00	37.50	0.80	0.90	0.80	1 33.33	25.00							
6	34-KM9602C	Nitrogen Compressor Motor	GENERON		х	30.00		0.80	0.90	0.80						1	33.33	25.00	
7	34-EM9602A	Aftercooler for Nitrogen Compressor	GENERON		x	1.15	2.50	0.46	0.78	0.80			1	1.47	1.11				
8	34-EM9602B	Aftercooler for Nitrogen Compressor	GENERON	-	X	1.15	2.50	0.46	0.78	0.80			1	1.47	1.11	1		1.08	
9	34-EM9602C 34-H9602	Aftercooler for Nitrogen Compressor Nitrogen Heater	GENERON	+	×	6.20	1.00	6.20	0.80	1.00						1	1.44	1.08	
1	34-PM9701A	Hydraulic Fluid Pump - Wellhead HPU - Very High Pressure	FRAMES	+	×	0.19	0.55	0.35	0.90	0.70			1	0.24	0.24				
2	34-PM9701B	Hydraulic Fluid Pump - Welhead HPU - Very High Pressure	FRAMES	+	ı x	0.19	0.55	0.35	0.80	0.70			1	0.24	0.24	Н			
13	34-PM9702A	Hydraulic Fluid Pump - Wellhead HPU - Medium High Pressure	FRAMES	\vdash	x	5.80	7.50	0.77	0.80	0.86			1	7.25	4.30				
14	34-PM9702B	Hydraulic Fluid Pump - Wellhead HPU - Medium High Pressure	FRAMES		х	5.80	7.50	0.77	0.80	0.86			1	7.25	4.30				
5	34-A9704A	Hydraulic Fluid Pump -IOPPS Valves HPU	LEDEEN		х	5.42	5.50	0.99	0.80	0.86			1	6.78	4.02				
16	34-A9704B	Hydraulic Fluid Pump -IOPPS Valves HPU	LEDEEN		X	5.42	5.50	0.99	0.80	0.86			1	6.78	4.02				
7	34-PM9705A 34-PM9705B	Hydraulic Fluid Pump - ESDVs HPU	LEDEEN	1	X	5.42	5.50	0.99	0.80	0.86			1	6.78	4.02	\square			
18	34-PM9705B AC-3435	Hydraulic Fluid Pump - ESDV's HPU Crane motor	LIEBHERR	-	X	112.00		0.99	0.80	0.96		_	1	117.89	4.02 57.10	\vdash			
10	34-XZM8303	Lifeboat Recovery Starter Panel	SCHAT HARDING	-	×	8.74		0.80		0.90		+	,	117.89	57.10	1	9.60	6.70	
l1	CP34302	Flare Knock Out Drum Heater Control Panel	CHROMALOX	-	Ŷ	35.00		1.00	0.90	0.90		_	1	38.89	18.83		0.00	0.70	
_	HVAC LOADS		0.110.114.00.1	+	17	00.00	00.00	1100	0.00			_		00100	10.00				
_	34-YH4201ACCU01	Ale Control Condension Unit - DE	сстс	Н.		37.25	42.90	0.87	0.82	0.80	1 45.43	34.07				\vdash			
3	34-YH4201ACCU02	Air Cooled Condensing Unit - 01 Air Cooled Condensing Unit - 02	CCTC	H.	+	37.25	60.00	0.62	0.82	0.80	40.40	34.07					45.43	34.07	
4	34-YH4201AHU01	Air Handling Unit - 01	CCTC	H â		8.85	10.00	0.89	0.80	0.80	1 11.06	8.30				-	40.43	34.07	
5	34-YH4201AHU02	Air Handling Unit - 02	CCTC	×		8.85	10.00	0.89	0.80	0.80	11100	0.00				1	11.06	8.30	
6	34-YH4201FF01	Fresh Air Fan - 01	CCTC	l x		8.00	8.00	1.00	0.90	0.80	1 8.89	6.67							
17	34-YH4201FF02	Fresh Air Fan - 02	CCTC	×		8.00	8.00	1.00	0.90	0.80						1	8.89	6.67	
8	34-YH4201EF01	Exhaust Fan - Toilet	CCTC	X		1.00	1.00	1.00	0.90	0.80			1	1.11	0.83				
9	34-YH4201EDH01	Duct heater - 01	CCTC	×	4	9.78	9.78	1.00	1.00	1.00		_	1	9.78	0.00	-			
10	34-YH4201EDH02	Duct heater - 02 Duct heater - 03	CCTC	l X		4.69 0.90	4.69	1.00	1.00	1.00		_		4.69	0.00				
11	34-YH4201EDH03 34-YH4201EDH04	Duct heater - 03 Duct heater - 04	CCTC	l ×		4.98	0.90 4.98	1.00		1.00		_	1	0.90	0.00				
12		Dact House - O4	COIC	 ^	++	4.00	4.00	1.00	1.00	1.00		_	-	4.00	0.00				
_	ELECTRICAL LOADS			ш.	\perp											ш			
3	AC-3431 UPS-3441/3442/3443	Power Distribution Board	MASSEERA GUTOR	l x		41.00		1.00	0.98	0.80	1 41.84	31.38				Н			Inclusive of MOV, Choke valve, Control valve and heat tracing loa
5	BC-3442	UPS- Mein/Bypess Switchgear 24 V DC UPS	SAFT	H.		1.20	1.20	1.00	0.82	0.80	1 1.50					Н			
6	LTR-3431	Lighting Transformer for LP-3431	SCHNEIDER	l ×	1	27.00		1.00			1 27.58								Inclusive of lighting load, convenience outlets and small power loa
17	ELTR-3431	Lighting Transformer for ELP-3431	SCHNEIDER	l î		27.00		1.00		0.90	1 27.58					Н			Inclusive of lighting load, convenience outlets and small power load
8	WD-3431A	Welding Socket Outlet 1 - Upper Deck	STAHL	Η'n	x	33.00		1.00	0.98	0.80	2100	10.04				1	33.67	25.26	
•	WD-3431B	Welding Socket Outlet 2 - Upper Deck	STAHL		x	33.00	33.00	1.00	0.98	0.80						1	33.67	25.26	
0	WD-3432A	Welding Socket Outlet 1 - Lower Deck	STAHL	П	x	33.00		1.00		0.80						1	33.67	25.26	
1	WD-3432B	Welding Socket Outlet 2 - Lower Deck	STAHL	н	X	33.00	33.00	1.00	0.98	0.80						1	33.67	25.26	
3	WD-3433A WD-3433B	Welding Socket Outlet 1 - Mezz Deck	STAHL STAHL	-	X	33.00	33.00	1.00	0.98	0.80						1	33.67 33.67	25.26 25.26	
4	WD-3433B WD-3434	Welding Socket Outlet 2 - Mezz Deck Welding Socket Outlet - Cellar Deck	STAHL	++	- X	33.00	33.00	1.00	0.98	0.80						1	33.67	25.26	
4	WD-3434	Welding Socket Outlet - Cellar Deck	SIAPL	-	X	33.00	33.00	1.00	0.96	0.80		_				,	33.07	20.20	
	Max. of normal running plant load	1: 353 kW, 232 kVAr,	V(kW2 + kVdr-7)		423	KVA	×	100		OTAL	278	195		252	125		671	503	Power factor without compensation [Cos φ] 0.836
	(Est. x %E + y %F)						y.	30	μ,	U.AL	2/8	195		202	120		6/1	903	Power factor with compensation [Cos q ₁]
	Peak load: (Est. x %E + y %F + z%G)	420 kW, 282 kVAr,	$\sqrt{(kW^2 + kV_0h^2)}$		506	kVA	Z	10	AFA=1	(RF*+R54r)		339		2	82	\vdash	8	18	Reqd capacitor rat: [=kW(ten \varphi - ten \varphi,)] KVA
		b) Absorbed loads:		-	C.	Consun	ed loads:	_				G - "	Stand -	hy": low	Is required	in			
ıs -					111			": all loads	that may								nter		
s -										mal operation									
n)	Load classification/restarting: For definitions of "Vital", "Essent	- for pumps, shaft load on duty point.	nmunication, & air		continuously be required for normal operation pumps or those of not normally											QATARGAS 3&4			
8-	Load classification/restarting:	- for pumps, shaft load on duty point for instrumentation, computers, con					operation including lighting and workshops running electrically driven units & F - "intermittent and spares"; the loads required for electrical stand - by for normally									OFFSHORE FACILITIES PROJECT			
n)	Load classification/restarting: For definitions of "Vital", "Essent Non - Essential", services and ap	- for pumps, shaft load on duty point. ial" and - for instrumentation, computers, con- optication condit'g, the required load during fu									r								OFFSHORE FACILITIES PROJECT
8.	Load classification/restarting: For definitions of "Vital", "Essent Non - Essential", services and as of "Restarting", see DEP 33.64.1	iel" and - for pumps, shaft load on duty point. Iel" and - for instrumentation, computers, con condity, the required load during fu 0.10 - Gen for lighting, during dark hours.	Il operation of plant.			F - *	Intermittent	and spare	ss"; the loa			e	lectrica unning	al stand - steam - o	by for norr triven ones	maily	charge		OFFSHORE FACILITIES PROJECT WELLHEAD PLATFORM 7
s -	Load classification/restarting: For definitions of "Vital", "Essent Non - Essential", services and ap	iel" and - for pumps, shaft load on duty point. Iel" and - for instrumentation, computers, con condity, the required load during fu 0.10 - Gen for lighting, during dark hours.	Il operation of plant.			F-	Intermittent ntermediate	and spare pumping,	storage,	nds required fo		e	lectrica unning	al stand - steam - o	by for norr triven ones	maily	charge		OFFSHORE FACILITIES PROJECT WELLHEAD PLATFORM 7
