

Design and Analysis of Ground Grid System For Substation using E-TAP Software and FDM code in MATLAB

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Abstract–The paper depicts about design of ground grid system for 66/11KV rectangular substation. Although it is designed by IEEE Std 80-2000, it also illustrates step potential, touch potential and absolute potential in normal and faulty condition by E-TAP intelligent software version 12.6.0. Furthermore, its graph design is analyzed by FDM (Finite Difference Method) via MATLAB code. Some of the factor which are useful in ground grid study are described below,

- 1) Fault current magnitude and duration
- 2) Geometry of grounding mat
- 3) Soil resistivity
- 4) Human factors Such as
-Body resistance -Standard assumption on physical condition of the individual

Keywords– Ground grid system, FDM (Finite Difference Method) MATLAB code, E-TAP version 12.6.0 ground grid design, Substation grounding

I. INTRODUCTION

In substation earthing system is essential not only for providing the protection for people working in the vicinity of earthed facilities and equipment against danger of electric shock but also maintain proper function of electrical system. Reliability and security are to be taken in consideration as well as adherence to statutory obligations (IEEE and Indian standards on electrical safety [1-2] and environmental aspects). This paper is concerned with earthing practices and design for particular 66/11KV outdoor AC substation for power frequency in the range of 50 Hz. DC substation GIS and lightning effects are not covered in this paper. Moreover, the software output also has been seen for crosschecking of theoretical calculation. Furthermore, the analysis of software graph is done by FDM (Finite Difference Method) which is one of the mathematical solutions and it shows that how the graph generates in software.

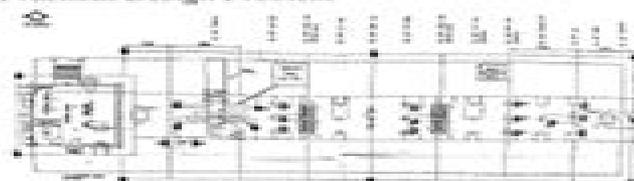
II. EARTHING SYSTEM FOR SUBSTATION

A. Components of earthing system

An effective substation earthing system typically consists of earth rods, connecting cables from buried earthing grid to metallic parts of structures and equipment, connections to earthed system neutrals, and the earth surface insulating covering material briefly discussed in [1,3]. Current flowing into the earthing grid from lightning arrester operation impulse or switching surge flashover of insulators and line to ground fault current from the bus or connected

transmission lines all cause potential differences between earthed points in the substation. Without a properly designed earthing system, large potential differences can exist between different points within the substation itself. Under normal circumstances, it is the current constitutes the main threat to personal.

B. Practical Design Problem



1. All dimensions are in mm unless otherwise specified.
2. Earth mat & earth electrode location shown are indicative. Only minor modification if any may be carried out at site.
3. Wherever earthing conductor infringes with cable trench it shall be laid at 300mm below the trench.
4. Main grid conductor shall laid at minimum 600mm below figure.
5. minimum distance of 6000mm shall be maintained between any two adjacent earth electrodes.
6. wherever earthing grid infringes with foundation, grid conductor shall be diverted suitable at site.
7. Every equipment/structure shall be connected to grid by two distinct earth connections.
8. Every alternate fence post shall be earthed with 25x3mm galvanized iron flat.
9. Gate shall be earthed with 25x3mm galvanized iron flat.
10. BMKs junction for current transformer and potential transformer shall be earthed at two points with 25x3mm galvanized iron flat.
11. For standard earthing drawings of various equipment refer figure.

III. MATHEMATICAL SOLUTION

A. Given Data: -

1. Fault duration $t_f=1s$
2. Current division factor (α_f)=1

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