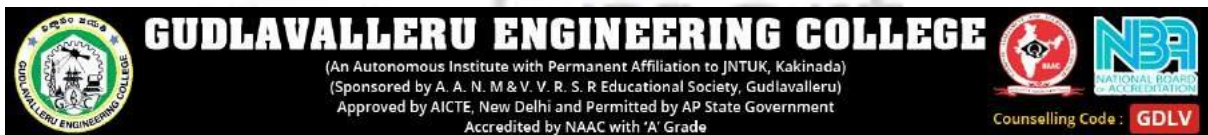


# Internship Program Report

By

**TALARI PAVANI -18481A0286**



**In association with**



## Contents

Introduction .....	3
Program organiser .....	3
Courtesy .....	3
Program details .....	3
Internship program .....	3
3 <sup>rd</sup> May2021: Introduction to EPC Industry.....	4
4 <sup>th</sup> May2021: Engineering documentation for EPC projects .....	5
5 <sup>th</sup> May2021: Engineering documentation for commands and formulae.....	6
7 <sup>th</sup> May2021: Engineering documentation for Electrical system design.....	7
10 <sup>th</sup> May2021: Engineering documentation for Typical diagrams.....	8
11 <sup>th</sup> May2021: Classification of Transformers and Generators .....	9
12 <sup>th</sup> May2021: Classification of Switchgare construction and power factor improvement .....	10
17 <sup>th</sup> May2021: Detailing about UPS system and Busducts.....	11
18 <sup>th</sup> May2021: Detailing about Motor Starters and Sizing of motors. ....	12
19 <sup>th</sup> May2021: Discribing about Earthing system and Lighting Protection .....	13
20 <sup>th</sup> May2021: Lighting or illumination systems and calculations.....	14
21 <sup>th</sup> May2021: Lighting or illumination systems using DIALUX software.....	15
24 <sup>th</sup> May2021: Cabling and their calculations and types .....	16
25 <sup>th</sup> 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
Feedback:.....	22

## Introduction

Internship program arranged by GUDLAVALLERU ENGINEERING COLLEGE in association with Smart Internz, Hyderabad for the benefit of 3<sup>rd</sup> 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