a)	Load classification/restarting: For definitions of "Vital", "Essent Non - Essential", services and as of "Restarting", see DEP 33.64.1	- for pumps, shaft load on duty point. Isal and - for instrumentation, computers, completes, completes, completes, computers, computers, computers, computers, computers, computers, computers, computers, considerable, and computers of comp	Il operation of plant.			F-	Intermittent ntermediate	and spare pumping,	storage,	nds required fo loading, etc, a		e	lectrica unning	al stand - steam - o	by for norr	maily	charge		OFFSHORE FACILITIES PROJECT WELLHEAD PLATFORM 7
a)	Load classification/restarting: For definitions of "Vital", "Essent Non - Essential", services and as of "Restarting", see DEP 33,64.1 Electrical engineering guidelines The Panel shall feed Injection Pu	- for pumps, shaft load on duty point. Isal and - for instrumentation, computers, completes, completes, completes, computers, computers, computers, computers, computers, computers, computers, computers, considerable, and computers of comp	Il operation of plant. d in normal full			F-	Intermittent ntermediate	and spare pumping,	storage,	nds required fo loading, etc, a		e	lectrica unning	al stand - steam - o	by for norr triven ones	maily	charge		OFFSHORE FACILITIES PROJECT WELLHEAD PLATFORM 7
a)	Load classification/restarting: For definitions of "Vital", "Essent Non - Essential", services and as of "Restarting", see DEP 33,64.1 Electrical engineering guidelines The Panel shall feed Injection Pu	- for pumps, sheft laad on oldy point. Ialf and - for instrumentation, computers, con- optication conditry, the required load uning fu 0,10 - Gen for lighting, during dark hours for workshops, the average total load operation.	Il operation of plant. d in normal full			F-	Intermittent ntermediate	and spare pumping,	storage,	nds required fo loading, etc, a		e	lectrica unning	al stand - steam - o	by for norr triven ones	maily	charge		OFFSHORE FACILITIES PROJECT WELLHEAD PLATFORM 7
a)	Load classification/restarting: For definitions of "Vital", "Essent Non - Essential", services and as of "Restarting", see DEP 33,64.1 Electrical engineering guidelines The Panel shall feed Injection Pu	- for pumps, sheft laad on oldy point. Ialf and - for instrumentation, computers, con- optication conditry, the required load uning fu 0,10 - Gen for lighting, during dark hours for workshops, the average total load operation.	Il operation of plant. d in normal full			F-	Intermittent ntermediate	and spare pumping,	storage,	nds required fo loading, etc, a		e	lectrica unning	al stand - steam - o	by for norr triven ones	maily	charge		OFFSHORE FACILITIES PROJECT WELLHEAD PLATFORM?
d)	Load classification/restarting: For definitions of "Vital", "Essent Non - Essential", services and as of "Restarting", see DEP 33,64.1 Electrical engineering guidelines The Panel shall feed Injection Pu	- for pumps, sheft laad on oldy point. Ialf and - for instrumentation, computers, con- optication conditry, the required load uning fu 0,10 - Gen for lighting, during dark hours for workshops, the average total load operation.	Il operation of plant. d in normal full			F-	Intermittent ntermediate	and spare pumping,	storage,	nds required fo loading, etc, a		e	lectrica unning	al stand - steam - o	by for norr triven ones	maily	charge		OFFSHORE FACILITIES PROJECT WELLHEAD PLATFORM 7
d)	Load classification/restarting: For definitions of "Vital", "Essent Non - Essential", services and as of "Restarting", see DEP 33,64.1 Electrical engineering guidelines The Panel shall feed Injection Pu	Infrared on the purpose that fixed on only point, liaff and for instrumention, computers or optication conflict, the required tools during to 0.00 Germ. In fix lighting, during durin hours. In workshops, the average both bits operation, and the purpose of the	Il operation of plant. d in normal full			F-	Intermittent ntermediate	and spare pumping,	storage,	nds required fo loading, etc, a	d	b u	lectrica unning umps,	al stand - steam - o	by for norr triven ones	maily	charge		OF SHORE FACILITIES PROJECT WELLHEAD PLATFORM 7
d)	Load classification/restarting: For definitions of "Vita", "Essent Nessentia", services and as of "Restarting", see DEP 33.64. Electrical engineering guidelines The Panel shall feed Irijection Pu Batch Injection pump considered	Infrared on the purpose that fixed on only point, liaff and for instrumention, computers or optication conflict, the required tools during to 0.00 Germ. In for lighting, during dark hours. In workshops, the average both be operated on the purpose of the purpos	d in normal full			F-	Intermittent ntermediate	and spare pumping,	es"; the los storage, electrical	eds required fo loading, etc, a y driven units.	FOR CON	e n p	lectrica unning umps,	al stand - steam - o boiler fee	by for norr triven ones	maily	charge		OF SHORE FACILITIES PROJECT WELLHEAD PLATFORM 7
a)	Load classification/restarting: For definitions of 'Villa', 'Essent Non - Essentia', nevtoes and a of 'Restarting', see DEP 33.64.1 Electrical engineering guidelines The Panel shall feed injection Pur Batch Injection pump considere	Inf and only point, and had not only point, liaf and of rein insurancesino, computers, or optication configure, and charging to 10 - 0 cm for instructioning dark hours, or for lighting, during dark hours, or for workshops, the average total ban operation. The properties of the	d in normal full d in normal full ing philosophy.			F-	Intermittent ntermediate	and spare pumping,	es"; the los storage, electrical	ads required for loading, etc., a loading, etc., a loading, etc., a loading, etc., a APPROVED	FOR CON	STRUCTION WITH	lectrica unning umps,	al stand - steam - o boiler fee	by for norr triven ones	maily	charge		OFFSHORE FACILITIES PROJECT WELLHEAD PLATFORM 7
n)	Load classification/restarting: For definitions of "Ville", "Essential", services and as Ville", Essential", services and as of "Restarting", see DEP 33.64. Electrical engineering guidelines The Panel shall feed Injection Pu Batch Injection pump consideres	Inf and	d in normal full d in normal full ling philosophy. AK PJ			F-	Intermittent ntermediate	and spare pumping,	es"; the los storage, electrical	APPROVED FOR	FOR CON	STRUCTION WITH	lectrica unning umps,	al stand - steam - o boiler fee	by for norr triven ones	maily	charge		OFFSHORE FACILITIES PROJECT WELLHEAD PLATFORM 7

