Exp - 06	Short Circuit Fault Analysis

Aim:

To become familiar with modelling and analysis of power system under faulted condition to compare fault level post fault voltage and current for different type of faults both symmetric

Apparatus Required:

SI.No	Apparatus	Specification
1	PC	Dual core, RAM 512 MB 1.2 GHz speed, 80 GB
2	MATLAB	7.5

Theory:

When a fault occurs in a power system network, the current flowing is determined by the internal emf of the machines in the system, by their internal impedances and by impedances in the network between the machines and the fault. When the fault current is equal in all the phases, the fault is called symmetrical fault. The fault current will be symmetrical only in 3Φ faults in which all the 3Φ are shunted to ground.

The symmetrical fault can be analyzed on per phase basis using reactance diagram or by using per unit reactance diagram. The symmetrical fault analysis as to be performed separately for subtransient, transient and steady state condition of the fault, because the reactances and internal emfs of synchronous machines will be differ-ent in each state.

In symmetrical fault analysis, the reactance diagram of the power system is formed using the information in single line diagram. For estimation of subtrasient fault current, the synchronous machine is represented by its subtransients internal emf in series with subtransients reactance.

1. Symmetrical Fault :

Three phase fault :

From the thevenin's equivalent circuit

$$\text{Fault current If } = \frac{\text{Vth}}{\text{Z th}}$$

Where Vth = Thevenin's Voltage

Z th = Thevenin's Impedance

2. Unsymmetrical Fault :

Single line to ground fault :

Fault current If = Ia = 3Ia1

$$Ia1 = \frac{Ea}{Z_1 + Z_2 + Z_0}$$

Line to line fault:

Fault current If = Ia1(a^2 – a)

$$Ia1 = \frac{Ea}{Z_1}$$

Double Line to ground fault :

Fault current If = 2 Ia0 +(Ia1+ Ia2) (a^2 + a)

$$Ia1 = \frac{Ea}{Z_1 + Z_0 Z_2}$$

$$Ia2 = \frac{(-Ia1) * Z0}{Z_0 + Z_2}$$

Ia0 = -(Ia_1 - Ia_2)

Fault MVA = □3 * If * Vpu

where, Ia1, Ia2 and Ia0 are positive, negative and zero phase sequence currents

Z1 ,Z2 and Zo are positive, negative and zero phase sequence impedances

Algorithm:

Step1: Start the program

Step2: Set the generator data, transformer data, line data, default voltage V=1,base voltage and base MVA

Step3: Equivalent positive, negative zero sequence impedance are calculated

Step4: Get type of fault

Step5: Calculate fault current & fault MVA corresponding to the type of fault

Step6: display the output

Step7: stop the program

Program:

```
clc;
clear all;
g1=[.2j .2j .04j .5j];
g2=g1;
t1=[.08j .08j .08j 0];
t2=t1;
l1=[.15j .15j .5j];
l2=l1;
v=1;
sysv=20;
bmva=100;
a0=(l1(1)*l2(1))/(l1(1)+l2(1));
a1=(l1(3)*l2(3))/(l1(3)+l2(3));
b=3*g1(4)+g1(3);
z0=((t1(3)+b+a1+t2(3))*b)/(t1(3)+b+a1+t2(3)+b);
z1=((g1(1)+t1(1)+a0+t2(1))*g2(1))/(g1(1)+t1(1)+a0+t2(1)+g2(1));
z2=z1;
A=menu('enter the type of fault','symmetrical fault','L-G fault','L-L fault','L-L-G fault');
ib=bmva/(sqrt(3)*sysv);
a=1*cosd(120)+1*sind(120)*j;
if A==1
   ifpu=v/z1;
   ifa1=ifpu*ib;
elseif A==2
   ia1=v/(z0+z1+z2);
   ifpu=3*ia1;
   ifa1=ifpu*ib;
elseif A==3
   ia1=v/(z1+z2);
   ia2=-ia1;
   ib0=(a*a*ia1)+(a*ia2);
   ifa1=abs(ib0)*ib;
elseif A==4
   z=(z0*z2)/(z0+z2);
   ia1=v/(z+z1);
   ia2=(-v/z2)+((ia1*z1)/z2);
   ia0=-(ia1+ia2);
   ib1=ia0+(a*a*ia1)+(a*ia2);
   ic1=ia0+(a*ia1)+(a*a*ia2);
   ifpu=ib1+ic1;
   ifa1=ifpu*ib;
end
ifa1=abs(ifa1);
fmva=sqrt(3)*sysv*ifa1;
fprintf('fault current %d KA\n',ifa1);
fprintf('fault MVA is %d MVA \n',fmva);
```

Result: