Short Circuit Analysis of 66/11 kV Distribution

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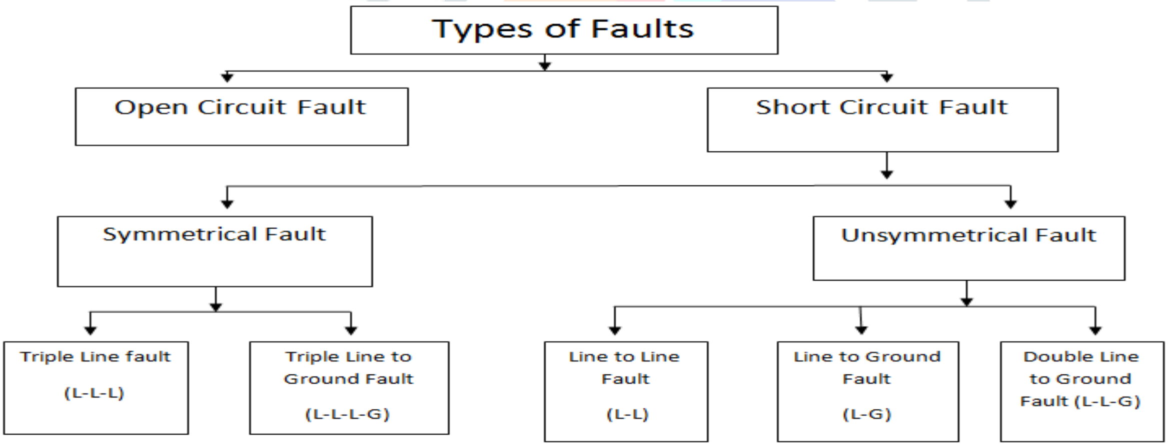
Abstract: The objective of the present study is to stimulate short circuit faults on different buses of a power system network and to estimate the state of the power system before and after fault, which includes various bus voltages and current flow on various transmission lines. The analysis of the power system under faulty conditions is important to determine the values of the system voltages and current during faulted conditions, so that protective devices may be set to minimize the harmful effects of such contingencies.

INDEX TERMS – SHORT CIRCUIT ANALYSIS, TYPES OF FAULT, MI-POWER SOFTWARE SIMULATION

I. INTRODUCTION

A Fault is defined as any failure which interferes with the normal current flow. All our power system is well adjusted with three phase Alternating Current. If any fault occurred, then our power system becomes unbalanced internally and externally. So when insulation of the power system fails, that time the conducting object comes in contact to the live parts of the power system which leads to Short Circuit analysis. Due to this situation the fault current levels increases in power system.

Types of Faults



SHORT CIRCUIT

It is used for the steady state determination of linear network with help of three phase balanced excitation. Short Circuit is phenomena when low resistance connection is build by two points in an electric circuit.

1) SYMMETRICAL FAULT

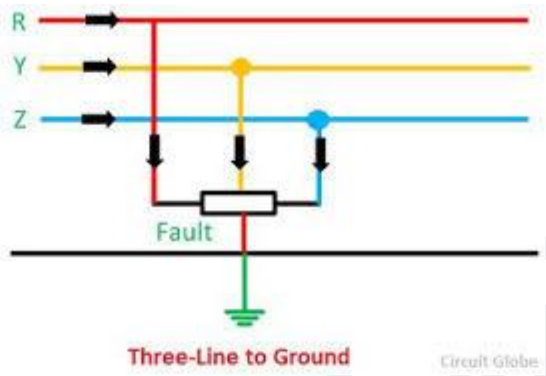
It is also known as Balanced Fault and are mainly classified as Triple Line fault (L-L-L) and Triple Line to Ground Fault (L-L-L-G). In this current and voltage is same in the lines.

1.1) TRIPLE LINE FAULT (L-L-L) FAULT

This type of fault are rarely generate in power system. In this type of fault a current level is maximum in the power system. Mainly this type of fault are generate at the generator side .A three phase lines are required to fault generation. Fault generation possibilities is 10 to 20% in the power system. Current relationship and as well as voltage relationship are same in three phase.