We conclude here how to do load calculations and Typical diagrams and inernal structure and also about the power flow diagram.

11th May2021: Classification of Transformers and Generators

6 Classification of Transformers and Generators

Topic Details: Classification of Transformers and Generators.







1 Ph. Pad mounted 3 Ph Pole mounted Commercial/ 3 Ph Oil filled (ONAN) Distribution Residential lighting Residential/ street lighting type for industrial & commercial.





415V Diesel generator sets for standby / 240V 1 ph diseal generator set for lighting and & small power only Emergency power supply.

Transformer shall include a primary disconnect on the incoming power source. The disconnect means shall be either a breaker or a load break primary switch that is fused. Transformers are sized to carry the peak running load of all busses connected to them. In addition, feeders to and from power transformers shall be rated to carry full current at the maximum rating.

The packaged combination of a diesel engine, an alternator and various ancillary devices such as base, canopy, sound attenuation, control systems, circuit breakers, jacket water heaters, starting systems etc., is referred to as a Diesel Generating Set or a DG Set in short.

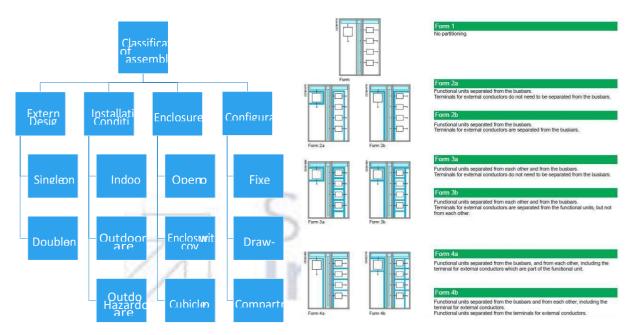
12th May2021: Classification of Switchgare construction and power factor improvement

7 Classification of Switchgare construction and power factor improvement

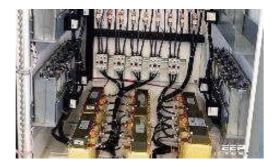
Different types of Switchgare assembles

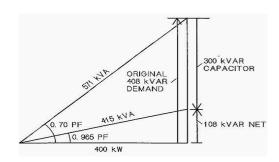
Power factor improvement

Topic details: Classifiaction of Switchgare contruction and Power Factor Improvement.



Switchgear includes switching & protecting devices like fuses, switches, CTs, VTs, relays, circuit breakers, etc. This device allows operating devices like electrical equipment, generators, distributors, transmission lines, etc.





Power factor defined as the ratio of real power to volt-amperes and is the cosine of the phase angle between the voltage and current in an AC circuit.

17th May2021: Detailing about UPS system and Busducts.

8	Detailing about
	UPS system and
	Busducts

Uninterruptible power supply system

Busduts of the system

Topic details: Power distribution of UPS system and Busducts.

UPS systems are designed to provide continuous power to a load, even with an interruption or loss of utility supply power. UPS generally involves a balance of cost Vs need.



Busducts are classified into various types depending on its application viz phase separated Busducts, segregated phase busducts, non-segregated phase busducts.



18th May2021: Detailing about Motor Starters and Sizing of motors.

9 Detailing about Motor Motor Starters and Sizing of motors

Motor starters and drives

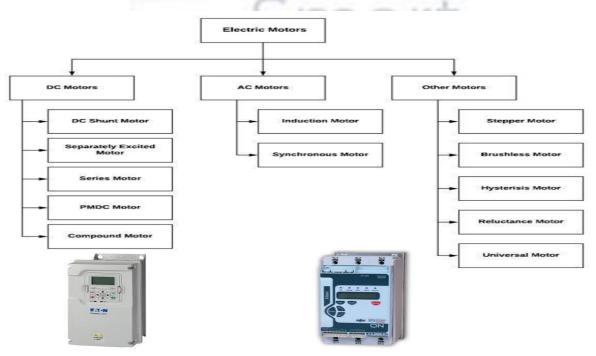
Sizing and selection of motors

Topic details: Detailing about Motor Starter and Sizing of motors and their selection.

The principal function of a motor starter is to start and stop the respective motor connected with specially designed electromechanical switches which are similar in some ways to relays. The main difference between a relay and a starter is that a starter has overload protection for the motor that is missing in a relay.

Different types of motor starters are as follows:

- Direct-On-Line Starter
- Rotor Resistance Starter
- Stator Resistance Starter
- Auto Transformer Starter
- Star Delta Starter



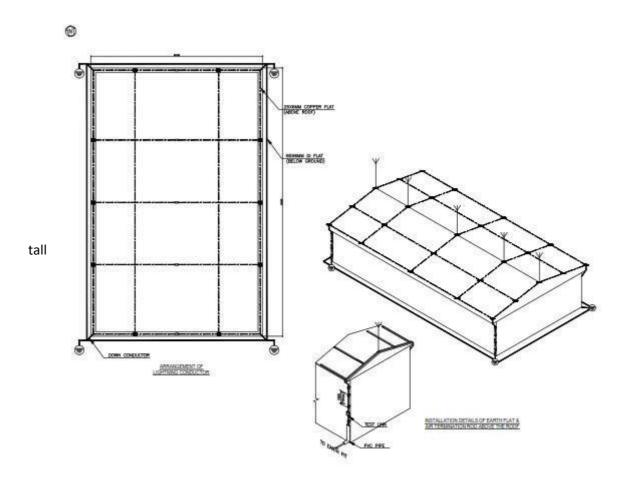
- Starting method soft starter, Auto transformer, Star/Delta
- Speed variation Constant speed, variable speed for VFD
 - Frame Size 56 to 280
- Insulation class & Temp rise A, E, B, F & H
- Protection Protection based on voltage & KW rating
- Cable entry, size & termination Cable sizing based on staring/running voltage drop and short circuit current Vibration monitoring based on KW rating.

19th May2021: Discribing about Earthing system and Lighting Protection.

Protection.	10	Discribing about Earthing system and Lighting Protection	Plant Earthing system	Lighting Protection materials
-------------	----	--	-----------------------	-------------------------------

Topic details: Discribing about Earthing system and Lighting Protection.

The purpose of earthing is to prevent damage to people and prevent or limit plant damage. Various earthing systems are provided with each earthing system is isolated from the other.



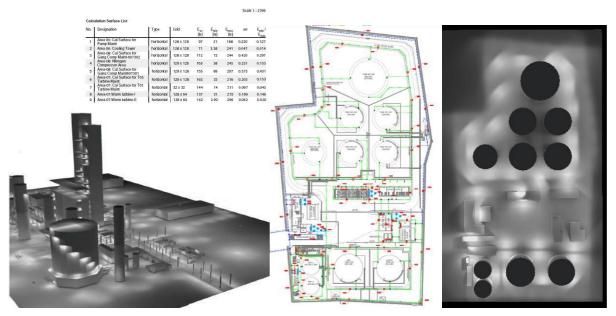
Lightning protection required for high rise structures and important buildings against lightning currents during thunder storms. Primarily Lightning protection system calculations are done based on soil resistivity, conductor material, coverage structure / Building to determine whether lightning protection is required or not.