Mr. G. Srinivasa Rao – Internship coordinator

Mr. Ramesh V - Mentor

Mr. Vinay Kumar - System Support

Mr. Harikanth – Software/Technical Support

## Program details

Smart Internz program schedule: 4 weeks starting from 3<sup>rd</sup> May 2021

Daily schedule time shall be 4PM to 6.30PM

Mode of Classes: On line through ZOOM

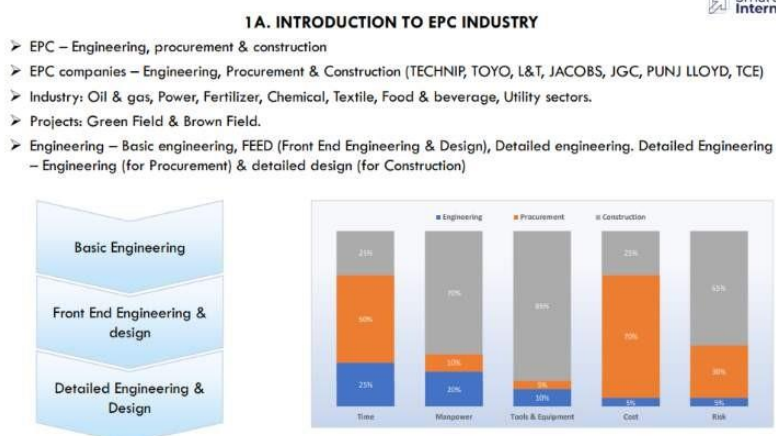
Presenter: Mr Ramesh V

## 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.

### 3<sup>rd</sup> May2021: Introduction to EPC Industry

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



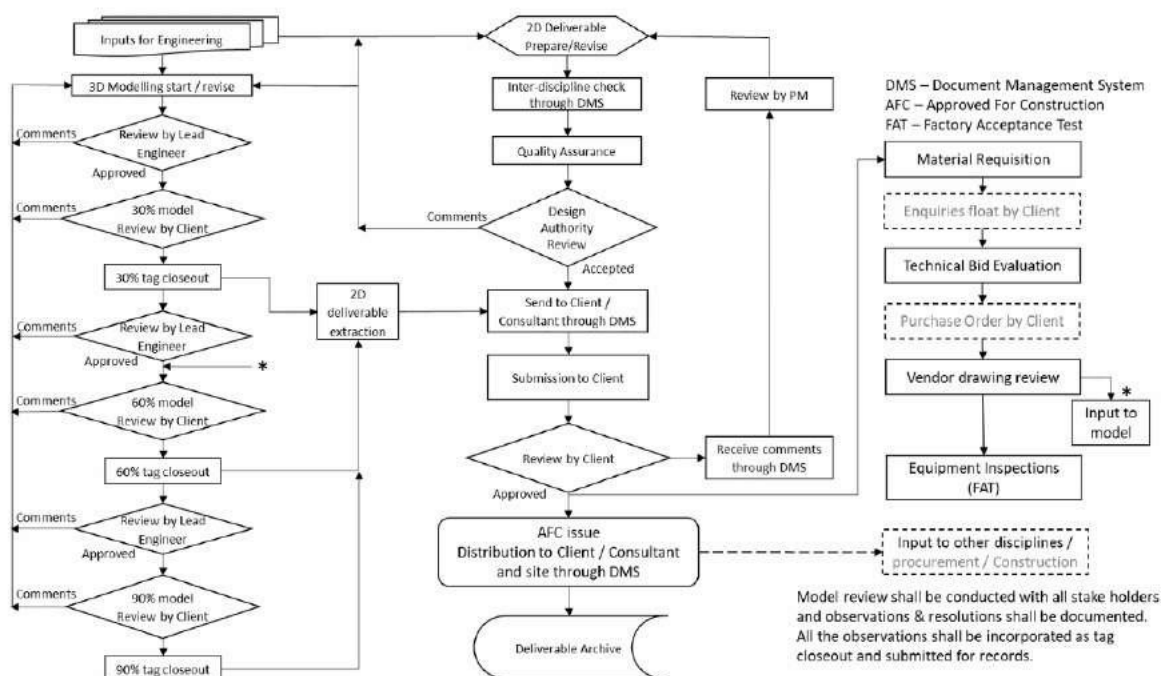
Topic details:

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

4<sup>th</sup> May2021: Engineering documentation for EPC projects

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

### 3. ELECTRICAL DESIGN & DETAILED ENGINEERING - PROCESS



Topic details:

Engineering deliverables list, detailed engineering flow, engineering support flow, engineering support to procurements.

5 th May2021: Engineering documentation for commands and formulae

3	Document & Drawing tools	MS Word	Report / Calculations formats
		MS Excel	Basic excel commands
		Autocad	Basic line diagrams and layout commends

### 3C. AUTOCAD BASIC COMMANDS



A 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			
COMMAND WIN	Ctrl+9	VERTICAL	VER			

Topic details:

