

Shielding Of Magnetic Fields Of An Electrical Substation

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Abstract

Normally, power lines for electrical power distribution are shielded such that there is (almost) no magnetic field outside the cable. In a substation, these cables are connected to transformers via unshielded components such as switching boards and busbars. Thus, magnetic fields are produced by the currents through these components. There are regulations concerning the exposure of humans to such fields. As a consequence, shielding of these fields is necessary such that the fields just outside such a substation are small enough. In the design of such a shielding, simulations are useful to minimize the costs of shielding material.

For calculating the magnetic field of distribution lines, it is convenient to use the Edge Current feature in the Magnetic Fields interface as this way it is not necessary to mesh the cross section of the conductor. However, in a substation there can be large number of cables and other connections. In the simulation, the appropriate edge current should be specified for each of the line segments. As the direction of an edge is arbitrarily defined in the geometry, this requires consistent sign usage to apply the correct current to each line segment. Moreover, the network also contains junctions where one needs to consider conservation of current. For typical situations in a substation this becomes too tedious to setup manually, and mistakes are easily made, so we developed a handier method to define these edge currents.

We solved this by defining and solving a current conservation problem on all the distribution lines. This was done using the General Form Edge PDE interface with appropriate boundary conditions on end points. The output of this interface is an edge current on each line segment that is used as input in the Magnetic Fields interface with appropriate phase factors. With this setup, we could calculate the magnetic fields that are generated by power cables in a transformer station. This in turn allowed us to design magnetic shielding that reduces the magnetic field strength outside of the station.

Figures used in the abstract

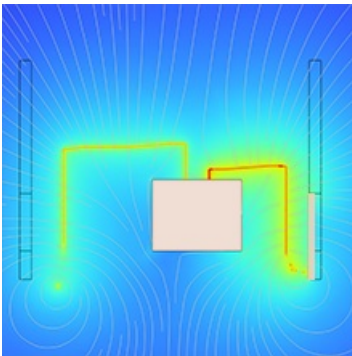


Figure 1 : Cross section of the substation showing the magnetic field with magnetic shielding included.