AUTOMATIC CHANGEOVER WITH THREE-PHASE SUPPLY IN EDUCATIONAL INSTITUTION

Harsh Deep Singh[a], A Aakash[a], S Akash[a], R.Murugan[a]
Department of Electrical and Electronics Engineering,

KCG College of Technology, Karapakkam, Chennai-600 097, India

ABSTRACT

The process plants run 24/7 a year. Any disruption in the power supply can cause the process to halt, resulting in significant productivity loss and financial consequences. If the TANGEDCO main supply fails, the standby power should kick in without much delay. An Automatic Mains Failure (AMF) arrangement is necessary to satisfy this requirement, which automatically switches from utility to DG power in the event of utility power failure. An AMF arrangement was fabricated, wired up, interfaced with a laboratory three-phase alternator, and tested for various sequences as part of this project work. Interlocks and multiple operation sequences were also investigated in a real-time AMF circuit. The attached load information on the college campus was gathered, and the cable sizing was examined from the standpoint of generator activity. The generator was appropriately sized based on the load data obtained, the neutral arrangement was all checked, and proper sizing was arrived at to ensure stable operation of the Diesel Generator in standby mode of operation. The current continuous set mode of operation for DG sets with TANGEDCO supply is contrasted to the continuing HT conversion mode. Based on a comparative study, the economics of diesel consumption/TANGEDCO tariff is calculated. The proposed DG set's positioning has also been optimized for greater service stability to feed the campus loads without disruption and to ensure effective operation. The proposed DG set's location has also been optimized for greater versatility in service, to feed the campus loads without disruption and to ensure the DG set's efficient operation. The entire function of the DG set is examined, taking into account all factors such as AMF, economics, operational stability, and so on.

Key Words
–Generator, power supply, air circuit breaker, bus bar and automatic changeover

1. INTRODUCTION

We will develop and incorporate a system for automatic power supply switching in this project. In the case that TANGEDCO's primary supply fails, the waiting force can reach the line quickly and without human intervention. The power supply would be automatically configured to link the power source from its primary source to the standby source.A one-line diagram of the KCG compass was read. The connection details of the compass were measured, designing a switch to improve full utilization and efficient power distribution, a 625kVA generator can be installed and 250kVA and a 180kVA generator, as well as suggestions for loading information.

The key aim of this project is to illustrate the economic effect of Diesel Generators (DGs) diesel overload, reliability problems, lack of output stability, over-performance of Diesel Generators (DG) due to the negligent attitude of electricians, and when we build a solution to address such issues in many developing countries around the world. Our college ideas' complete study and structure. In this project, these important issues are tackled by designing an automatic change in the wait generator. In the event of a power outage, DG sets are currently switched on manually. To avoid wasting fuel, occupational electricians should switch off the DG at the same time when high power returns.

The majority of the time, this does not occur. Therefore the need for automatic modification of the stand-alone generator system for use. The aim of this project is to build an automatic switching circuit and a demonstration device based on the circuit design. When the supply of big pipes fails, the computer hardware in our project guarantees the engine switch is replaced. We used electric contactors, electric clocks, and relays to create a basic design for our work.

2. OBJECTIVE

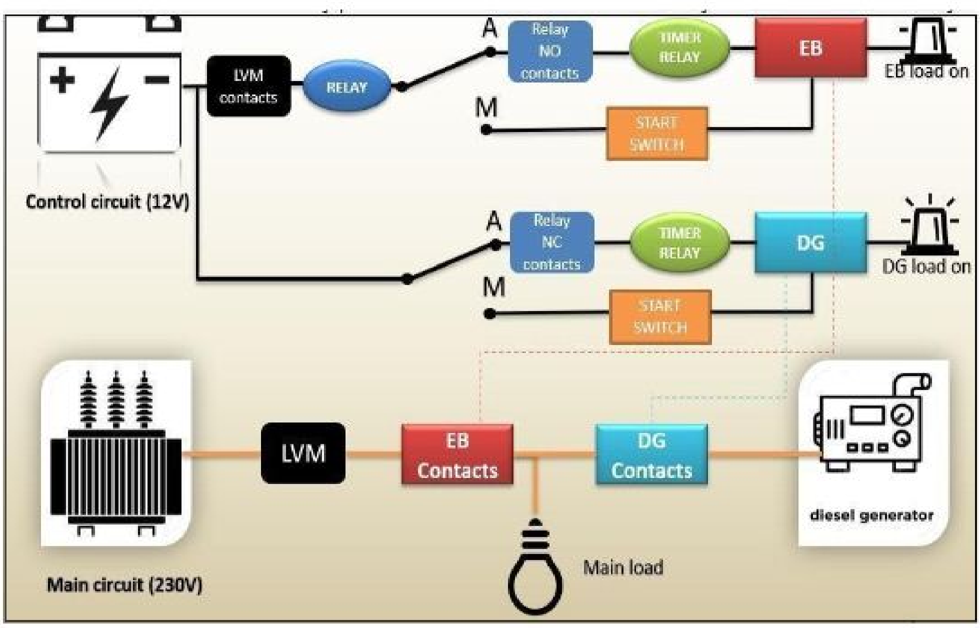
Thechiefintentionofthisproject workistominimizehumaninterventionsbyimplementing auto changeover to standby generator circuit & to give the costestimation of busbar andgenerator.

