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Short Circuit Analysis on 400 Kv Sub-Station Soja

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Abstract:- A Short Circuit analysis is used to determine the magnitude of short circuit current. To demonstrate its use, a simple 19-bus system was selected as a example of 400kV SOJA substation.

Keywords:- Fault current, short circuit

I. INTRODUCTION

The reliability of power supply implies much more than merely being available. Short circuit studies and hence the fault analysis are very important for the power system studies since they provide data such as voltages and currents during and after the various types of faults which are necessary in designing the protective schemes of the power system. Current that flows in the power system components just after the occurrence of faults, that flows a few cycles later and the steady state value (i.e. sustained value of) fault currents differ very much from each other. Protective scheme, basically consists of protective relays and switch gears such as circuit breakers etc.

There are different types of faults in the power system which can broadly be divided into symmetrical and unsymmetrical faults [4]. The currents and voltages resulting from various types of faults occurring at different locations throughout the power system network must be calculated in order to provide sufficient data for designing the protective scheme [1].

II. OBJECTIVE

As electrical utilities grow in size the number of interconnections increased, planning for future expansion going to be complex. In the paper circuit analysis has been carried out using Mi-power software on 400 kV soja substation.

III. SHORT CIRCUIT STUDY

Short circuit studies are very important from the operating and planning points of view. Abnormal conditions can arise in a power system owing to short circuits between two phases, or a line snapping and making contact with ground or a lightning stroke hitting a particular transmission line. These give rise to heavy current in the system. Before these current can do any damage to equipments such as expensive generator and transformer, the faulty parts of the transmission system must be isolated [5]. This is done by circuit breakers actuated through sensing relays hence, the determination of the interrupting duties of circuit breaker as well as relay setting is needed. This information can be easily calculated if we know the current in the system on the occurrence of a fault such investigation are termed as short circuit studies. Consequently, the short circuit studies become essentially a linear network problem since the generator will be represented by means of a voltage source in series with a reactance (generally the transient or sub transient reactance).

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Certain Assumptions Will Be Made:
[1] The generated e.m.f. system is of positive sequence only.
[2] The impedance of the fault is zero.
[3] Any one phase shall be taken as the reference phase.

IV. VARIOUS TYPE OF FAULTS

1. Line to ground fault (L-G)
2. Line to line fault (L-L)
3. Double line to ground fault (L-L-G)

4. Three phase to ground fault(L-L-L-G)

V. AN INTRODUCTION ABOUT 400KV S/S SOJA

The Gujarat Energy Transmission Corporation has established a 400kV SOJA sub-station it is 1.5km between from Gojariya- Gandhinagar highway.

The incoming line of 400kV at Soja s/s is from Wanakbori and PGCIL 400kV s/s which is single circuit type transmission line. The tower required for eraction of 400kV transmission line which is coming from Wanakbori and PGCIL s/s are of three type i.e., A, type C and type D tower. The total number of tower required between Wanakbori & PGCIL and soja s/s is 412. The line has charged since 28th January 1987.In single line diagram two incoming lines from Wanakbori and PGCIL of 400kV, and two incoming line from Gandhinagar of 220kV.

Figure-1 Single Line Diagram of 400 kV Soja Substation

5.1 Objective

Short circuit analysis taken here for case study is with reference to the 400 kV sub-station of Soja, Gandhinagar. The network shown in Figure-1 is a single line diagram is prepared using Mi-Power software. The data required for the network, some of which are taken from 400 kV Soja sub-station. Entered in the Mi-Power database.

- In the network taken here, there are 19buses, 3transformers, 12transmission lines and 3 generators.

5.2 RESULTS & DISCUSSIONS:

- **Faults on Bus-17**

Current (Amps/degree)			**Fault MVA**		
Sequence Magnitude	**(1,2,0) Angle**	**Phase Magnitude**	**(A,B,C) Angle**	**Sequence Magnitude(1,2,0)**	**Phase (A,B,C) Magnitude**
655	82.26	1965	82.26	250	749
655	82.26	0	0	250	0
655	82.26	0	0	250	0

Table 5.1: Fault at bus 17

Post Fault Bus voltages			
Bus no.	**1**	**2**	**0**
1	0.922	0.989	0.905
2	0.901	0.985	0.890

3	0.825	0.943	0.816
4	0.882	0.978	0.868
5	0.856	0.966	0.896
6	0.837	0.957	0.829
7	0.823	0.967	0.821
8	0.821	0.825	0.967
9	0.878	0.984	0.875
10	0.820	0.972	0.823
11	0.809	0.967	0.812
12	0.808	0.966	0.811
13	0.808	0.966	0.811
14	0.811	0.807	0.964
15	0.810	0.808	0.966
16	0.811	0.808	0.966
17	0.811	0.669	0.965
18	0.807	0.965	0.810
19	0.807	0.965	0.810

Table 5.2: Post Fault Bus voltages

Single phase fault level		
Bus no.	**Fault MVA**	**Fault I (KA)**
1	0.9	0.047
2	0.9	0.045
3	0.8	0.001
4	0.8	0.001
5	0.8	0.001
6	0.8	0.001
7	0.8	0.013
8	0.8	0.013
9	0.7	0.012
10	0.6	0.001
11	0.5	0.001
12	0.5	0.001
13	0.5	0.001
14	0.5	0.001
15	0.5	0.001
16	0.5	0.001
17	**748.7**	**1.965**
18	0.5	0.001
19	0.5	0.001