20th May2021: Lighting or illumination systems and calculations.

11 Lighting or Illumination systems and Calculations	Lighting or illumination systems	Lighting calculations
--	----------------------------------	-----------------------

Topic details: Lighting or Illumination systems and Calculations.

All outdoor lighting fittings shall be connected with armoured PVC cable of suitable no. of cores and size. Necessary type and no. of junction boxes shall be provided for branch connections. Indoor light fittings shall be connected with FRLS PVC wires laid in cable trunks or conduits.



Inputs required: Equipment and cable routing layouts, lighting calculations, Design basis for type of light fittings to be used, required lux levels

Lighting calculations software: Dialux, Chalmlite, Calculux, Relux, Luxicon, CG Lux

Applicable Standards: IS 6665: Code of practice for industrial lighting, IS 3646: Code of practice for interior illumination, IEC 60598: Luminaires, IEC 62493: Assessment of lighting equipment related to human exposure to electromagnetic field

Deliverables: Indoor Lighting layouts, socket outlet layouts, Street lighting and area lighting layouts. BOQ.

Types of light fittings: Industrial, flame proof type (EX d), increased safety type (Ex e).

21th May2021: Lighting or illumination systems using DIALUX software.

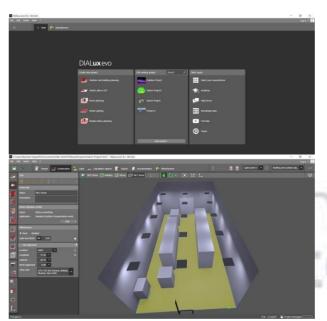
12 Lighting or
Illumination using
DIALUX software

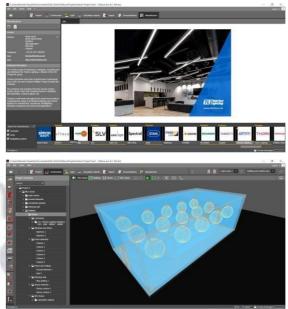
Lighting or illumination systems

Operation of dialux software

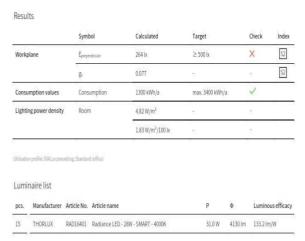
Topic details: Lighting or Illumination Calculations using DIALUX software.

Here we are using this Dialux evo 5.9.2 software windows to construct the power plant and we can perform the operation from this software.





We have the indoor calculations and outdoor calculations too.



Indoor calculation



outdoor calculations

24th May2021: Cabling and their calculations and types.

Cabling and their types and claculations

Cabling calculations

Types of cabling materials

Topic details: Cabling and their types and claculations.



Electrical cables must be properly supported to relieve mechanical stresses on the conductors, and protected from harsh conditions such as abrasion which might degrade the insulation.

Cables generally laid in the cable trays above ground, direct buried underground and in metallic or PVC conduits. Derating factors may be applicable for each type of cable laying conditions.

Cable trays shall be generally loaded 60 to 70% leaving space for future use. Underground cabling shall be done in concrete cable trenches with cable trays in paved areas and directly buried with mandatory gap of 300mm between different systems of cables.

25th May2021: Cabling calculations and Cable gland selection.

14	Cabling claculations and cable gland selection	Cabling calculations	Cable gland selection
	SCICCIOII		

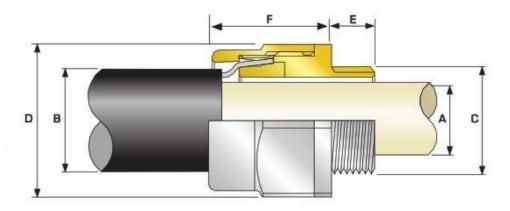
Topic details: Cable sizing calculation and cable gland selection.

Inputs required: Load List, Design basis, Electrical equipment layout, cable schedule, vendor catalogues for cable tray.

Cable tray sizing shall be performed for each branch of cable tray routing up to the load point.

Results shall be checked with specified limits mentioned in design basis.

Cable gland:



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

Cable Gland Size	(Alternat	Entry Threads "C" te Metric Thread hs Available)	Cable Bedding Diameter "A"	Overall Cable Diameter "B"	Armou	r Range	Across Flats "D"	Across Corners "D"	Protrusion
Size	Metric	Thread Length (Metric) "E"	Max	Max	Min	Max	Max	Max	Length "F"
20516	M20	10.0	8.7	13.2	0.8	1.25	24.0	26.4	35.2
205	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
50\$	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
635	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
755	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

28 th May2021: Load calculations and Transformer sizing calculations

15 Load calculations and TR Load calculations TR calculations calculations

Topic details:

List of electrical load calculations.

14-A 14-B 15 15 08 13	Equipment De Silica (filter feed pump Absorbers (filter and oil pump (fil) Absorbers (filter and oil pump (fil) Feed Pump (Sperator) MODER (VI)	cription	Breaker Rating	Breaker Type	Breaker No. of Poles	ELCB Rating mA	Absorbed Load [A]	Motor / Load Rating	Load Factor [A]/[B] [C]	Efficiency at Load Factor [C]	Power Factor at Load Factor [C]	Continue		Intermit	tent	Stand-b	Ьу
14-A 14-B 15 15 08 13	Absorbesht/Neutral oil pump (W) Absorbesht/Neutral oil pump (S) Feed Pump (Seperator) MIXER (W)		Α			mA						500					
14-A 14-B 15 15 08 13	Absorbesht/Neutral oil pump (W) Absorbesht/Neutral oil pump (S) Feed Pump (Seperator) MIXER (W)		_ A			mA	kW.	LW.									
14-A 14-B 15 15 08 13	Absorbesht/Neutral oil pump (W) Absorbesht/Neutral oil pump (S) Feed Pump (Seperator) MIXER (W)								decimal	decimal	cos d	kW	kVAR	kW.	KVAR	kW	RVAF
14-A 14-B 15 15 08 13	Absorbesht/Neutral oil pump (W) Absorbesht/Neutral oil pump (S) Feed Pump (Seperator) MIXER (W)						12.47	15.00	0.83	0.85	0.73	14.67	13.74				
14 -B 15 15 08 13	Absorbesnt/Neutral oil pump (S) Feed Pump (Seperator) MIXER (W)						3.62	4.70	0.77		0.73	4.3	4.0				
05 05 08 13	Feed Pump (Seperator) MIXER (W)						3.11	3.70	0.84		0.73	4.3	71.01			3.7	3
05 08 13	MIXER (W)						12.58	15.00	0.84		0.73	14.8	13.9				
08 13							12.68	15.00	0.85		0.73	14.9	14.0				
13	MIXER(S)			·			12.68	15.00	0.85		0.73	14.0	17.0			14.9	14.
	Blower						5.45	7.50	0.73	0.85	0.73	6.4	6.0				
	TK 2313B (II)			· · · · · · · · · · · · · · · · · · ·			0.53	0.75	0.71		0.73			0.6	0.6		
	Screw conveyor (I)						1.23		0.82		0.73			145	1.35		•
244				t			0.91					107	100				
24B							0.91									11	1 1
												3.93	3.68	,			
														·	·		
							121							·			
							2 12										***************************************
	DOSE NO DOSE LA MENDA CO.			t			160.760	3,00						,	tt		
_			4								_		-	ř – –	- 1		
um of norm <e+y%f)< td=""><td>al running plant load :</td><td>66.0 kW</td><td></td><td>61.8</td><td>KVAR</td><td></td><td>sqn</td><td>kW' +kVAR') =</td><td>90.4</td><td>kVA</td><td>TOTAL</td><td>65.40</td><td>61.23</td><td>2.07</td><td>1.94</td><td>19.65</td><td>18.3</td></e+y%f)<>	al running plant load :	66.0 kW		61.8	KVAR		sqn	kW' +kVAR') =	90.4	kVA	TOTAL	65.40	61.23	2.07	1.94	19.65	18.3
oad:		68.0 kW		63.7	EVAR		sgrt	kW*+kVAR*)=	93.1	kVA	kVA	89.55		2.8	4	26.91	1
4E + 9%F +	z%G)																_
nptions																	
factor, Eff	iciency and Power factor.																
	> 2U - <= 45 > 4E - 2 4E0		0.	91													
	>= 150		0.5	94		0.02											
	24A 24B 25 25 29 29 20 20 20 20 20 20 20 20 20 20 20 20 20	Citica exist on a grateor (V) Citica desid and agrateor (V) Citica desid and agrateor (S) Citica desident agrateor (S) Citica desident agrateor Citica desident agrateor M. Soap Addrotham Tarik Agrateor Soap Addrotham Tarik Agrateor and foormal running plant load (E + y/CF) coad cit + y/CF + ±/CG)	Carlo acid on agration (V)	Chris acid fam agration (W)	24A	Clinic section angitector (W)	26A	Ost Ost	24A	Ceric and tan againster (V)	Chris acid san agridator (V) 0.91 130 0.03 0.05	Chric acid san agridator M 0.51 130 0.65 0.75	Clinic acid san agripator (M) 0.91 130 0.83 0.85 0.75 107	Clinic acid tain againster (W)	Clinic and ten against relative (5)	Clinic acid tan againstant (b)	Clinic acid ten agridator (W) Clinic acid ten agridator (W