I. Human interventions are not necessary as the auto changeover tostandby generator automatically connects the load to source basedonthe mainsON/OFF condition.
II. The interruption delay caused due to mains failure is significantlyreducedwhichhelpsinrunningorganizedfunctionssmoothly.
III. TheAMFarrangementsreducesthefrequencyofmaintenancetobecarriedout.
IV. Compactsystemwhichfitsinasmallboardwillreducetheareausedandthusaccommodatemorespace forinstallingothercomponents.
V. Lowvoltagecircuitforcontrollinghighpowerswitchingreducesthepower consumption, as well as the harmonics induced because ofelectroniccomponents,areusedforswitching,thentheyactasa sourceforharmonics whichsignificantlyaffectsthepowerfactor.

Thus,by implementing this project laborsfor operatingcan be reducedandeffectivefault troubleshootingwiththehelpofSLDlayout.

3. FUNCTIONAL DETAIL

I. Block Diagram



Block Diagram Representation

The above block diagram shows the power flow diagram being executed in theproposedautochangeoversystemanditsexpansionoftheblocksisasfollows:

A. LowVoltageMonitoring(LVM)

The low voltage monitoring unit continuously checks for set input voltage fromthe mains. If the input value is less than the set value, then the control circuitautomaticallytriggersthechangeoverofload to thebackupgenerator.

B. ElectricityBoard(EB)

EB is the mains or input supply from TNEB (Tamil Nadu Electricity Board). EBintheaboveblockdiagramreferstotherelaythatcontrolstheEBsupplytoloadsand runson 12VDC.TheEBcontactscontrol ACsupply.

C. DieselGenerator(DG)

DG is the backup generator used in case of supply failure. The DG in the aboveblockdiagramreferstorelaythatcontrolstheDGON/OFFaswellasthecontactsofgeneratoroutputto load.

II. Power Sources

A. ACSupply

In comparison to direct current (DC), which only travels in one direction, alternating (current) is an electric current that constantly inverts its direction. Usually, these currents alternate at higher speeds than those found in power transmission.

B. Battery

The lead-acid battery is the first type of rechargeable battery, having been patented in 1859 by Gaston Plante who was a French Physicist. The cells' ability to produce powerful surge currents, despite their low power and energy-to-volume ratios, makes them ideal to be used in motor vehicles and provide the high current provided by car starter motors.Owing to their low cost relative to traditional technologies, lead-acid alloys are usually used although the surge is not significant along with other variants of greater energy concentrations are available. Large-format lead-acid designs are used in emergency power sources in cellular towers, rising environments such as laboratories, and hang power grids.In these applications, gel-cells and absorbed glass-mat batteries are used, and modified versions of the conventional battery can be used to extend storage times and lower maintenance costs.

B.1 BatterySpecification

Dimension	70*47*101(mm)
Weight	700gm
Dischargecurrent	4.5Ah
Dischargetime	20hours
Nominalvoltage	6V
Jacket	ABS container(Acrylonitrile ButadieneStyrene)

III. Control Unit

A. EB - DG Control Unit

Thecontrolcircuithasthefollowingthecomponents:

1. Relay
2. Timerrelay
3. Contactor
4. SPSTswitch
5. 3-wayswitch
6. LEDindicator

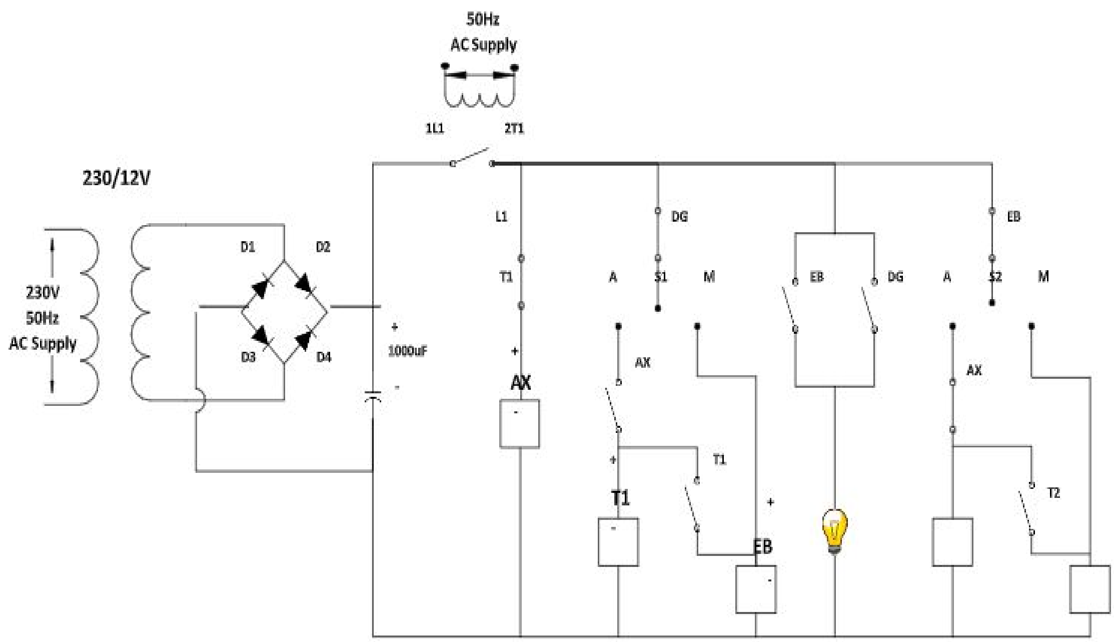


Fig. Control Circuit

D1, D2, D3, D4 - Diodes

AX - Auxiliary relay

A1 A2 L1 L2 - Contactors

DG - Generator Relay

EB - EB Relay

T1 - Timer Relay for EB Control Circuit

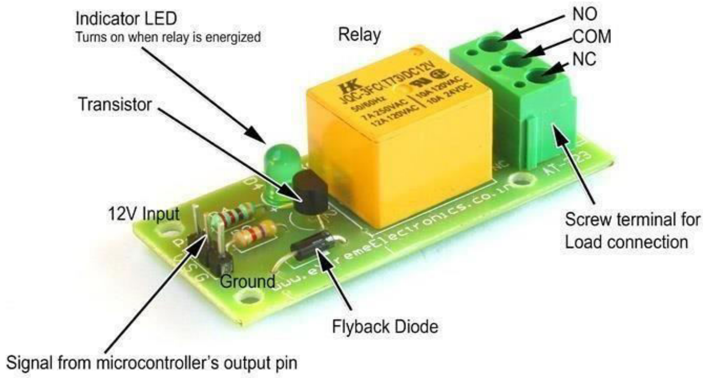
T2 - Timer Relay for DG Control Circuit

S1, S2 - 3-way Switches

A, M - Automatic, Manual

B. Relay

A relay is a switch that is regulated by electricity. Often relays use an electromagnet to mechanically control a switch, but solid-state relays and other operating concepts are also used. Relays are used where independent low-power signals are required to operate a circuit or where multiple circuits may be operated by a single signal.



B.1 Relay in "Normally Open" Condition

As enough power is supplied to the nucleus, it produces a magnetic space around it which behaves also as a magnet. Although the movable armature is beyond its radius, it is drawn to the magnetic space formed by the nucleus, causing the armature's direction to change. It's now wired to the return path typically open button, and the additional circuit attached to it works differently.

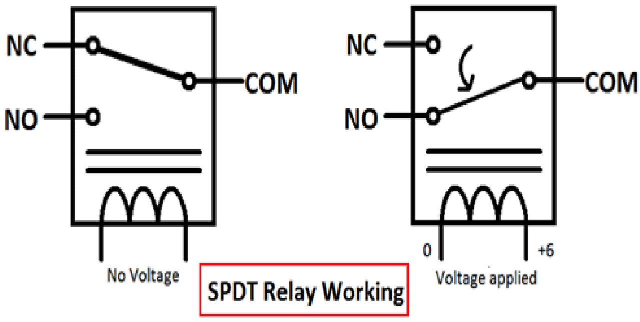


Fig. Illustrationofswitchingstatesbeforeandafterapplyingvoltage

C. Contactors

The contactor is a switch that is operated electrically and is used to switch an electrical power circuit. A 24-volt coil electromagnet operating a 230-volt motor switch is an example of a contactor operated by a circuit with a much-reduced power rate than that of the switched circuit.Contactors, unlike general-purpose relays, are intended to be wired directly to high-current load systems. Relays are commonly smaller in size and built for both electrically isolated and fully open applications. Contactors are devices that switch more than 15 amps or are used in circuits of more than a few kilowatts of power. A contactor is composed of 3 common components.The current-carrying component of the contactor is the contacts. Control connections, auxiliary contacts, and touch springs are also used. The electromagnet (or "coil") is responsible for closing the contacts.

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Fig. 230VContactor

A magnetic field is created as power passing via the electromagnet, which draws the contactor's travelling nucleus. The electromagnet coil absorbs more current at first, but when the metal core approaches the coil, its inductance increases. The rotating core propels the moving contact, while the electromagnet's power binds the moving and fixed contacts together.Pressure or perhaps a trigger moves the magnetic coil heart to its original location and activates the links as the contactor coil is de-energized.

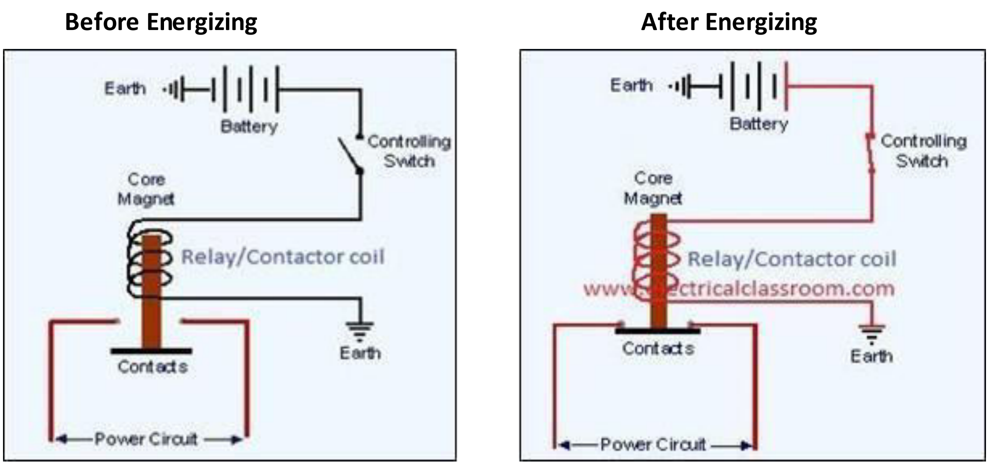
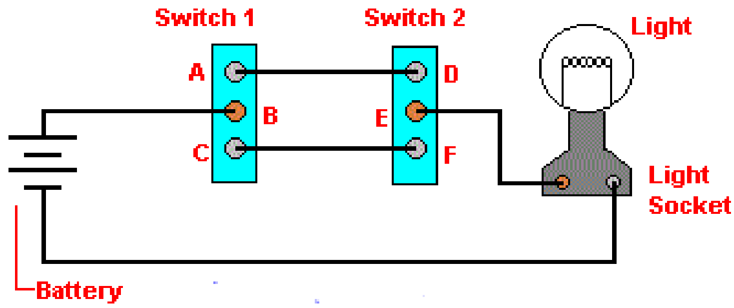


Fig. Illustration of wiring and working of contactor

D. 3-way Switch

One pole, dual throws (SPDT) turn is a standard "three-way" switch electrically. Disabling either switch changes the status of the load from an off to being on or vice versa if two of these switches are properly connected. For off, the switches can be arranged in the same direction, and for ON, they can be arranged in different orientations.



Switch (3-way) **Fig. 3-way Switch wiring diagram**

The switch toggle lever on a three-way switch decides the latching of theconnections connected inthecommonterminal.Ifthetogglelevelislefttorestinthemiddleposition,thenthecommonwon'tbeconnectedtoanyoftheterminals,resultingin the isolationoftheinputtotheswitch.Whenthetoggleleverispushedupordown,thelatchingterminalsgetconnectedor shorted accordingly and remains intact until its being pushed back to the neutralposition.

4. OVERALL SYSTEM DESIGN

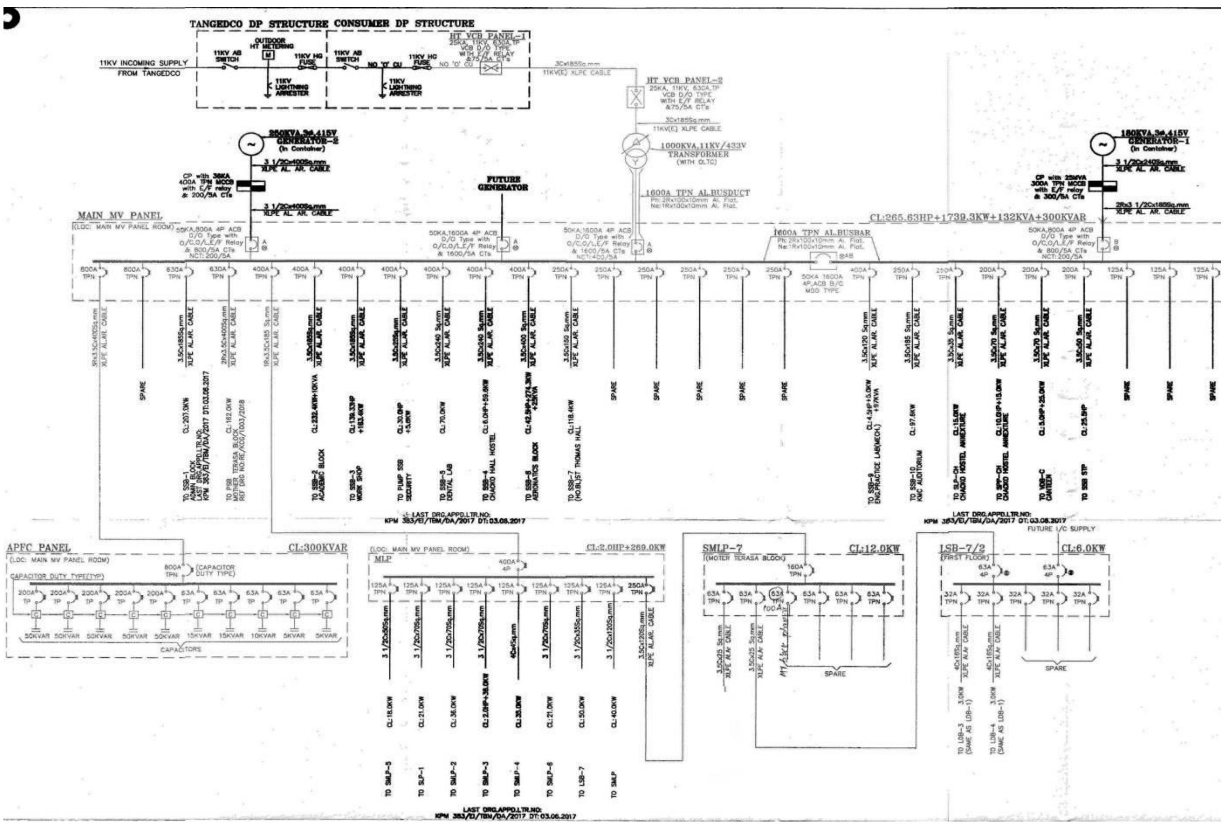


Fig. Single Line (SL) Diagram of KCG Campus

The subsystem is interested in providing energy to the field where the track is situated. The key purpose of the powerstation is to report higher electricity from the substation, reduce the intensity to an acceptable level for local delivery, and provide shifting facilities.

