

Position Optimization of Grading Rings

Introduction

This model extends the model High Voltage Insulator in the AC/DC Module Application Library by adding an Optimization study node. The Optimization study is aimed at finding the optimum position of the grading rings to obtain the highest flashover voltage.

Model Definition

In this model, a boundary probe defining the maximum value of the vertical component of the tangential electric field of the high voltage insulator is first created. The boundary probe is then set as the Objective Function. The control variables are the diameter of the grading ring and the distance from the end.

Results and Discussion

Figure 1 compares the vertical component of the tangential electric field along the first six sheds from the line end under different conditions. It is shown that the maximum of the tangential electric field is further reduced with the use of the Optimization study.



Figure 1: Comparison of the z-component of the tangential electric field along the surface of the first six sheds from the line end in different cases.

2 | POSITION OPTIMIZATION OF GRADING RINGS

Application Library path: ACDC_Module/Electromagnetics_and_Optimization/ grading_ring_optimization

Modeling Instructions

ROOT

In this model version you determine the optimum position of the grading rings by using an **Optimization** study node.

APPLICATION LIBRARIES

I From the File menu, choose Application Libraries.

- 2 In the Application Libraries window, select ACDC Module>Devices, Capacitive> high_voltage_insulator in the tree.
- 3 Click 💿 Open.

ADD STUDY

- I In the Home toolbar, click $\sim\sim$ Add Study to open the Add Study window.
- 2 Go to the Add Study window.
- 3 Find the Studies subsection. In the Select Study tree, select General Studies>Stationary.
- 4 Click Add Study in the window toolbar.
- 5 In the Home toolbar, click 2 Add Study to close the Add Study window.

STUDY 3

Optimization

In the Study toolbar, click optimization and choose Optimization.

COMPONENT I (COMPI)

In the Model Builder window, expand the Component I (compl) node.

DEFINITIONS

Boundary Probe 1 (bnd1)

- I In the Model Builder window, expand the Component I (compl)>Definitions node.
- 2 Right-click Definitions and choose Probes>Boundary Probe.

- 3 In the Settings window for Boundary Probe, locate the Probe Type section.
- 4 From the Type list, choose Maximum.
- 5 Locate the Source Selection section. From the Selection list, choose Shed Surface.
- 6 Locate the Expression section. In the Expression text field, type es.tEz.
- 7 In the Table and plot unit field, type kV/cm.

STUDY 3

Optimization

- I In the Model Builder window, under Study 3 click Optimization.
- 2 In the Settings window for Optimization, click Add Expression in the upper-right corner of the Objective Function section. From the menu, choose Component I (compl)> Definitions>compl.bndl Boundary Probe I V/m.
- 3 Locate the Control Variables and Parameters section. Click + Add.
- **4** In the table, enter the following settings:

Parameter name	Initial value	Scale	Lower bound	Upper bound
D (Diameter of	350[mm]	1[m]	200[mm]	1000[mm]
the grading ring)				

5 Click + Add.

6 In the table, enter the following settings:

Parameter name	Initial value	Scale	Lower bound	Upper bound
d (Distance of the grading ring from the end)	150[mm]	1[m]	10[mm]	500[mm]

7 In the **Home** toolbar, click **= Compute**.

TABLE

- I Go to the **Table** window.
- 2 Click Display Probe Table I in the window toolbar.

RESULTS

With Grading Rings, Optimized

I In the Model Builder window, expand the Results>Tangential Electric Field, z-Component node.

- 2 Right-click With Grading Rings and choose Duplicate.
- 3 In the Settings window for Line Graph, type With Grading Rings, Optimized in the Label text field.
- 4 Locate the Data section. From the Dataset list, choose Study 3/ Parametric Solutions I (sol4).
- 5 From the Parameter selection (D, d) list, choose From list.
- 6 Locate the Selection section. From the Selection list, choose Shed Surface.
- 7 In the Tangential Electric Field, z-Component toolbar, click 💽 Plot.
- 8 Click to expand the Legends section. In the table, enter the following settings:

Legends

With grading rings, optimized

Tangential Electric Field, z-Component

- I In the Model Builder window, click Tangential Electric Field, z-Component.
- 2 In the Tangential Electric Field, z-Component toolbar, click 💽 Plot.
- **3** Click the **Com Extents** button in the **Graphics** toolbar.

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