TR sizing calculations:

Calculation for Transformer Capacity

I.O Example of calculation for Transformer Capacity I.1 Calculation for consumed load Consumed loads used for this example are as follows:

	kV	k¥ar	kVA	
a. Continuous load	65.4	61.2	89.57	(i)
 b. Intermittent load / Diversity Factor 	2.07	1.9	2.81	(ii)
 Stand-by load required as consumed load 	19.65	18.4	26.92	(iii)
Max. Consumed load = ((i) + 30% (ii) + 10% (iii)) =	66.0	61.8	90.42	
Future expansion load (20% capacity)	13.2	12.4	18.08	
TotalLoad =	79.2	74.2	108.50	

1.2 Calculation for 3.3kV / 0.433 kV transformer capacity

 Max. Consumed load
 =
 90.4 kVA

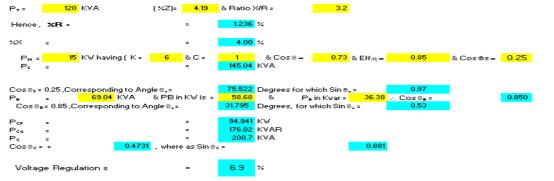
 Spare capacity
 =
 18.1 kVA

 Required capacity
 =
 108.5 kVA

 Transformer rated capacity
 =
 120 kVA

I.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:



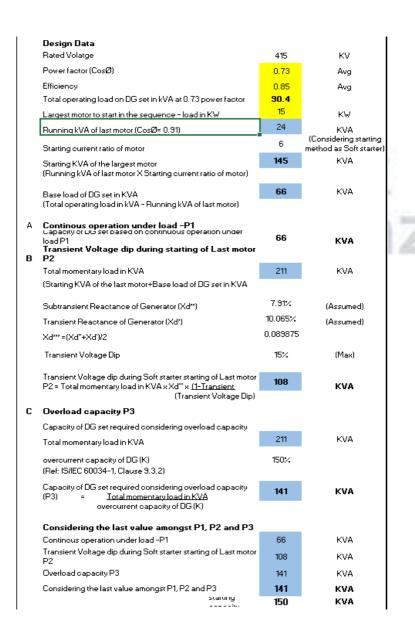
Result During starting of max. capacity motor, while all other loads are running , the voltage regulation at Transformer secondary terminals is appro: 6.90%

29th May2021: DG set calculations.

DG set calculations

Topic details:

Transformer and DG set calculations, types , sizing or selections



2nd june2021: Caluculations of Earthing and Lighting protection.

17 Calculation of
Earthing and
Lighting protection
calculations

Earthing calculations

Lighting protection calculation

Topic details:

Calculation of Earthing and Lighting protection calculations

	2		
Location	Bangalore		
Building	Srtuctural, Industrial		
Type of Building	Triangle Roofs (c)		
Building Length (L)	18		
Building breadth (W)	8		
Building Height (H)	6		
Risk Factor Calculation			
Collection Area (A _c)			
A _c		-	(3.14*H*H)+(2*H*W)
			209.04
Probability of Being Struck (P)			
P		-	Ac * Ng * 10-6
			0.000585312
Overall weighing factor			
a) Use of structure (A)		500	1.0
b) Type of construction (B)		366	0.8
c) Contents or consequential effects (C)		200	0.8
d) Degree of isolation (D)		=	1.0
e) Type of country (E)		=	0.3
Wo - Overall weighing factor		_	A * B * C * D * E
		=	0.192
Overall Risk Factor	Po	-	P * Wo
	Po	_	0.00011238
	Pa		10-5
As per clause no. 9.7 of BS-6651, suggest	ted acceptable risk factor (Po) ha	s been taken as 10 ⁻⁵
Since Po > Pa lightning protection require	d.		

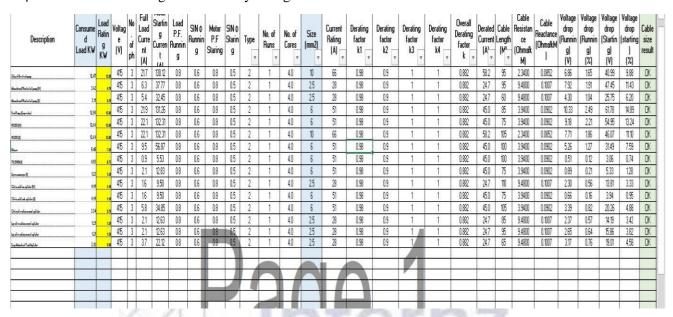
Earthing calculations:

	2	
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	4.5	
Soil resistivity Ω-meter	13	
Ambient temperature in deg C	55	
Plot dimensions (earth grid) L x B in meters	75	135
Number of earth rods in nos.	6	
Earth electrode sizing:		
Ac - Required conductor cross section in sq.mm		
$I_{lg} = A_c x \sqrt{\left[\frac{TCAPx10^{-4}}{t_c x \alpha_r x \rho_r}\right] x l_n \left[\frac{K_0 + T_m}{K_0 + T_a}\right]}$		
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	55	
I _{I-g} - 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	
KO - Factor at oC	293	

5 th june 2021: Cable sizing and cable tray sizing calculations.

Cable sizing and cable tray sizing Cable sizing calculations Cable tray calculation calculations

Topic details: Cable sizing and cable tray sizing calculations for LV cables and MV/HV cables.