1.2) TRIPLE LINE TO GROUND FAULT (L-L-L-G)

This type of fault are rarely generate in power system. Fault generation possibilities is 8 to 10% in the power system .During this fault three lines are connect to ground and also magnitude are same on three phase lines. . In this type of fault a current level is maximum in the power system .During a fault phase angle 120 degree each.

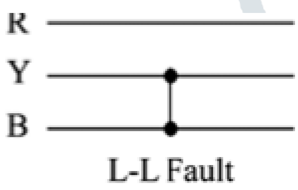


2) UNSYMMETRICAL FAULT

It is also known as Unbalanced Fault since there occurrence cause unbalanced in the system. They are mainly classified as Line to Line fault (L-L), Line to Ground Fault (L-G) and Double Line to Ground (L-L-G). In this current and voltage are different.

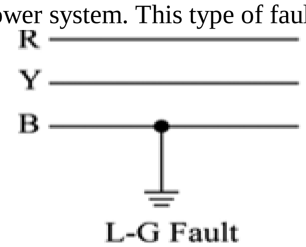
2.1) DOUBLE LINE FAULT (L-L)

A fault generate between two lines that's why is called double line fault. The current value is less compare to symmetrical fault. This type of fault is a unbalance fault. Fault generation possibilities are 15 to 20% in the power system.



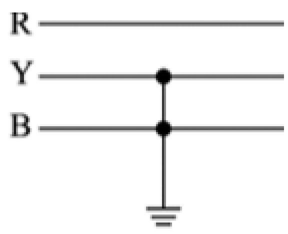
2.2) LINE TO GROUND FAULT (L-G)

This type of fault are maximum generate in a power system. . In this type of fault a current level is minimum in the power system. This type of fault is unbalance fault. Fault generation possibilities is 75 to 80% in power system.



2.3) Double Line To Ground Fault (L-L-G)

A fault generate between two lines that's why is called double line type fault. The current value is less compare to symmetrical type fault. This type of fault is unbalance because during a fault each lines current are different. Fault generation possibilities is 15 to 20% in the power system.