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

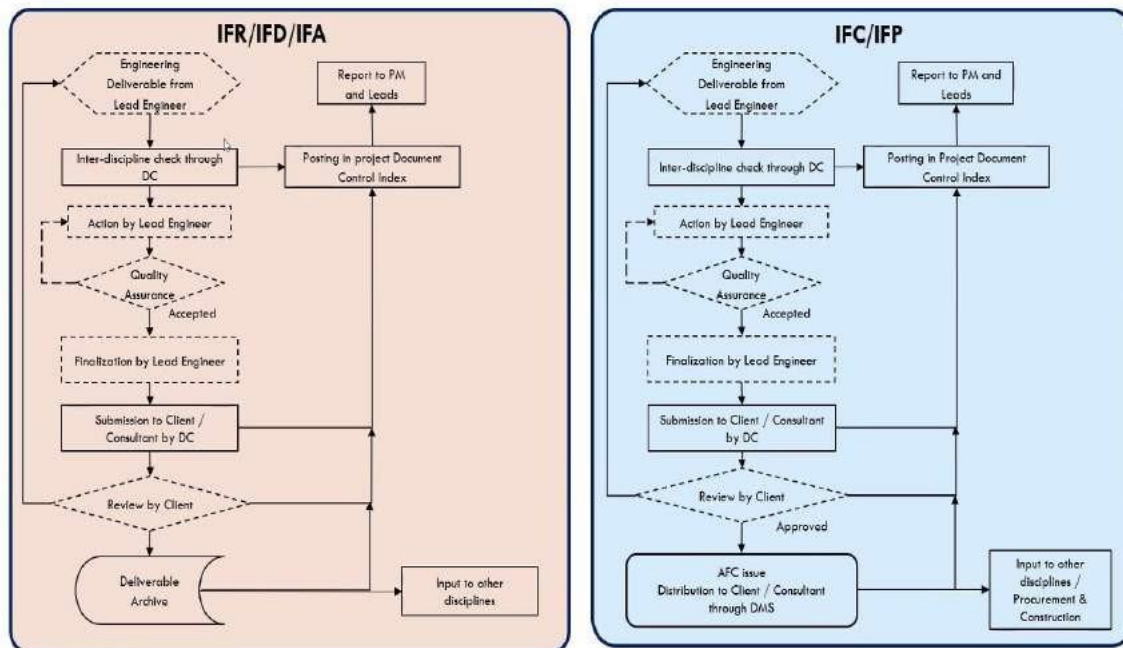
7 th May2021: Engineering documentation for Electrical system design

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

Topic details:



### 1C. DETAILED ENGINEERING



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







## 11<sup>th</sup> May2021: Classification of Transformers and Generators

6	Classification of Transformers and Generators	Different types of Transformers	Different types of Generators
---	-----------------------------------------------	---------------------------------	-------------------------------



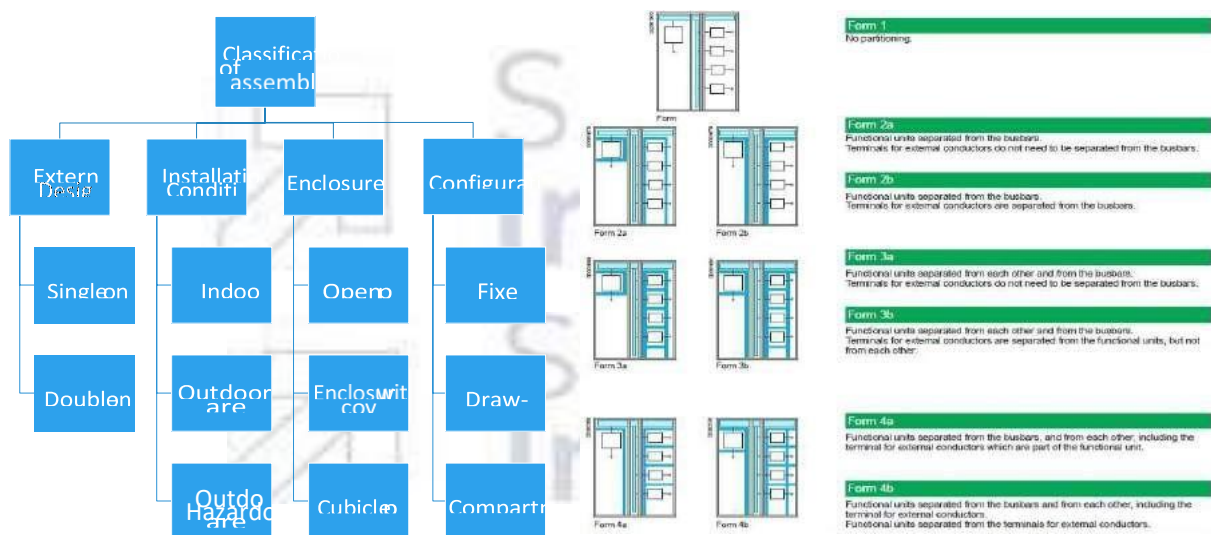
Topic details:

Classification of Transformers and Generators

---

12<sup>th</sup> May2021: Classification of Switchgare construction and power factor improvement

7	Classification of Switchgare construction and power factor improvement	Different types of Switchgare assemblies	Power factor improvement
---	------------------------------------------------------------------------	------------------------------------------	--------------------------

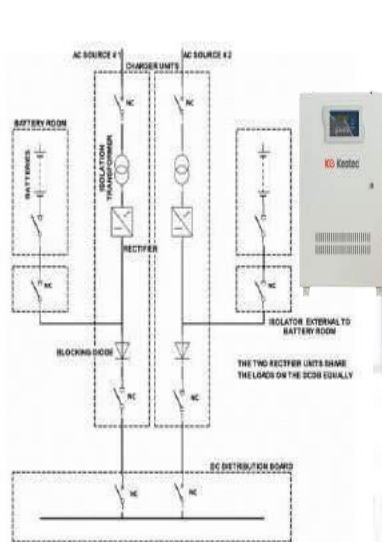


Topic details:

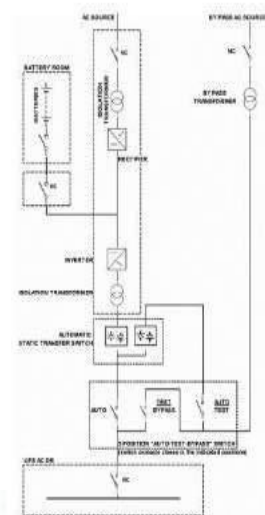
Classification of Switchgare contruction and Power Factor Improvement

17<sup>th</sup> May2021: Detailing about UPS system and Busducts.

8	Detailing about UPS system and Busducts	Uninterruptible power supply system	Busducts of the system
---	-----------------------------------------	-------------------------------------	------------------------