Cable Tray calculations:

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	LVMCC	4	10	1	18	18	3.95	0.9	
2	PU2315- VFD	4	10	1	18	18	0.37	0.9	
3	PU2315- VFD	5	1.5	1	15	15	3.95	0.4	
4	LV MCC	4	2.5	1	16	16	0.37	0.5	
5	LV MCC	5	1.5	1	15	15	3.95	0.4	
6	LV MCC	4	2.5	1	16	16	0.37	0.5	
7	PU 2314 -B- VFD	4	2.5	1	16	16	0.9	0.5	
8	PU 2314 -B- VFD	5	1.5	1	15	15	0.9	0.4	
9	LVMCC	4	6	1	18	18	2.9	0.7	
10	PU2305- VFD	4	6	1	18	18	1.2	0.7	
11	PU2305- VFD	5	1.5	1	15	15	1.2	0.4	
12	LV MCC	4	6	1	18	18	1.2	0.7	
13	LV MCC	5	1.5	1	15	15	1.45	0.4	
14	LV MCC	4	10	1	18	18	2	0.9	
15	LV MCC	5	1.5	1	15	15	2.4	0.4	
16	LV MCC	4	6	1	18	18	2.4	0.7	
17	BW2313- VFD	4	6	1	18	18	0.85	0.7	
18	BW2313- VFD	5	1.5	1	15	15	0.85	0.4	
19	LV MCC	4	6	1	18	18	0.85	0.7	
20	LV MCC	5	1.5	1	15	15	1	0.4	
21	LV MCC	4	6	1	18	18	0.85	0.7	
	Total			21		348	33.91	12.3	
	ulation					Result			
Maxi	mum Cable Diameter:		18	mm		Selected Cab	le Tray width:	O.K	
Cons	ider Spare Capacity of Cable Tr	ay:	30%	1		Selected Cal	ole Tray Depth:	O.K	
Dista	nce between each Cable:		0	mm		Selectrd Cab	le Tray Weight:	O.K	Including Spare Capacity
Calc	ulated Width of Cable Tray:		452	mm		Selected Cal	ole Tray Size:	O.K	Including Spare Capacity
Calc	ulated Area of Cable Tray:		8143	Sq.mm					
	f Layer of Cables in Cable Tray:		2			Required Cal	ole Tray Size:	300 x 50	mm
	cted No of Cable Tray:		1	Nos.		Required Nos of Cable Tray:		1	No
	cted Cable Tray Width:		300	mm		Required Cable Tray Weight:		150.00	Kg/Meten/Tray
	cted Cable Tray Depth:		50	mm		Type of Cabl		Ladder	7
	cted Cable Tray Weight Capacity	:	150	Ko/Mete	эг	, , , , , , , , , , , , , , , , , , , ,	·7·		
	of Cable Tray:		Ladder			Cable Trav W	idth Area Reman	25%	
	Area of Cable Tray:		15000	Sq.mm			rea Remaning:	46%	

Conclusion:

We have been taught many aspects of engineering activities during the EPC stages for all electrical and related other disciplines also.

Feedback:

Smart Bridge

They conduct summer internships, work shops, debates, hackthons, technical sessions.

Method of conducting program

Online virtual program with presentation slides and explanation on the topic and practical usage of topic and with some examples.

Program highlights

It is for the detailed design of any industrial sectors.

Material

The material was good.

Benefits

It has been given the opportunity to learn and interact with industry experienced engineering specialist to learn the Electrical detailed design engineering for various industrial sectors.

Assignment-1 ELECTRICAL LOAD CALCULATIONS LV MCC

												kW = [A] / [D]	(Consumed I	_oad	kVAR = kW	x tan φ	
	Equipment No.	Equipment Description	Breaker Rating	Breaker Type	Breaker No. of Poles	ELCB Rating	Absorbed Load	Motor / Load Rating	Load Factor [A] / [B]	Eff ciency at Load Factor [C]	Power Factor at Load Factor [C]	Continu	ous	Intermi	ttent	Stand-	ру	Remar
			Α			mA	[A] kW	kW [B]	[U] decimal	נטן decimal	cos φ	kW	kVAR	kW	kVAR	kW	kVAR	
											'							
	PU2315	Silica filter feed pump					12.47		0.83			14.67	13.74					
	PU 2314-A	Absorbesnt/Neutral oil pump (W)					3.62		0.77		0.73	4.3	4.0					
	PU 2314 -B	Absorbesnt/Neutral oil pump (S)					3.11		0.84		0.73					3.7	3.4	
	PU2305	Feed Pump (Seperator)					12.58		0.84			14.8	13.9					
	MX2305	MIXER (W)					12.68		0.85		0.73	14.9	14.0					
	MX 2308	MIXER (S)					12.68		0.85	0.85	0.73					14.9	14.0	
_	3W2313	Blower					5.45		0.73		0.73	6.4	6.0					
	Rotary valve	TK 2313B (I)					0.53				0.73		<u> </u>	0.6	0.6			
	SC2314	Screw conveyor (I)	1				1.23		0.82 0.83		0.73	4.07	1.00	1.45	1.35			
	AG 2324A AG 2324B	Citric acid tan agitator (W)	1				0.91 0.91		0.83		0.73 0.73	1.07	1.00			4 4	1.0	
	AG 2324B AG 2305	Citric acid tank agitator (S) Citric oil rection vessol agitator					3.34		0.83		0.73	3.93	3.68			1.1	1.0	
	AG 2309	Lye oil reaction vessel agitator					1.21		0.90		0.73	1.42	1.33					
	AG 2310	Lye oil reaction vessel agitator					1.21		0.81		0.73	1.42	1.33					
	AG 2314	Soap Adsorbant Tank Agitator					2.12		0.71		0.73	2.49	2.34					
+	10 2014	- Coup / Good Dank Talik / Ighator					2.12	0.00	0.7 1	0.00	0.70	2.40	2.04					
								-										
	Maximum of norm Est. x%E + y%F;	nal running plant load : 66.0 kW		61.8	kVAR		sqrt	$(kW^2 + kVAR^2) =$	90.4	kVA	TOTAL	65.40	61.23	2.07	1.94	19.65	18.39	
	Peak Load :	68.0 kW		63.7	kVAR		sqrt	$(kW^2 + kVAR^2) =$	93.1	kVA	kVA	89.59	9	2.8	4	26.91		
(E	Est. x%E + y%F	+ z%G)																
	Assumptions	ficiency and Power factor.																
Ι.	, 2000 100tor, 21	Load Rating (kW)		iency		Power fa												
		<= 20	0.8			0.73												
		> 20 - <= 45	0.9			0.78												
		> 45 - < 150 >= 150	0.9			0.82 0.91												
		Z= 100	0.3	J -1		0.91												
2	2) Coincidence fa	ctors x= 1.0, y= 0.3, and z=0.1 considered for contnious, intermittent and standby load																
		,																

Calculation for Transformer Capacity

Example of calculation for Transformer Capacity Calculation for consumed load

Consumed loads used for this example are as follows:

	kW	kVar	kVA	
a. Continuous load	65.4	61.2	89.57	(i)
b. Intermittent load / Diversity Factor	2.07	1.9	2.81	(ii)
c. Stand-by load required as consumed load	19.65	18.4	26.92	(iii)
Max. Consumed load = ((i) + 30% (ii) + 10% (iii)) =	66.0	61.8	90.42	
Future expansion load (20% capacity)	13.2	12.4	18.08	
Total Load =	79.2	74.2	108.50	

Calculation for 3.3kV / 0.433 kV transformer capacity

 Max. Consumed load
 =
 90.4 kVA

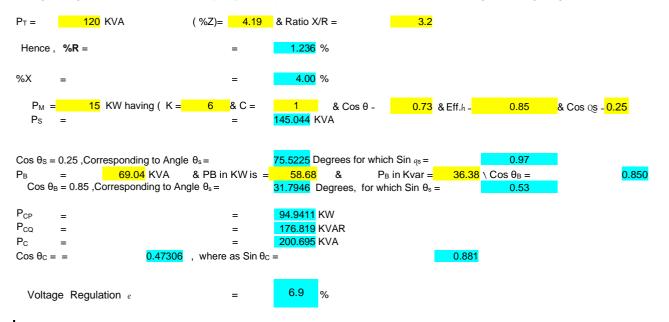
 Spare capacity
 =
 18.1 kVA

 Required capacity
 =
 108.5 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:



Result: During starting of max. capacity motor, while all other loads are running, the voltage regulation at Transformer secondary terminals is approx 6.90%

1.4 Selection of rated capacity

120 kVA transformer selected.