L-L-G Fault

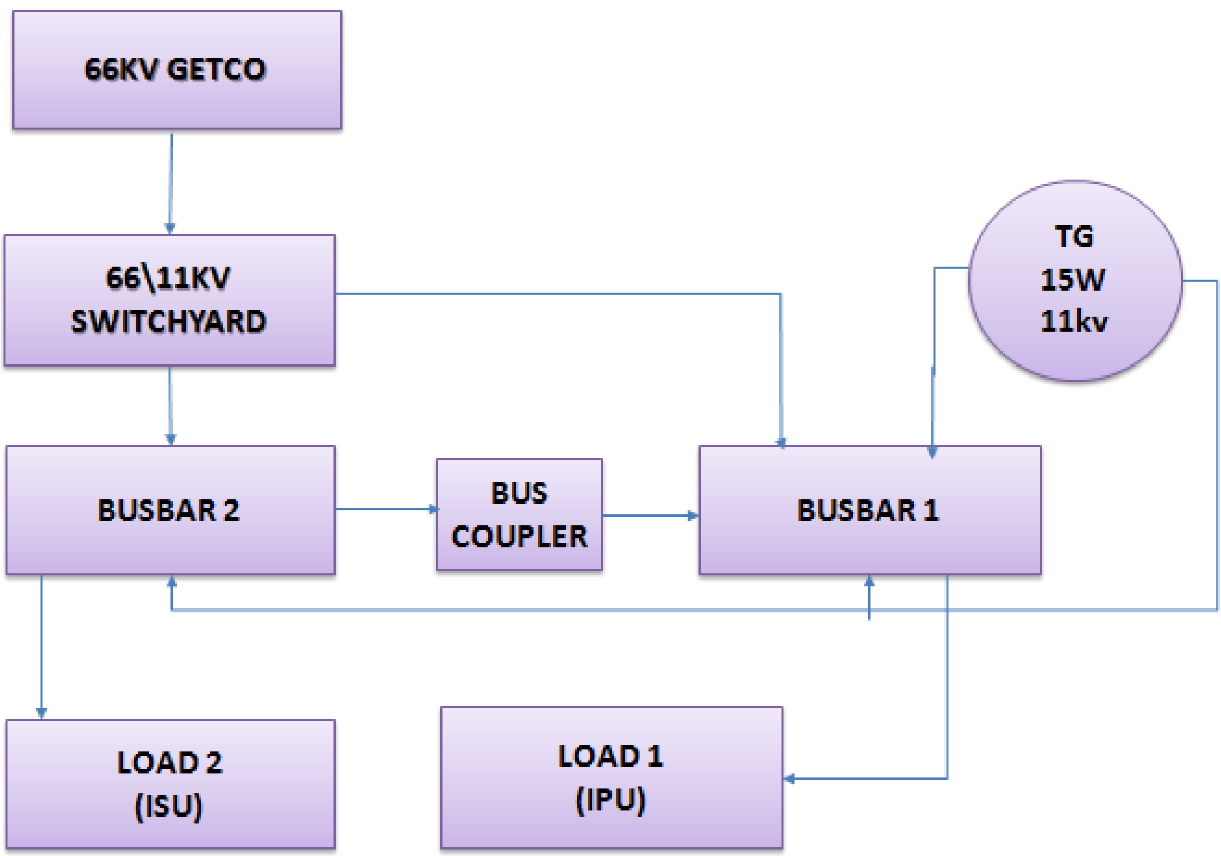
3) Causes of Fault Generation

These are due to Heavy winds, Vehicles colliding with towers or poles, Aircraft colliding with lines, Small animals entering switchgear, Line breaks due to excessive loading and Mechanical causes is over heating.

II . SHORT CIRCUIT ANALYSIS

A fault generation is irregular terms in a power system. A power system is working on well-adjusted 3 phase alternating current. During a fault our insulating material strength down and current direction of power system is change. If any faults is discovered then our power system becomes unbalanced internally and externally as well. So when insulation of the power system fails, that time the conducting object comes in contact to the live parts of the power system which leads to Short Circuit analysis. Due to this situation the fault current levels increases in power system. We want to the protecting a power system under the fault conditions so that's why important of short circuit analysis. In a short circuit analysis, the protective devices can be set to detect and minimize the harmful effect of the system. From the short circuit analysis report we can identify the circuit breaker rating and Relay coordination which is useful for the stability and protection of the power system. So Basic purpose of short circuit analysis is protection of power system.

66/11 KV DISTRIBUTION SYSTEM OF ET(ELECTROTHERM INDIA LTD.



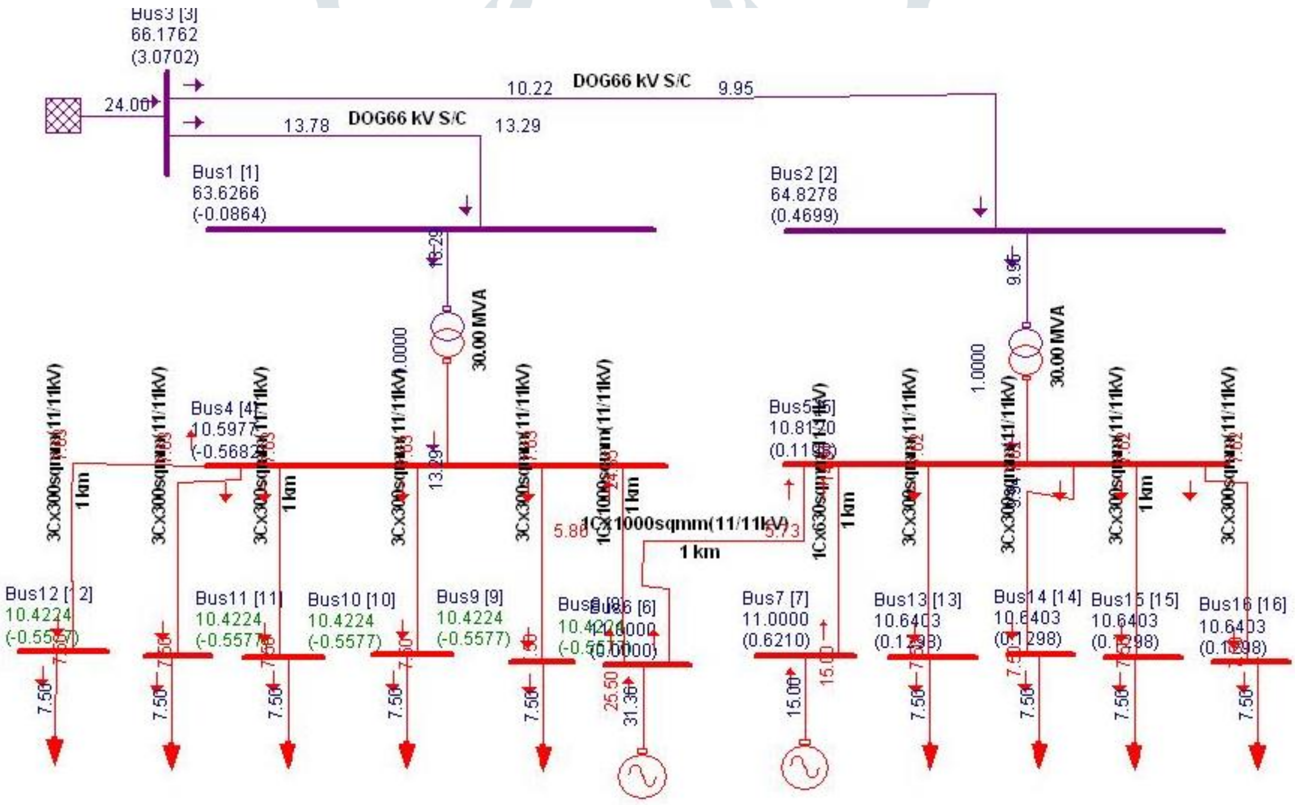
Block Diagram

In our system there are two units ISU (Integrated Steel Unit) and IPU (Integrated Pipe Unit) both units are connected with the substation which supply Power. Substation consist BUS-1 and BUS-2. Both the buses are connected by bus coupler. In these case faults occur in BUS-1 then supply can be provided with the help of BUS-2 or vice versa. Electrotherm has its own Power plant which is known as Captive power plant, one is 30 MW and another one of 15 MW. Both the power plant produces power which is supplied to the substation by transmission line. Here 30 MW CPP is connected to BUS-1 and BUS-2 and 15 MW is connected to BUS-2.There is an alternative source of power which we received from GETCO Station. The supply from the Samakhiyari substation is 66KV which is step down from 66kv to 11kv with the help of Transformer 1 and Transformer 2. In present time the 30 MW CPP is in workingconditionand15MWCPPispurposed.Powerisgeneratedfrom30MWCPPandsuppliedto11KVBuslinewiththe helpof transmission line. Here in the system 2 buses areconnected to ISU and IPU where total system is synchronized. If any fault occur or demand increase then further power will collect from the GETCO Station.