Transmission lines are divided into two categories. One being the traditional switching system, in which power grids are coupled in varied contexts and shifting stations convert AC to DC or vice versa, as well as amplitude between higher towards lower or lower towards higher.

The line outline simplifies the device and renders interpreting the electrical source and association easier. A one-line diagram, also known as a single-line diagram (SLD), is a condensed notation for describing a three-phase power grid in electrical power.

The single-line diagram is most often seen in load flow experiments. Circuit breakers and transformers are examples of electrical components.Only one conductor is represented, rather than each of the three phases being represented by a single line or terminal. It is a type of schematic that graphically depicts the power flow pathways between device nodes.

Although the components on the illustration do not reflect the actual scale or position of the electrical appliances, it is standard practice to arrange the diagram in the same left-to-right, top-to-bottom order as the switch-gear and perhaps other instruments. A depiction of conduit loops for a PLC control device at a substantial stage.

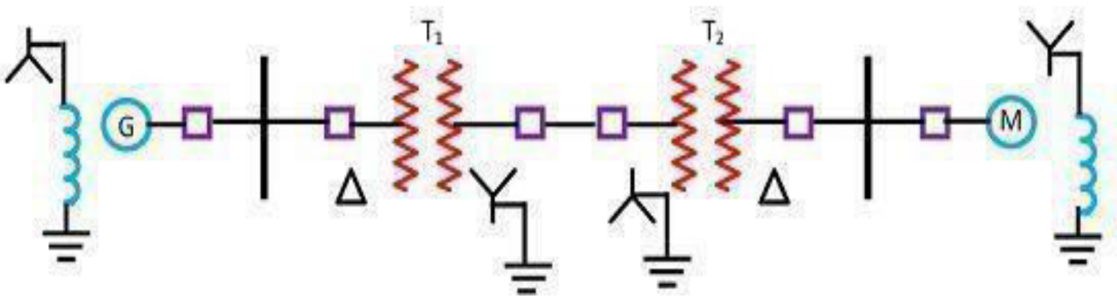


Fig. Single Line (SL) Representation of a typical power system

I. Design Implementation

Knowing the power of the generator to be used for the device is the first step in designing the change-over switch. As a result, a 220V/415V 15kVA generator with a power factor of 0.8 was selected. The rating of the contactors to be used, as well as the cable length, were calculated in the following study.

We Know That,

Cos θ = active power (Kw) / apparent power (KVA)
active power (P) = Cos θ * apparent power
Apparent power = 15 * 10^3 VA, Phase voltage (V_{ph}) = 220V, Cos θ = 0.8
Therefore,

Active Power (P) = 0.8 * 15 * 10^3 VA = 12000W or 12 kW,

Also,
P = $3V_{ph} I_{ph} Cos\theta$ (Power per Phase) => $I_{ph} = P/ 3V_{ph} Cos\ \theta$ = 12000 / 3 * 220 * 0.8 = 22.73 A
For increasedc efficacy, the tolerance is of -+25% is present.
Therefor,The rating of the contactor is taken as

= 22.73 + (25/100 *22.73) = 28.41 A

The current I_{ph} (22.73A)present per step deduced As a result, the cord ought to be able to carry about 1 1/2 times the current. In addition, the operational environment may play a part. A current of at least 1 amp should be carried by the appropriate cable.

= 22.73 + (1.5 * 22.73)
= 56.825 A ≈ 57A

The cord width ability to fulfill 57 A of current is**4nm**.

II. Simulation Models

To assess its viability, Automation Studio was used to simulate it. The following can be seen.