110V or 220V DC  
UPS System



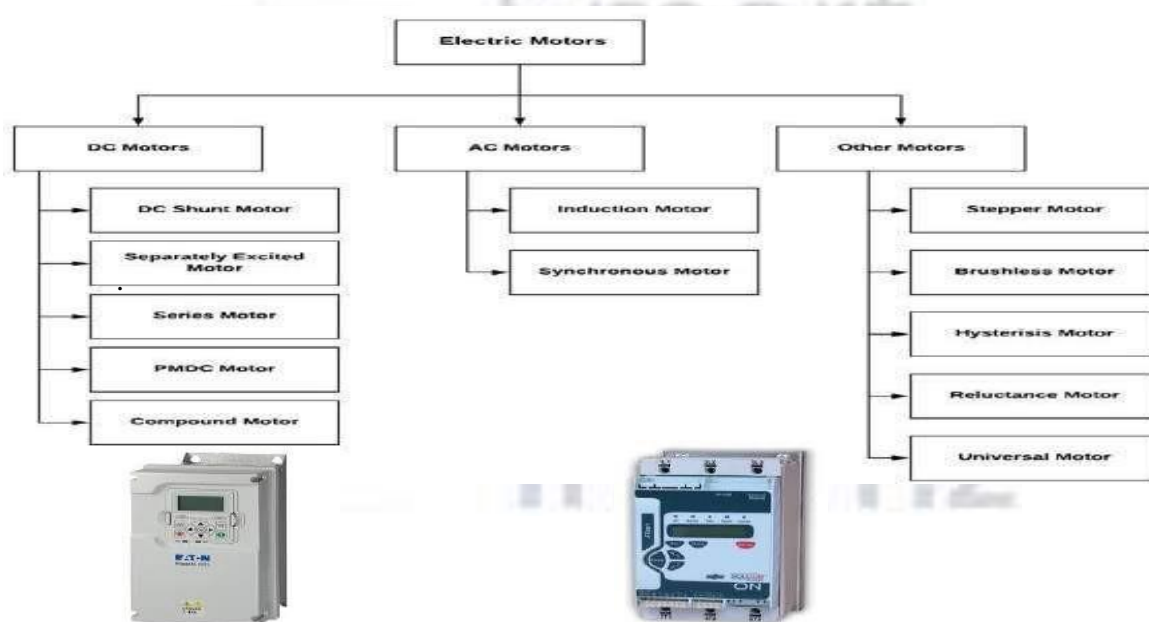
110V or 230V  
AC UPS System

**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.

18<sup>th</sup> May2021: Detailing about Motor Starters and Sizing of motors.

9	Detailing about 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.

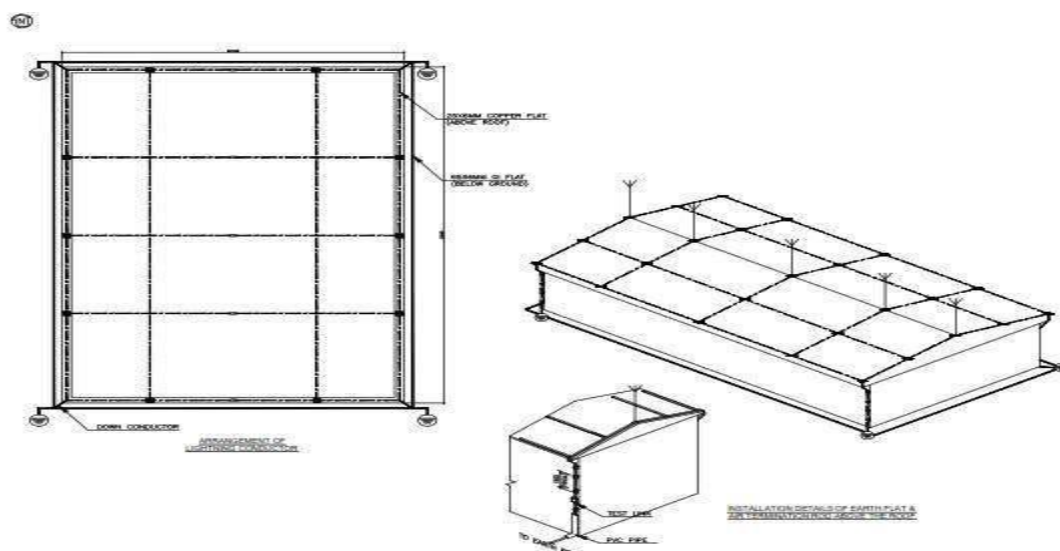
The principal function of a motor starter is to start and stop the respective motor connected with specially designed electromechanical switches which are similar in some ways to relays. The main difference between a relay and a starter is that a starter has overload protection for the motor that is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

19<sup>th</sup> May2021: Discribing about Earthing system and Lighting Protection.

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



**Topic details:** Discribing about Earthing system and Lighting Protection.

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.

20<sup>th</sup> 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, Chalmrite, 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.