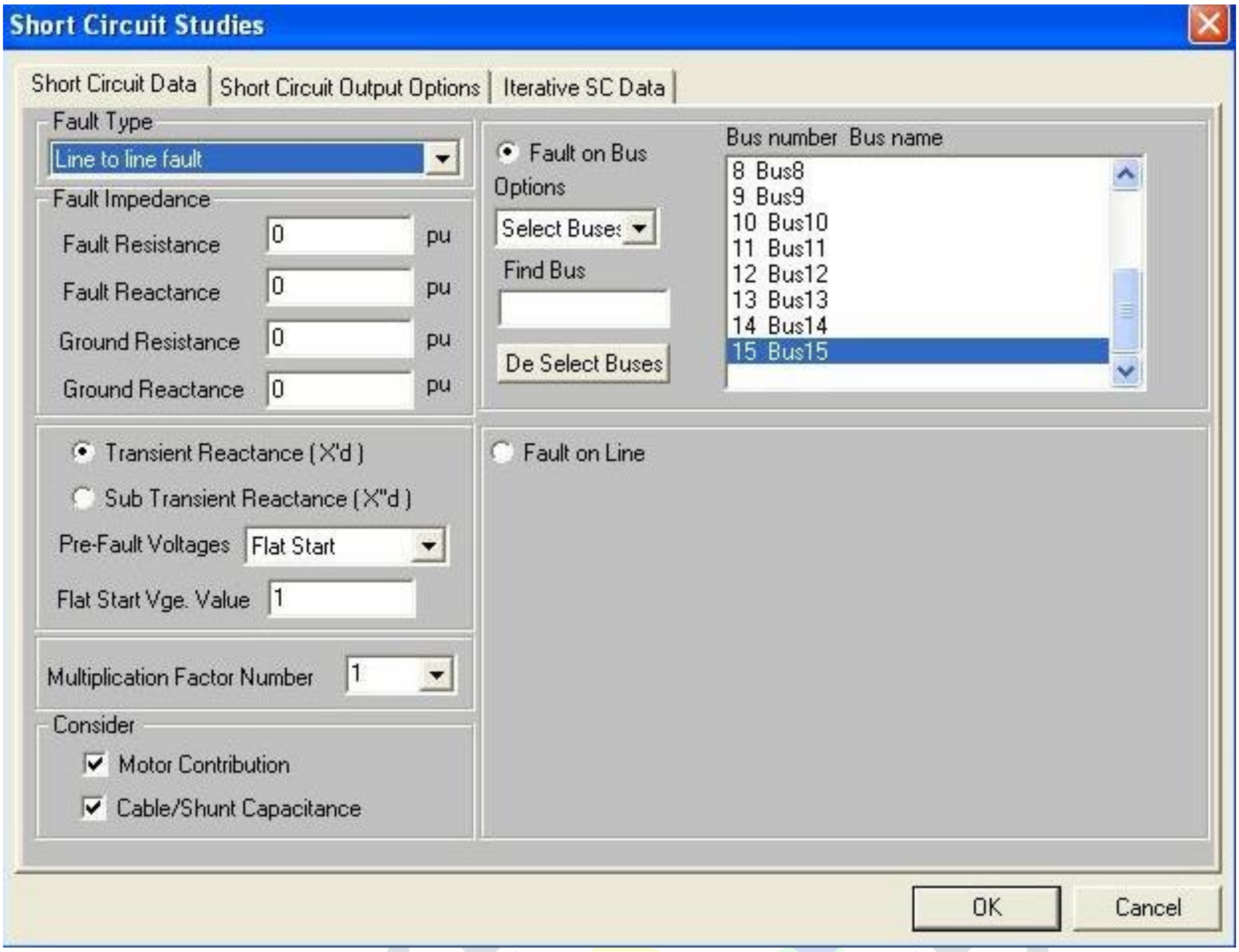
Input Parameters of System

1) Actual number of buses: 16
2) Number of transmission line: 14
2) Number of two winding transformer: 2
4) Number of Generator: 2