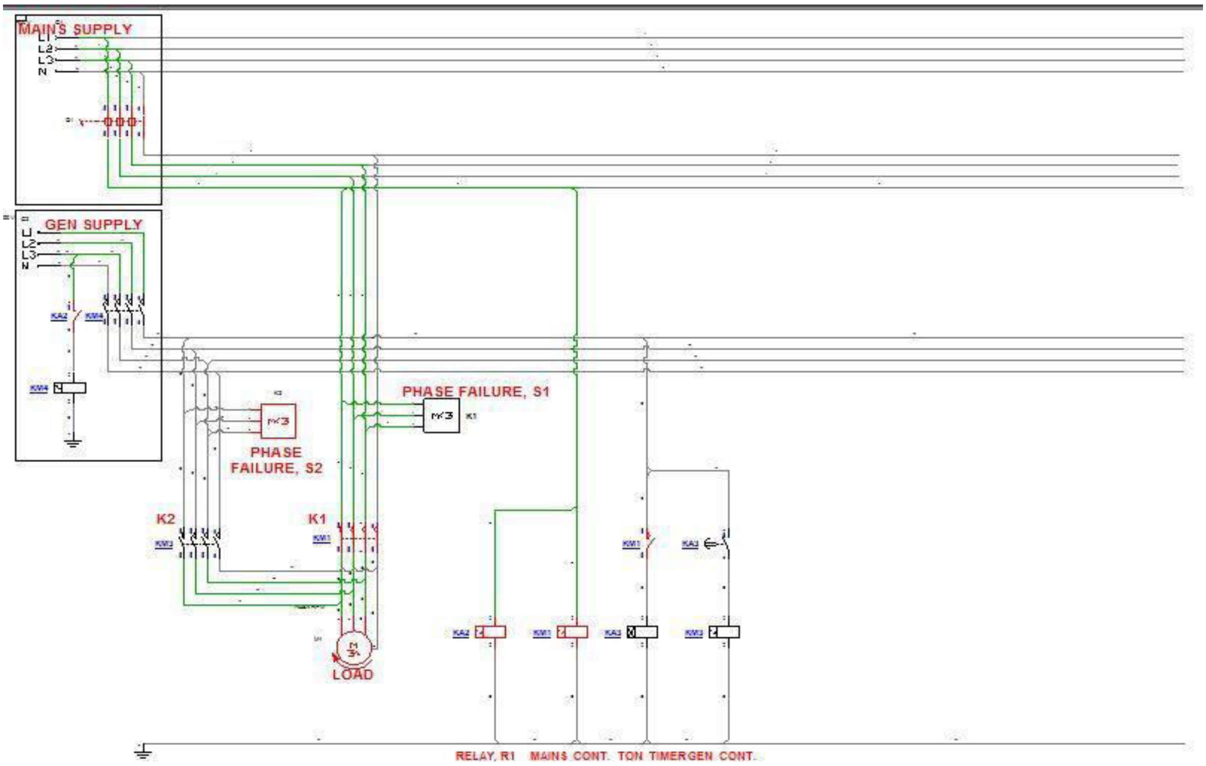


Fig. Simulation Model of Mains Supply ON and Generator in the OFF Position

The system was powered after all of the components were properly connected, and it performed as intended. The generator was made to remain in the OFF role by the machine while electricity was supplied from a centralized repository. When there was a blackout or fault on the public grid, the engine immediately turned on.

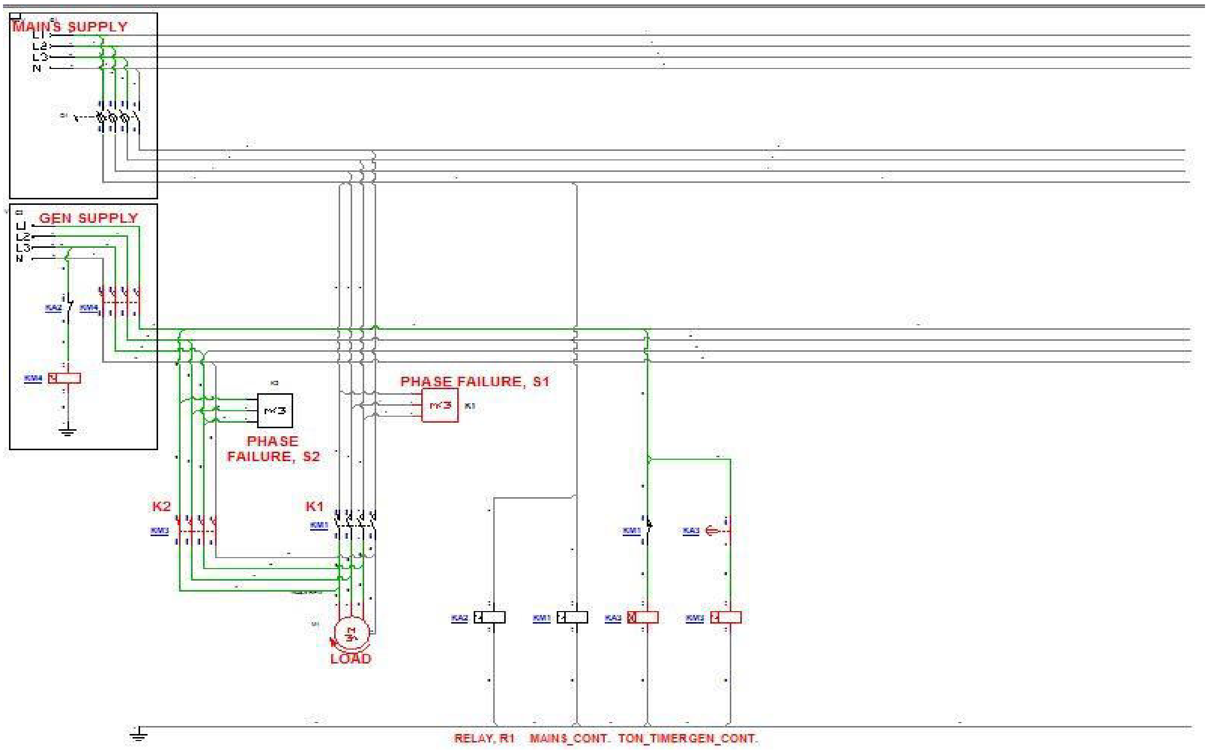


Fig. Where the mains supply fails and a generator is used and simulation model formulated