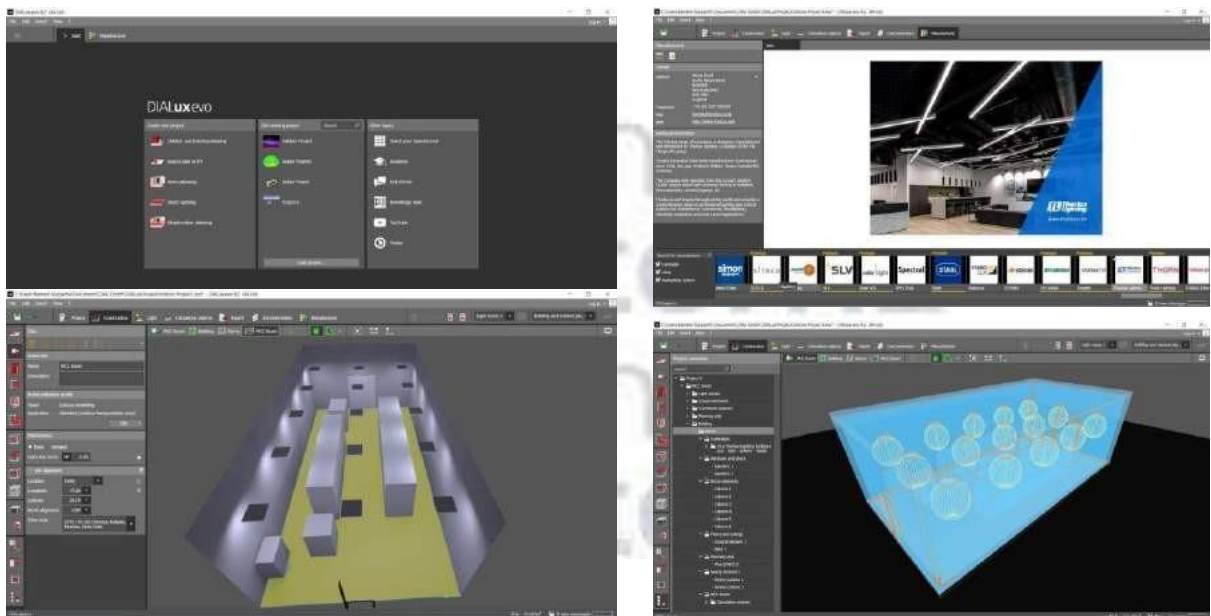
Types of light fittings: Industrial, flame proof type (EX d), increased safety type (Ex e).

21<sup>th</sup> 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.





24<sup>th</sup> May2021: Cabling and their calculations and types.

13	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.

25<sup>th</sup> May2021: Cabling calculations and Cable gland selection.

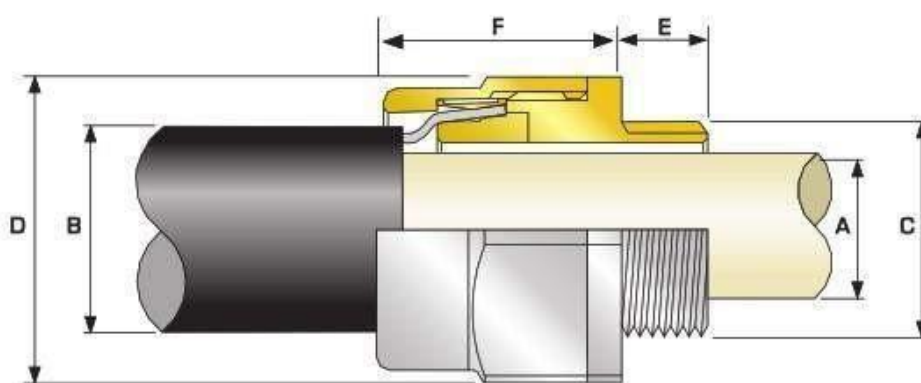
14	Cabling calculations and cable gland selection	Cabling calculations	Cable gland selection
----	------------------------------------------------	----------------------	-----------------------