	Assignment-3		
	DG SIZING CALCULATIONS		
	Design Data		
	Rated Volatge	415	KV
	Power factor (CosØ)	0.73	Avg
	Efficiency	0.85	Avg
	Total operating load on DG set in kVA at 0.73 power factor	90.4	
	Largest motor to start in the sequence - load in KW	15	KW
	Running kVA of last motor (CosØ= 0.91)	24	KVA
	Starting current ratio of motor	6	(Considering starting method as Soft starter)
	Starting KVA of the largest motor	145	KVA
	(Running kVA of last motor X Starting current ratio of motor)		
	Base load of DG set in KVA (Total operating load in kVA – Running kVA of last motor)	66	KVA
Α	Continous operation under load -P1		
	Capacity of DG set based on continuous operation under load P1	66	KVA
В	Transient Voltage dip during starting of Last motor P2		
	Total momentary load in KVA	211	KVA
	(Starting KVA of the last motor+Base load of DG set in 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)	108	KVA
С	Overload capacity P3		
	Capacity of DG set required considering overload capacity		
	Total momentary load in KVA	211	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)	141	KVA
	Considering the last value amongst P1, P2 and P3 Continous operation under load -P1	66	KVA
		108	KVA
	Transient Voltage dip during Soft starter starting of Last motor P2		
	Overload capacity P3	141	KVA
	Considering the last value amongst P1, P2 and P3 starting capacity	141 150	KVA KVA
	Hence,DG set is 150 KVA is adequated and catch	.50	N/A
	NOTE:VOLTAGE DIP CONSIDERED - 15%		

Earthing calculations

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	4.5	
Soil resistivity Ω-meter	13	
Ambient temperature in deg C	55	
Plot dimensions (earth grid) L x B in meters	75	135
Number of earth rods in nos.	6	

Earth electrode sizing:

Ac - Required conductor cross section in sq.mm

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

αr - Thermal co-efficient of resistivity, at 20 oC	0.0032
• • • • • • • • • • • • • • • • • • • •	
pr - Resistivity of ground conductor at 20 oC	20.10
Ta - Ambient Temperature is °C	55
I _{I-g} - 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

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

αr - Thermal co-efficient of resistivity, at 20 oC	0.0032
pr - Resistivity of ground conductor at 20 oC	20.10
Ta - Ambient Temperature is °C	55
I _{l-g} - 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 flat area in mm	12
Earth flat area (including 25% corrosion allowance) in mm	15
Selected flat size W * Thk in sq mm	20

Rg - Grid resistance

Grid resistance can be calculated using Eq. 52 of IEEE 80

$$R_{g\, \beta \rho} \, {}_{\beta L}^{-\beta} \, - \, \frac{1}{\sqrt{20 \ x \ A}} \, {}_{\beta}^{-\beta} \, - \, \frac{1}{1 \, \beta h} \, \sqrt{20 \ /A} \, {}_{\beta g\, \beta \rho} \, {}_{\beta L}^{-\beta} \, - \, \frac{1}{\sqrt{20 \ /A}} \, {}_{\beta L}^{-\beta} \, - \, \frac{1}{\sqrt{20 \ /A}} \, {}_{\beta L}^{-\beta} \, - \, \frac{1}{\sqrt{20 \ /A}} \, {}_{\beta L}^{-\beta} \, - \, \frac{1}{\sqrt{20 \ /A}} \, {}_{\beta L}^{-\beta} \, - \, \frac{1}{\sqrt{20 \ /A}} \, {}_{\beta L}^{-\beta} \, - \, \frac{1}{\sqrt{20 \ /A}} \, {}_{\beta L}^{-\beta} \, - \, \frac{1}{\sqrt{20 \ /A}} \, {}_{\beta L}^{-\beta} \, - \, \frac{1}{\sqrt{20 \ /A}} \, {}_{\beta L}^{-\beta} \, - \, \frac{1}{\sqrt{20 \ /A}} \, {}_{\beta L}^{-\beta} \, - \, \frac{1}{\sqrt{20 \ /A}} \, {}_{\beta L}^{-\beta} \, - \, \frac{1}{\sqrt{20 \ /A}} \, {}_{\beta L}^{-\beta} \, - \, \frac{1}{\sqrt{20 \ /A}} \, {}_{\beta L}^{-\beta} \, - \, \frac{1}{\sqrt{20 \ /A}} \, {}_{\beta L}^{-\beta} \, - \, \frac{1}{\sqrt{20 \ /A}} \, {}_{\beta L}^{-\beta} \, - \, \frac{1}{\sqrt{20 \ /A}} \, - \, \frac{1$$

 ρ - Soil resistivity in Ω -meter= 13 L - Total buried length of ground conductor in meter 420 h - Depth of burial in meter 0.5 A - Grid area in sq. meter 10125

Rg - Grid resistance 0.088

Rr - Earth Electrode resistance

Grid resistance can be calculated using Eq. 55 of IEEE 80

 ρ - Soil resistivity in Ω -meter, 16.96 13 n - No of earth electrodes 6 Lr - Length of earth electrode in meter 4.5 b - Diameter of earth electrode in meter 0.020 k1 - co-efficient 1 A - Area of grid in square metre 10125

Rr-Earth Electrode resistance 4.7747

Grounding system resistance

Grounding system resistance can be calculated using equation 53 of IEEE 80 as follows:

$$R_{s\,0}\,\frac{R_g\,x\,R_{\,2\,0}\,{R_m}^2}{R_{g\,0}\,R_2\quad {}_{0}\,2R_m}$$

 R_m - Mutual ground resistance between the group of ground conductors, R_g and group of electrodes, R_r in Ω . Neglected R_m , since this is for homogenous soil

Rs-Total earthing system resistance 0.087 Ohms

The calculated resistance grounding system is less than the allowable 1 Ω value.

Lighting Protection Caculations

Location	Bangalore		
Building	Srtuctural, Industrial		
Type of Building	Triangle Roofs (c)		
Building Length (L)	18		
Building breadth (W)	8		
Building Height (H)	6		
Risk Factor Calculation			
1 Collection Area (A _c)			
A _c		=	(3.14*H*H)+(2*H*W)
			209.04
2 Probability of Being Struck (P)			
Р		=	$A_c^* N_a^* 10^{-6}$
			0.000585312
3 Overall weighing factor			
a) Use of structure (A)		=	1.0
b) Type of construction (B)		=	0.8
c) Contents or consequential effects (C)		=	0.8
d) Degree of isolation (D)		=	1.0
e) Type of country (E)		=	0.3
Wo - Overall weighing factor		=	A*B*C*D*E
		=	0.192
4 Overall Risk Factor	Po	=	P * Wo
	Po	=	0.00011238

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)	
	=	52	Mts.
6 Down Conductors			
Perimeter of building	=	52	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)