III. Auto Operation Mode (Design Testing)

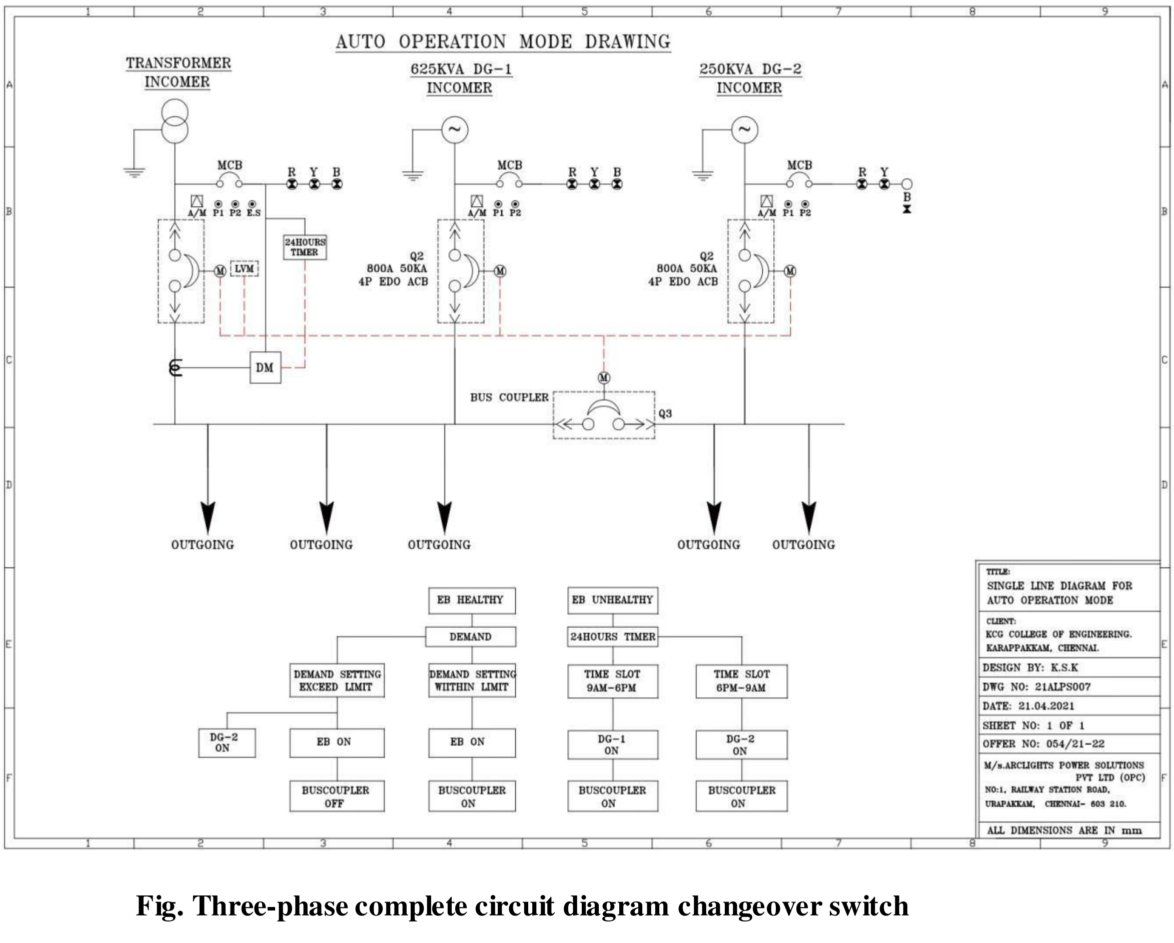


Fig. Three-phase complete circuit diagram changeover switch

5. DESIGN CONSIDERATIONS

I. Feeder Load Details

FeederNumber	Location	Switch	Cable coreanddimensions(insq.mm)	ConnectedloadinkW	ConnectedLoad for0.8pF (inkVA)
1	APFC Panel	800A,TPN,MCCB	2R, 3.5CX400 sq.mm	-	-
2	MTBlock	630A,TPN,MCCB	2R, 3.5CX400 sq.mm	64	80
3	AcademicBlock(EEE,ECE, IT)	400A,TPN,MCCB	1R, 3.5CX185 sq.mm	144	180
4	Aeronautical Block	400A,TPN,MCCB	1R, 3.5CX400 sq.mm	277.85	347.3125
5	Workshop(MECH,EIE)	400A,TPN,MCCB	1R, 3.5CX185 sq.mm	446.4	558.25
6	ChackoHallHostel	250A,TPN,MCCB	1R, 3.5CX185 sq.mm	21.21	26.5125
7	AdminBlock(CSE,LIBRARY)	400A,TPN,MCCB	1R, 3.5CX185 sq.mm	143.2	179
8	ST. ThomasHall	250A,TPN,MCCB	1R, 3.5CX150 sq.mm	55.11	68.8587

9	KMC Auditorium	250A,TPN,MCCB	1R, 3.5CX185 sq.mm	-	-
10	EPLLab	250A,TPN,MCCB	1R, 3.5CX120 sq.mm	108.59	135.7375
11	MainLighting Panel	400A,TPN,MCCB	1R, 3.5CX400 sq.mm	-	-
12	PowerHouse FFPower	200A,TPN,MCCB	1R, 3.5C X25 sq.mm	20	25
13	ChackoHostelAnnex	200A,TPN,MCCB	1R, 3.5C X70 sq.mm	22.43	28.0375
14	To MainGate	125A,TPN,MCCB	1R, 3.5C X50 sq.mm	35.63	44.5375
15	SewageTreatmentPanel	125A,TPN,MCCB	1R, 3.5C X50 sq.mm	-	-
16	Canteen	125A,TPN,MCCB	1R, 3.5C X35 sq.mm	13.32	16.65