**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	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



## 29th May2021: DG set calculations

16	DG set calculations
----	---------------------

## Topic details:

Transformer and DG set calculations,types ,sizing or selections

Assignment - 3 DG SIZING CALCULATIONS		
<b>Design Data</b>		
Rated Voltage	415	KV
Power factor (Cosφ)	0.77	Avg
Efficiency	0.89	Avg
Total operating load on DG set in KVA at 0.77 power factor	409.4	
Largest motor to start in the sequence - load in KW	75	KW
Running KVA of last motor (Cosφ= 0.91)	109	KVA
Starting current ratio of motor	6	(Considering starting method as Soft starter)
Starting KVA of the largest motor	657	KVA
(Running KVA of last motor X Starting current ratio of motor)		
Base load of DG set in KVA	300	KVA
(Total operating load in KVA – Running KVA of last motor)		
<b>A Continuous operation under load -P1</b>		
Capacity of DG set based on continuous operation under load P1	300	KVA
<b>B Transient Voltage dip during starting of Last motor P2</b>		
Total momentary load in KVA	957	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)
$X_d'' = (X_d' + X_d' / 2)$	0.089675	
Transient Voltage Dip		
Transient Voltage dip during Soft starter starting of Last motor	15%	(Max)
P2 = Total momentary load in KVA x $X_d''$ x (1-Transient Voltage Dip)		
(Transient Voltage Dip)		
Overload capacity P3	FALSE	KVA
Capacity of DG set required considering overload capacity Total momentary load in KVA		
overcurrent capacity of DG (K) (Ref. IS/IEC 60034-1, Clause 9.3.2)		
Capacity of DG set required considering overload capacity (P3)	-	
<b>C Total momentary load in KVA</b>		
overcurrent capacity of DG (K)	957	KVA
Considering the last value amongst P1, P2 and P3		
Continuous operation under load -P1	150%	
Transient Voltage dip during Soft starter starting of Last motor P2 Overload capacity P3		
Considering the last value amongst P1, P2 and P3	638	KVA
	300 FALSE	KVA KVA
	636	KVA
	638	KVA







## 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

[illegible]

## Assignment - 2

### 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	324.46	242.3	404.94	--- (i)
b. Intermittent load / Diversity Factor	11.2	10.3	15.23	--- (ii)
c. Stand-by load required as consumed load	97.5	71.0	120.63	--- (iii)

Max. Consumed load = ((i) + 30% (ii) + 10% (iii)) =	337.6	252.5	421.54
Future expansion load (20% capacity)	67.5	50.5	84.31
Total Load =	405.1	303.0	505.85

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

Max. Consumed load	=	421.5 kVA
Spare capacity	=	84.3 kVA
Required capacity	=	505.9 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 :

$$P_T = 409.4 \text{ KVA} \quad (\%Z) = 4 \quad \& \text{ Ratio } X/R = 3.3$$

$$\text{Hence, } \%R = 1.176 \%$$

$$\%X = 3.82 \%$$

$$P_M = 75 \text{ KW having } (K = 6 \& C = 1 \& \cos \theta = 0.81 \& \text{Eff.} \eta = 0.89 \& \cos \theta_s = 0.25$$

$$P_s = 624.22 \text{ KVA}$$

$$\cos \theta_s = 0.25, \text{Corresponding to Angle } \theta_s = 75.5225 \text{ Degrees for which } \sin \theta_s = 0.97$$

$$P_B = 421.5 \text{ KVA} \quad \& \text{ PB in KW is } 358.275 \quad \& \quad P_B \text{ in Kvar } = 252.5 \therefore \cos \theta_B = 0.850$$

$$\cos \theta_B = 0.85, \text{Corresponding to Angle } \theta_s = 31.7883 \text{ Degrees, for which } \sin \theta_s = 0.53$$