Table 5.3: Single phase fault level

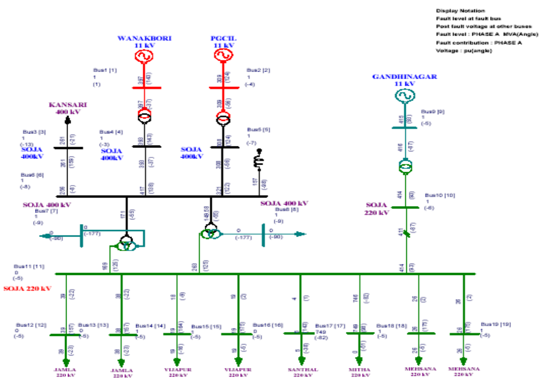

Figure-2 Results of fault on bus-17

Faults on Bus-15

Current (Amps/degree)				**Fault MVA**	
Sequence Magnitude	**(1,2,0) Angle**	**Phase Magnitude**	**(A,B,C) Angle**	**Sequence Magnitude(1,2,0)**	**Phase (A,B,C) Magnitude**
3581	84.40	3581	84.40	1364	1364
0	90.00	3581	155.60	0	1364
0	90.00	3581	35.60	0	1364
Peak asymmetrical Short-Circuit Current :7313 Amps					

Table 5.4: Fault at bus 15

Post Fault Bus voltages			
Bus no.	**1**	**2**	**0**
1	0.667	0.667	0.667
2	0.592	0.592	0.592
3	0.431	0.431	0.431
4	0.547	0.547	0.547
5	0.479	0.479	0.479
6	0.437	0.437	0.437
7	0.365	0.365	0.365
8	0.369	0.369	0.369
9	0.515	0.515	0.515
10	0.345	0.345	0.345
11	0.315	0.315	0.315
12	0.315	0.315	0.315
13	0.315	0.315	0.315
14	0.314	0.314	0.314
15	**0.000**	**0.000**	**0.000**
16	0.314	0.314	0.314
17	0.314	0.314	0.314
18	0.314	0.314	0.314
19	0.314	0.314	0.314

Table 5.5: Post Fault Bus voltages

Three phase fault level		
Bus no.	**Fault MVA**	**Fault I (KA)**
1	0.7	0.035
2	0.6	0.031
3	0.4	0.001
4	0.5	0.001
5	0.5	0.001
6	0.4	0.001
7	0.4	0.006
8	0.4	0.006
9	0.5	0.009
10	0.3	0.001
11	0.3	0.001

12	0.3	0.001
13	0.3	0.001
14	0.3	0.001
15	**1364.4**	**3.5881**
16	0.3	0.001
17	0.3	0.001
18	0.3	0.001
19	0.3	0.001

Table 5.6: Three phase fault level

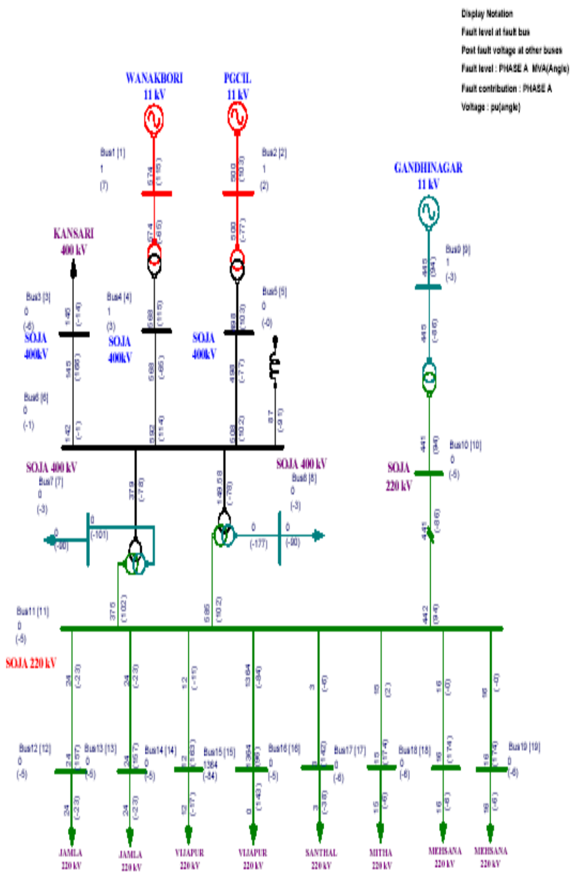

Figure-3 Results of fault on bus-17

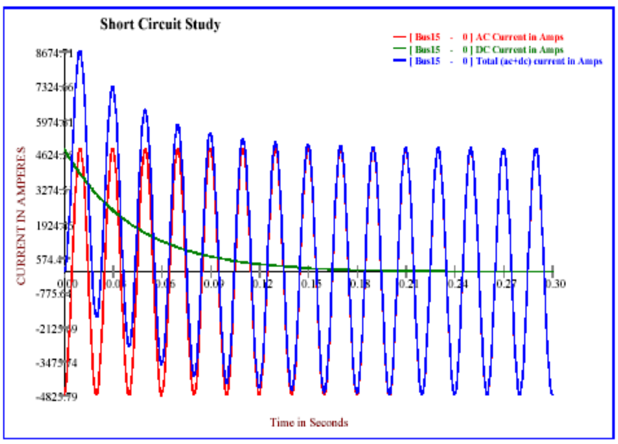

Figure-4 Mi-power generated graph shows the fault current with respect to time

VI. CONCLUSION

Above result shows the fault MVA and fault current on the faulted bus-17, 704.8 MVA and 1.850 KA respectively.

Above result shows the 3 phase fault MVA and fault current on the faulted bus-15, are 1300 MVA and 3.413 KA respectively.

Mi-power generated single line diagram shows the fault MVA and phase angle on each bus and on each line.

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