POWERFACTORY

PowerFactory 2021

Technical Reference

DC Inductive Coupling

ElmMdc

PF2021

POWER SYSTEM SOLUTIONS
MADE IN GERMANY

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Contents

1 General Description

The *DC Inductive Coupling* element is used for modelling the DC inductive coupling between two DC inductances. The *ElmMdc* is a four-port element and can be connected to DC terminals only.

The element is considered only by the load flow calculation and by the RMS and EMT simulations. The same load flow model is used in the balanced and in the unbalanced load flow calculation. Furthermore, the same dynamic model is used for the balanced/unbalanced RMS and EMT simulations.

2 Load flow analysis

For load flow analysis, the *DC Inductive Coupling* is element is considered as resistance without any mutual coupling effects. For the load flow analysis the model corresponds to the equivalent circuit shown in 2.1.

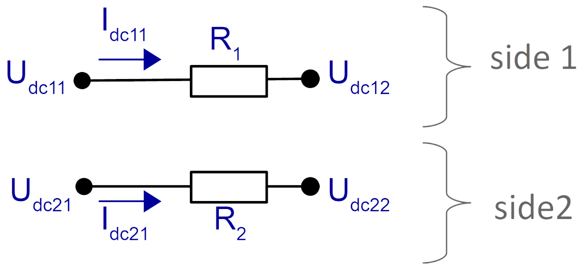

Figure 2.1: Load flow model

2.1 Model Equations

The model of the *ElmMdc* is represented by the following equations:

$$\begin{aligned} U_{dc11} - U_{dc12} &= R_1 \cdot I_{dc11} \\ U_{dc21} - U_{dc22} &= R_2 \cdot I_{dc21} \end{aligned} \tag{1}$$

where:

- $U_{dc11}, U_{dc12}, U_{dc21}, U_{dc22}$ are the terminal DC voltages of the element in kV;
- I_{dc11}, I_{dc21} are the DC currents flowing through the element in kA;
- R_1, R_2 are the internal resistances in Ω.

3 Time domain simulation

As shown in Figure 3.1 the model for the RMS and EMT simulations includes the inductances and the mutual coupling inductance.

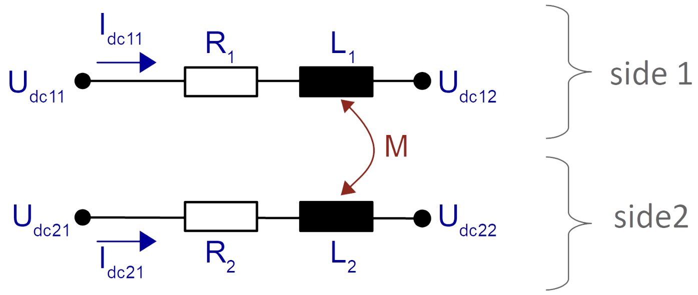

Figure 3.1: RMS and EMT simulation model

3.1 Model Equations

The model of the *ElmMdc* is represented by the following equations:

$$\begin{aligned} U_{dc11} - U_{dc12} &= R_1 \cdot I_{dc11} + (L_1 + M) \cdot \frac{dI_{dc11}}{dt} + M \cdot \frac{dI_{dc21}}{dt} \\ U_{dc21} - U_{dc22} &= R_2 \cdot I_{dc21} + (L_2 + M) \cdot \frac{dI_{dc21}}{dt} + M \cdot \frac{dI_{dc11}}{dt} \end{aligned} \tag{2}$$

where:

- $U_{dc11}, U_{dc12}, U_{dc21}, U_{dc22}$ are the terminal DC voltages of the element in kV;
- I_{dc11}, I_{dc21} are the DC currents flowing through the element in kA;
- R_1, R_2 are the internal resistances in Ω;
- L_1, L_2 are the internal inductances in H;
- R_1, R_2 is the internal mutual inductance in H.

List of Figures