$$P_{CP} = 514.33 \text{ KW}$$

$$P_{CQ} = 856.898 \text{ KVAR}$$

$$P_C = 999.405 \text{ KVA}$$

$$\cos \theta_C = 0.51464, \text{ where as } \sin \theta_C = 0.857$$

$$\text{Voltage Regulation } \varepsilon = 9.5 \%$$

**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.

## DG SIZING CALCULATIONS

<b>Design Data</b>		
Rated Voltage	415	KV
Power factor (CosØ)	0.77	Avg
Efficiency	0.89	Avg
Total operating load on DG set in kVA at 0.77 power factor	409.4	
Largest motor to start in the sequence - load in KW	75	KW
Running kVA of last motor (CosØ= 0.91)	109	KVA
Starting current ratio of motor	6	(Considering starting method as Soft starter)
Starting KVA of the largest motor	657	KVA
(Running kVA of last motor X Starting current ratio of motor)		
Base load of DG set in KVA	300	KVA
(Total operating load in kVA - Running kVA of last motor)		
<b>A Continuous operation under load -P1</b>		
Capacity of DG set based on continuous operation under load P1	300	KVA
<b>B Transient Voltage dip during starting of Last motor P2</b>		
Total momentary load in KVA	957	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)
$X_d''' = (X_d'' + X_d')/2$	0.089875	
Transient Voltage Dip	15%	(Max)
Transient Voltage dip during Soft starter starting of Last motor		
$P2 = \text{Total momentary load in KVA} \times X_d''' \times (1 - \text{Transient Voltage Dip})$		
(Transient Voltage Dip)	FALSE	KVA
<b>Overload capacity P3</b>		
Capacity of DG set required considering overload capacity Total momentary load in KVA		
overcurrent capacity of DG (K) (Ref: IS/IEC 60034-1, Clause 9.3.2)		
Capacity of DG set required considering overload capacity (P3) =		
Total momentary load in KVA		
overcurrent capacity of DG (K)	957	KVA
Considering the last value amongst P1, P2 and P3		
Continuous operation under load -P1	150%	
Transient Voltage dip during Soft starter starting of Last motor P2 Overload capacity P3		
Considering the last value amongst P1, P2 and P3	638	KVA
	300	KVA
	FALSE	KVA
	638	KVA
	638	KVA

Asssignment - 4  
Eathing caluculation

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		
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 <sub>lg</sub> - RMS fault current in kA = 50 KA	14	
tc - Short circuit current duration sec	1	
Thermal capacity factor, TCAP J/(cm <sup>3</sup> .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		
$I_{lg} = A_c \times \sqrt{\left[ \frac{TCAP \times 10^{-4}}{t_c \times \alpha_r \times \rho_r} \right] \times \ln \left[ \frac{K_0 + T_m}{K_0 + T_a} \right]}$		
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 <sub>lg</sub> - RMS fault current in kA = 50 KA	14	
tc - Short circuit current duration sec	1	
Thermal capacity factor, TCAP J/(cm <sup>3</sup> .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:		

# Assignment -5

## Lightning protection

	14
Location	Delhi
Building	Strtuctural, Industrial
Type of Building	Triangle Roofs (c)
Building Length (L)	11
Building breadth (W)	7
Building Height (H)	5

### Risk Factor Calculation

#### 1 Collection Area (A<sub>c</sub>)

$$A_c = \frac{3.14 * h * h + 2(h * l)}{188.5}$$

#### 2 Probability of Being Struck (P)

$$P = \frac{A_c * N_g * 10^{-6}}{0.00035815}$$

#### 3 Overall weighing factor

a) Use of structure (A)	=	1.0
b) Type of construction (B)	=	0.4
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	=	$A * B * C * D * E$
	Wo	= 0.096

#### 4 Overall Risk Factor

Po	=	$P * Wo$
Po	=	3.43824E-05
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	=	$2(L+W)$	
	=	36	Mts.

#### 6 Down Conductors

Perimeter of building	=	36	Mts.
No. of down conductors based on perimeter	=	2	Nos.

Hence 2 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

Basis:

### Cable tray sizing

[illegible]



### Calculation

Maximum Cable Diameter:	29	mm
Consider Spare Capacity of Cable Tray:	30%	
Distance between each Cable:	0	mm
Calculated Width of Cable Tray:	384	mm
Calculated Area of Cable Tray:	11122	Sq.mm
No of Layer of Cables in Cable Tray:	2	
Selected No of Cable Tray:	1	Nos.
Selected Cable Tray Width:	300	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:	30000	Sq.mm

### Result

Selected Cable Tray width:	O.K	
Selected Cable Tray Depth:	O.K	
Selectrd Cable Tray Weight:	O.K	Including Spare Capacity
Selected Cable Tray Size:	O.K	Including Spare Capacity
Required Cable Tray Size:	300 x 100	mm
Required Nos of Cable Tray:	1	No
Required Cable Tray Weight:	90.00	Kg/Meter/Tray
Type of Cable Tray:	Ladder	
Cable Tray Width Area Remaning	36%	
Cable Tray Area Remaning:	63%	