II. MV Panel Readings on Peak Load Day

Source	**Time**	**Voltage(V)**			**Current(A)**			**pF**	**kW**	**kVA**
		R	**Y**	**B**	**R**	**Y**	**B**			

DG1	8:50	404	404	404	209	189	169	0.96	113.7	119.6
DG2	8:50	407	402	415	34	148	153.4	0.88	67.1	75.6
DG1	9:30	404	403	403	200	180	164	0.41	129	38.5
DG2	9:30	407	402	414	40	150.1	148.1	0.88	10.8	37.42
EB	10:00	406	406	406	177	158	123	0.94	100.6	106.9
DG2	10:00	407	402	416	35	155.8	148.3	0.88	70.3	79.4
EB	10:30	404	403	403	169	144	134	0.95	93.8	98.7
DG2	10:30	407	402	413	52	153	153	0.86	74.2	84.3
EB	11:00	403	402	402	236	177	167	0.9	111	119
DG2	11:00	407	401	411	57	137	158	0.87	71	82
EB	11:30	403	401	401	258	193	186	0.96	141	148
DG2	11:30	408	402	412	47	122	143	0.86	63	73
EB	12:00	403	402	402	270	190	211	0,93	142.3	158.7
DG2	12:00	408	408	412	41	118.4	139.4	0.88	60.8	69.9

EB	12:30	403	402	402	208	142	144	0.85	104	122
DG2	12:30	407	401	412	60	141.6	165.3	0.89	78.5	74.3
EB	13:00	407	407	406	226	181	136	0.92	134.8	144.3
DG2	13:00	407	402	412	58	144.2	155.7	0.88	73.3	83.5
EB	13:30	409	408	408	190	113	102	0.94	92	98
DG2	13:30	407	403	412	55	144	148	0.88	72	81
EB	14:30	405	404	404	213	154	162	0.90	110.9	120.4
DG2	14:30	407	401	411	57	129.1	151.1	0.88	69.8	79.1
EB	15:00	404	403	403	212	145	164	0.91	112.7	123.7
DG2	15:00	408	401	412	44	116.5	148.5	0.87	63.1	71.9
EB	15:30	405	405	405	149	106.1	108.5	0.94	87.3	92.2
DG2	15:30	407	403	413	39	134.9	144.6	0.88	66.3	74.5
EB	16:00	404	404	404	190	155.3	154.4	0.95	111.4	35.6
DG2	16:00	408	402	412	39	119.4	143.8	0.87	60.8	69.7

III. Suggested Load Details For Each DGs

180kVADG	250kVADG	625kVADG
APFCPanel	APFCPanel	APFCPanel
		MTBlock
		AeronauticalBlock
		Workshop(MECH,EIE)
	AcademicBlock (EEE,ECE,IT)	ChackoHallHostel
EntireLightingLoad ofKCGCampus		ST.ThomasHall
		KMCAuditorium
	AdminBlock (CSE,Library)	EPLLab
		PowerHouse
		Chacko HostelAnnex
		Canteen

IV. Implemented System Setup

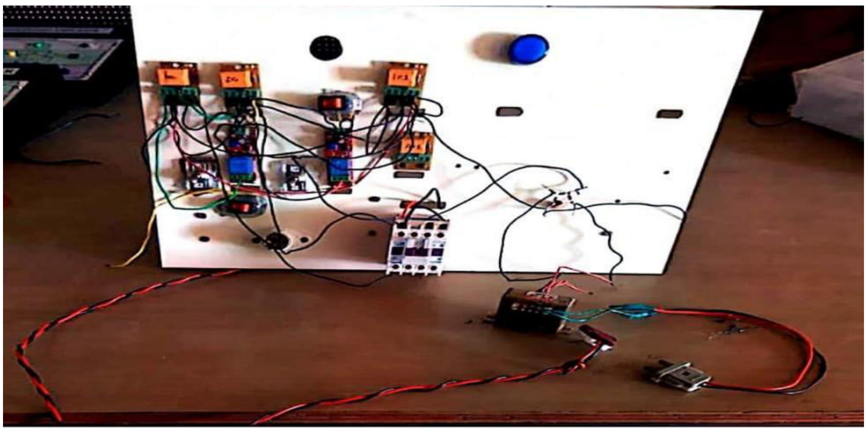


Fig. Automatic Changeover to Standby Generator Panel

6. CONCLUSION

This project work is vital in ensuring expertise and broad specific information to better understand the economics of DG operation, the sizing of DG sets fordefined operating conditions, and the specifications of AMF operation, among other things.Thus, the main objective of the Automatic changeover is to make the switches fully automatic without time delay and to eliminate human interventions for maintenance and monitoring is completed by implementation of the changeover panel which switches between the sources for an uninterrupted power supply. The Complete connected load details of KCG power layout is calculated to design the changeover switch. To enhance the overall consumption and to increase the efficiency we suggest the distribution of power efficiently and the loads are shared among the three Diesel Generators namely 180kVA, 250kVA and 625kVA respectively, and the auto changeover to standby generator circuit prototype has been built successfully.

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