Cable Sizing Calculations

S.NO.	Description	Equipment No.	Description	Consumed Load KW	Load Rating KW	Voltage (V)	No. Load			SIN Φ Mo Running Si			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 Resistance (Ohms/kM)	(Ohms/kM)	Voltage drop (Running) (V)	Voltage drop (Running) (%)	Voltage drop (Starting) (V)	(ctarting)	size	OD of Cable (mm)	Gland size
3	LV MCC	PU2315	Silica filter feed pump	12.47	15.00		3 21.7					0.5 2	1	4.0	10	66	0.98	0.9	1	1	0.882	58.2	95	2.3400	0.0852	6.86	1.65	40.99	9.88	OK	18	20
4	LV MCC	PU 2314-A	Absorbeant/Neutral oil pump (W)	3.62	4.70	415		37.77	0.8			0.5 2	1	4.0	2.5	28	0.98	0.9	1	1	0.882	24.7	95	9.4800	0.1007	7.92	1.91	47.45	11.43	OK	16	20s
5	LV MCC	PU 2314 -B	Absorbeant/Neutral oil pump (5)	3.11	370	415		32.45	0.8			0.5 2	1	4.0	2.5	28	0.98	0.9	1	1	0.882	24.7	60	9.4800	0.1007	4.30	1.04	25.75	6.20	OK	16	20s
6	LV MCC	PU2305	Feed Pump (Seperator)	12.50	15.00		3 21.9					0.5 2	1	4.0	6	51	0.98	0.9	1	1	0.882	45.0	85	3.9400	0.0902	10.33	2.49	61.78	14.89	OK	18	20s
7	LV MCC	MX2305	MIXER (W)	12.68	15.00	415	3 22.1	132.31	0.8	0.6	8.0	0.5 2	1	4.0	6	51	0.98	0.9	1	1	0.882	45.0	75	3.9400	0.0902	9.18	2.21	54.95	13.24	OK	18	20s
8	LV MCC	MCK 2308	MIXER (5)	12.68	15.00	415	3 22.1	132.31	0.8	0.6	0.8	0.5 2	1	4.0	10	66	0.98	0.9	1	1	0.882	58.2	105	2.3400	0.0852	7.71	1.86	46.07	11.10	OK	18	20s
9	LV MCC	BW2313	Blower	5.45	7.50	415	3 9.5	56.87	0.8	0.6	8.0	0.5 2	1	4.0	6	51	0.98	0.9	1	1	0.882	45.0	100	3.9400	0.0902	5.26	1.27	31.49	7.59	OK	18	20s
10	LV MCC	Rotary valve	TK 2313B (I)	0.53	0.75	415	3 0.9	5.53	0.8	0.6	8.0	0.5 2	1	4.0	6	51	0.98	0.9	1	1	0.882	45.0	100	3.9400	0.0902	0.51	0.12	3.06	0.74	OK	18	20s
11	LV MCC	902314	Screw conveyor (f)	1.22	1.50	415	3 2.1	12.83	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	0.89	0.21	5.33	1.28	OK	18	20
12	LV MCC	AG 2324A	Citric acid tan agitator (W)	0.91	1.10	415	3 1.6	9.50	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	110	9.4800	0.1007	2.30	0.56	13.81	3.33	OK	16	20s
13		AG 2324B	Citric acid tank agitator (5)	0.91	1.10	415	3 1.6	9.50	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	0.66	0.16	3.94	0.95	OK	18	20
14	LV MCC	AG 2305	Citric oil rection vessol agitator	3.34	170	415	3 5.8	34.85	0.8	0.6	0.8	0.5 2	1	4.0	6	51	0.98	0.9	1	1	0.882	45.0	105	3.9400	0.0902	3.39	0.82	20.26	4.88	OK	18	20
15	LV MCC	AG 2309	Lye oil reaction vessel agitator	1.21	1.50	415		12.63	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	85	9.4800	0.1007	2.37	0.57	14.19	3.42	OK	16	32
16	LV MCC	AG 2310	Lye oil reaction vessel agitator	1.21	1.50		3 2.1		0.8			0.5 2	1	4.0	2.5	28	0.98	0.9	1	1	0.882	24.7	95	9.4800	0.1007	2.65	0.64	15.86	3.82	OK	16	20s
17	LV MCC	AG 2314	Scap Adsorbant Tank Agitator	2.12	100	415	3 3.7	22.12	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	65	9.4800	0.1007	3.17	0.76	19.01	4.58	OK	16	20s
18																										-						
20							-		+									+				+			-	+						-
21																																-
22																										1						
23																																
24 25	-																															
26								-	1				-				-		+		-	-			-	 						
27								+	1				-				1	1	1				-	-	1	 						
21																			1		l	-				-						
-				+				+	1				-		-	1	1	1	1				-	-	1	 						
-				1	\vdash			+	1				-				-	-	-		-				-	1						
				1			1 1		1	1		1	1	l	1	1	1	1	1	1		- 1	1	1	1	1						

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 specing between two circulas

K3=Rating factor for specing between two circulas

LTMotors: 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%

Cable Tray Sizing calculations

CABL	LE TRAY: FROM	LT-4		TO	L.	T-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	LV MCC	4	10	1	18	18	3.95	0.9			
2	PU2315- VFD	4	10	1	18	18	0.37	0.9			
3	PU2315- VFD	5	1.5	1	15	15	3.95	0.4			
4	LV MCC	4	2.5	1	16	16	0.37	0.5			
5	LV MCC	5	1.5	1	15	15	3.95	0.4			
6	LV MCC	4	2.5	1	16	16	0.37	0.5			
7	PU 2314 -B- VFD	4	2.5	1	16	16	0.9	0.5			
8	PU 2314 -B- VFD	5	1.5	1	15	15	0.9	0.4			
9	LV MCC	4	6	1	18	18	2.9	0.7			
10	PU2305- VFD	4	6	1	18	18	1.2	0.7			
11	PU2305- VFD	5	1.5	1	15	15	1.2	0.4			
12	LV MCC	4	6	1	18	18	1.2	0.7			
13	LV MCC	5	1.5	1	15	15	1.45	0.4			
14	LV MCC	4	10	1	18	18	2	0.9			
15	LV MCC	5	1.5	1	15	15	2.4	0.4			
16	LV MCC	4	6	1	18	18	2.4	0.7			
17	BW2313- VFD	4	6	1	18	18	0.85	0.7			
18	BW2313- VFD	5	1.5	1	15	15	0.85	0.4			
19	LV MCC	4	6	1	18	18	0.85	0.7			
20	LV MCC	5	1.5	1	15	15	1	0.4			
21	LV MCC	4	6	1	18	18	0.85	0.7			
	Total			21		348	33.91	12.3			
alc	ulation					Result			ı		
	num Cable Diameter:		18	mm		Selected Cable T	rav width	O.K	ı		
	ider Spare Capacity of Cable Tray:		30%			Selected Cable T		0.K			
	nce between each Cable:		0	mm		Selected Cable Tr		0.K	Including Spare Capacit		
	lated Width of Cable Trav:		452	mm		Selected Cable T		O.K	Including Spare Capacit		
	lated Area of Cable Tray:		8143	Sq.mm		Selected Cable 1	ay Size.	O.K	including Spare Capacit		
	Layer of Cables in Cable Tray:		2	Jq.mm		Required Cable T	ray Size:	300 x 50	mm		
	ted No of Cable Tray:		1	Nos.		Required Nos of		300 X 50 1	No		
	ted No of Cable Tray.		300	mm		Required Cable T		150.00	Kg/Meter/Tray		
	ted Cable Tray Width.		50	mm		Type of Cable Tra		Ladder	regrimeter/11 dy		
	ted Cable Tray Depth.		150	Kg/Meter		. , pe or oable tre	·,·	Laudei			
	of Cable Tray:		Ladder	rigrivietei		Cable Tray Width	Area Pemaning	25%			
	or oable rray.		Laudei			Cable ITay Willing	Area Nemailing	23/0			