III. Simulation in MI-Power



IV. Short Circuit Analysis Window in MI Power



V. Result File of LL Type Fault

```
|~~~~~OUTPUT RESULTS~~~~~|
%-----------------------------------------------------------------------------------------------------------
|*****Case Number : 1*****|
LL FAULT ON    BUS.12 : NAME     Bus12
        CURRENT (AMP/DEGREE)                         MVA
 SEQUENCE (1,2,0)      PHASE (A,B,C)       SEQUENCE (1,2,0) PHASE (A,B,C)
   A         deg          A          deg           MVA              MVA
--------- --------   --------- --------   ---------------- ------------
 8199.646  -55.532        0.000    0.000            156.224        0.000
 8199.646  124.468    14202.204 -145.532            156.224      270.588
    0.000    0.000    14202.204   34.468              0.000      270.588
%-----------------------------------------------------------------------------------------------------------
|*****FAULT CONTRIBUTIONS FROM TRANSMISSION LINE*****|
UID                  FROM         FROM          TO          TO                 CURRENT                                  FAULT MVA
                     BUS          BUSNAME       BUS         BUSNAME        SEQUENCE(1,2,0)        PHASE(A,B,C)          PHASE(A,B,C)
                                                                          A            deg       A           deg           MVA
-----------       ----------- -----------    ----------- -----------   --------- --------   --------- --------    ------------
LIN.14            BUS.12       Bus12         BUS.4       Bus4          8199.878  124.467       0.280    90.000        0.005
                                                                       8199.646  -55.532    14202.325   34.467       270.591
                                                                          0.000    0.000    14202.484 -145.532       270.594
|*****BUS FAULT SUMMARY*****|
 Bus Number    Bus Name       Rated                   LL
                           Voltage(kV)      MVA      | Current(kA)
------------ ------------ ------------ ------------ ------------
BUS.12        Bus12           11.000      270.588        14.202
%-------------------------------------------------------------------------------------
```

VI. Result File of LLLG type Fault

```
|~~~~~OUTPUT RESULTS~~~~~|
%--------------------------------------------------------------------------------------------------------------------------------
|*****Case Number : 1*****|
.LLG FAULT ON    BUS.11 : NAME     Bus11
        CURRENT (AMP/DEGREE)                            MVA
 SEQUENCE (1,2,0)      PHASE (A,B,C)        SEQUENCE (1,2,0) PHASE (A,B,C)
   A          deg         A          deg              MVA              MVA
--------- --------    --------- --------    ---------------- ------------
16144.552  -55.767    16144.552  -55.767             307.595       307.595
    0.000    0.000    16144.552 -175.767               0.000       307.595
    0.000    0.000    16144.552   64.233               0.000       307.595
%--------------------------------------------------------------------------------------------------------------------------------
? / X OF THE SHORT CIRCUIT PATH          : 0.680
Time Constant                            : 0.00468s
?EAK ASYMMETRICAL SHORT-CIRCUIT CURRENT : 26240.04720A
?ASCC = k * sqrt(2) * If , k = 1.14927
%--------------------------------------------------------------------------------------------------------------------------------
|*****FAULT CONTRIBUTIONS FROM TRANSMISSION LINE*****|
JID                FROM         FROM          TO         TO                  CURRENT                                    FAULT MVA
                   BUS          BUSNAME       BUS        BUSNAME        SEQUENCE(1,2,0)        PHASE(A,B,C)            PHASE(A,B,C)
                                                                       A          deg          A          deg              MVA
------------    ------------ ------------  ------------ ------------  --------- --------   --------- --------   ------------
.IN.13          BUS.11       Bus11         BUS.4        Bus4          16144.784  124.233   16144.784  124.233     307.599
                                                                          0.000    0.000   16144.784    4.233     307.599
                                                                          0.000    0.000   16144.784 -115.767     307.599

|*****BUS FAULT SUMMARY*****|
 Bus Number   Bus Name      Rated                    LLLG
                          Voltage(kV)      MVA      | Current(kA)
------------ ------------ ------------ ------------ ------------
BUS.11       Bus11             11.000      307.595       16.145
```

VII. Different Type of Faults

FAULT	BUS	RATED VOLTAGE(KV)	MVA	CURRENT (kA)
LLLG	BUS11	11	270.588	16.145
LLG	BUS14	11	370.818	19.463
LL	BUS13	11	310.355	14.202
SLG	BUS15	11	312.235	16.388

From this we can analyzed that our system has 19.463 kA fault current in case of LLG and 14.202kA fault current in case of LL.

VIII. CONCLUSION

From this we can conclude that it is important to determine the value of the system voltage and current during various fault conditions. So the protective devices can be set to detect and minimize the harmful effect of the system. From this report we can identify the Circuit Breaker Rating and Relay coordination which is useful for the stability and protection of the power system.

IX. REFERENCES

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