P.U. IMPEDANCE DIAGRAM FOR THE POWER SYSTEM

Impedance diagram:

The impedance diagram on single-phase basis for use under balanced conditions can be easily drawn from the SLD. The following assumptions are made in obtaining the impedance diagrams.

Assumptions:

1. The single phase transformer equivalents are shown as ideals with impedance on appropriate side (LV/HV),

2. The magnetizing reactance of transformers are negligible,

3. The generators are represented as constant voltage sources with series resistance or reactance,

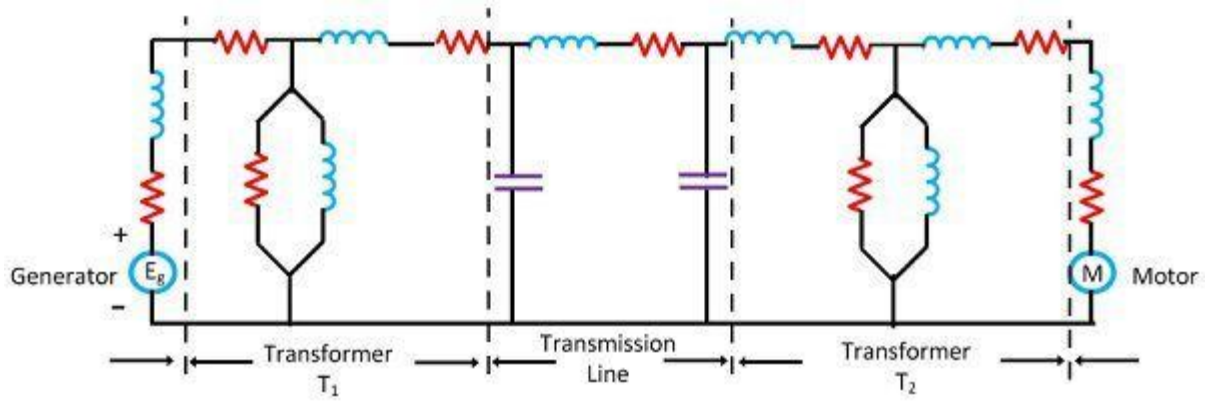
4. The transmission lines are approximated by their equivalent -Models,

5. The loads are assumed to be passive and are represented by a series branch of

Resistance or reactance

6. Since the balanced conditions are assumed, the neutral grounding impedance do not appear in the impedance diagram.

In impedance diagram, each component is represented by its equivalent circuit, e.g., the synchronous generator at the generating station by a voltage source in series with the resistance and reactance, the transformer by a nominal ∏-equivalent circuit. The load is assumed to be passive and is represented by a resistive and inductive reactance in the series. Neutral earthing impedance does not appear in the diagram as the balanced condition is assumed.



Impedance Diagram For The Power System

The diagram shown above is the balanced 3-phase diagram. It is also called positive sequence diagram. Three separate diagrams are also used for representing the positive, negative and zero sequence networks. The three separate impedance diagrams are used in the short circuit for the studies of unsymmetrical fault. The impedance diagram can further be simplified by making certain assumptions and reduced to simplified reactance. Reactance diagram is drawn by neglecting the effective resistance of generator armature, transformer winding resistance, transmission line resistance line charging and the magnetizing circuit of transformers.

PU Impedance / Reactance Diagram

For a given power system with all its data with regard to the generators, transformers, transmission lines, loads, etc., it is possible to obtain the corresponding impedance or reactance diagram. If the parametric values are shown in pu on the properly selected base values of the system, then the diagram is referred as the per unit impedance or reactance diagram. In forming a pu diagram, the following are the procedural steps involved:

1. Obtain the one line diagram based on the given data

2. Choose a common base MVA for the system

3. Choose a base KV in any one section (Sections formed by transformers)

4. Find the base KV of all the sections present

5. Find pu values of all the parameters: R,X, Z, E, etc.

6. Draw the pu impedance/ reactance diagram.

REACTANCE DIAGRAM FOR THE POWER SYSTEM

Reactance Diagram

With some more additional and simplifying assumptions, the impedance diagram can be simplified further to obtain the corresponding reactance diagram. The following are the assumptions made.

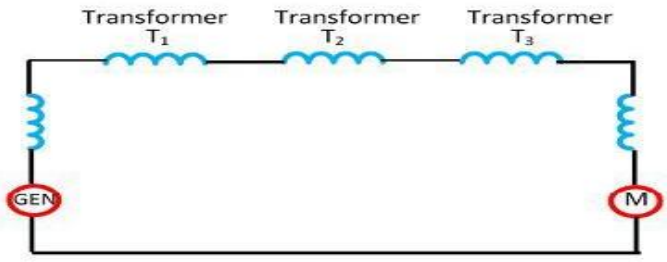
(i). The resistance is often omitted during the fault analysis. This causes a very negligible error since, resistances are negligible

(ii). Loads are Omitted

(iii). Transmission line capacitances are ineffective &

(iv). Magnetizing currents of transformers are neglected.

The reactance diagram gives an accurate result for many power system studies, such as short-circuit studies, etc. The winding resistance, including the line resistance, is quite small in comparison with leakage reactance and shunt path which includes line charging and transformer magnetising circuit provide a very high parallel impedance with fault.



Reactance Diagram For Power System

Circuit Globe

It is considered that if the resistance is less than one-third of the reactance, and resistance is ignored, then the error introduced will be not more than 5 %. If

the resistance and reactance ignored errors up to 12% may be introduced. The errors mean their calculation gives a higher value than the actual value.