

The use of numerical simulations as the only method for short-circuit evaluations is not the most reliable approach for the transformers short circuit evaluation since a failure may be caused by poor manufacturing quality.

Short circuit design rules in transformers are historically based on 2D FEM magnetic simulations, analytical calculations and comparison with full-scale tests on transformers or laboratory models.

This approach used in the industry can be improved by using more sophisticated simulations tools, for example:

- 3D FEM magnetic simulations to see effects of different boundary conditions, winding pitches etc.
- Nonlinear dynamic FEM mechanical simulations to see effects of structural resonances, clamping pressure etc.
- 3D mechanical simulations to analyze the behavior of certain components on the active part such as cleat & leads, clamping system, common insulation parts, winding end supports, etc.
- 3D mechanical simulations of elastic instability phenomena, such as winding buckling and tilting of conductors

Numerical simulations together with the comparison with full-scale tests and manufacturing quality checks help to ensure that the transformer is designed properly. This decreases the risk of failure.

