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Totally Integrated Power

Technical Series Edition 1

Modelling IT Isolating Transformers in SIMARIS® design for Hospital Applications

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Modelling IT Isolating Transformers in SIMARIS® design for Hospital Applications

1. Fundamentals

Planning a hospital is determined by the medical procedures and their interrelations. They always focus on the benefit of the patients. Therefore the objective of "patient protection" also applies to electrical plant design as first and foremost objective. In a direct sense, patients must be protected against the immediate effects of electric current during treatment. Indirectly, patients must be protected in terms of minimum medical treatment available to them at any time, also in case normal power supply is interrupted, even if this extends to a period of several days. IEC 60364-7-710 (DIN VDE 0100-710) divides power consumers in medically used areas into three groups. For areas categorized as Group 0 and 1, the standard demands, inter alia, a power system configuration as TN-S and a protection against excessively high touch voltages by means of residual current devices (RCD). The highest standard is provided in Group 2, where an interruption of medical examination or treatment would be irresponsible.

Group 0

From an electrical point of view, rooms in Group 0 are in no way differently equipped than rooms for any ordinary use also outside medical facilities. An assignment to this group however implies that such rooms nevertheless are of a considerable relevance to medical procedures.

Group 1

Group 1 covers all those rooms and areas where patients are in care whose condition and type of medical treatment places higher requirements on the electric installation. An unexpected interruption of power supply does not expose the patient to imminent danger and the medical examination can be repeated at any time.

Group 2

Rooms and areas categorized as Group 2 are used for diagnosis and patient therapy where the type of medical treatment may be directly or indirectly dangerous for the patient.

In parts of Group 2 and Group 1 areas there are IT isolating transformers which ensure an additional safety standard. The first fault, which would result in power failure in other common supply networks, remains without consequences in the IT network. Only the second fault will result in disconnection from supply and thus a power failure. This type of power system configuration is generally used in operating theatres, for example.

SIMARIS design can be used to dimension electric networks based on real products with a minimum of input – from medium voltage to the socket outlet. This software helps electrical engineering consultants reduce their overall planning expenses for power distribution systems and minimizes selection and dimensioning time for the necessary equipment enormously – at the same time offering a high degree of planning reliability into the bargain.

The use of 1-phase isolating transformers in these medical IT networks cannot, however, be simulated directly in SIMARIS design. But with the aid of equivalent circuit mapping, the circuits and the equipment applied as well as their selectivity towards these subnetworks can be verified.

2. Procedure for Equivalent Circuit Mapping

SIMARIS design provides the option to enter an equivalent impedance. This serves for simulating IT isolating transformers. The following product was referred to for basic technical data of the IT isolating transformers::

Bender product
Types: ES710 / 3150 - 8000
U: 230 V / 230 V, 1-phase

Step 1

Add the equivalent impedance

An IT isolating transformer is added by means of the equivalent impedance from the library for distribution board circuits (Figure 1).

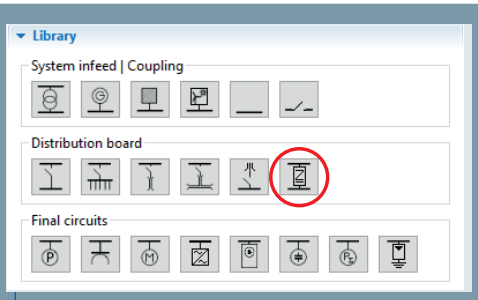

Figure 1: Adding the equivalent impedance

The installed 1-phase cable length between protection device and IT transformer must be doubled in the standard version of SIMARIS design, because the equivalent impedance is entered as a 3-phase system in the distribution circuit of the calculation. The cable length must also be doubled in the SIMARIS design „professional" version, when the setting „symmetrical" is selected for load flow calculations. If „asymmetrical" is selected, the single cable length has to be used.

Step 2

Enter the R and X values

To obtain an equivalent impedance, the resistances and reactances of the isolating transformers for the positive phase-sequence system and the two zero phase-sequence systems (phase-N and phase-PE) must be entered (Figure 2).

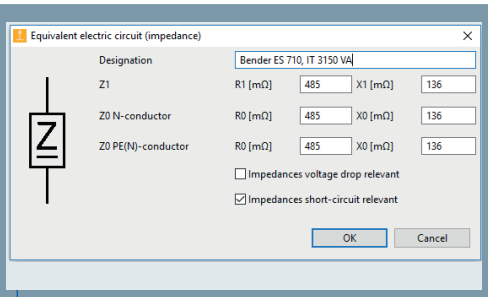

Figure 2: Entering resistances and reactances for the equivalent impedance

The primary- and secondary-side specification values from the Bender datasheet are summed up to build the R values. By entering the short-circuit voltage u_k, the X values are determined as follows:

Since these are 1-phase transformers (230 / 230 V),

- U = 230 V and
- zero phase-sequence data = positive phase sequence data

is specified.

$$Z = \frac{u_k \cdot U^2}{S} \qquad (1)$$

$$X = \sqrt{Z^2 - R^2} \qquad (2)$$

Regional hospital Feldkirch, Austria

This data basis supplies the following
R and X values for Bender transformers:

S in VA	R in mΩ	X in mΩ
3150	485	136
4000	245	312
5000	195	250
6300	150	202
8000	120	158

The option
„Impedances short-circuit relevant“
(see Figure 2) must be selected, to take into accout the attentuation of the short-circuit currents through the transformer.

The option
„Impedances voltage drop relevant“
must be de-activated, because the voltage-drop is compensated by the transformer ratio.

Step 3

Define the cross-sections of feeder cables and backup fuses

The maximum cable cross-section and backup fuse specifications for IT isolating transformers according to the datasheet are adopted from Bender (Figure 3).

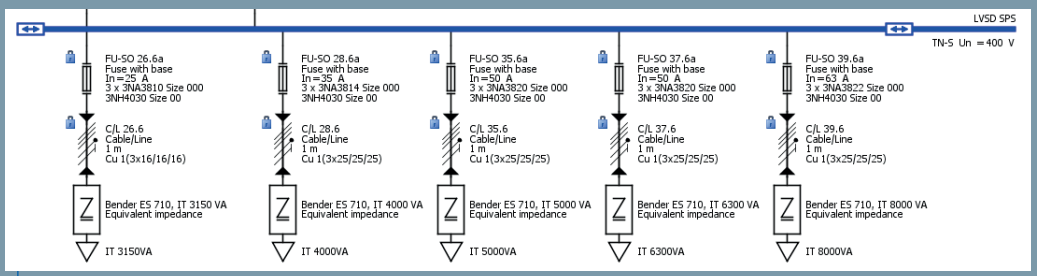

Figure 3: Cable cross-sections and backup fuses for IT isolating transformers

If a different product is used, all technical data such as impedances, cable cross-sections, backup fuses, etc. must be verified and adapted if necessary!

Step 4

Enter loads

Please note the following when entering loads:

- Only 1-pole loads may be entered
- Each load must be assigned to the same phase of the IT isolating transformer, e.g. all loads to L1
- All switching devices must manually be selected as 2-pole devices
- Warnings regarding RCD for loads connected downstream of IT isolating transformers are to be ignored, since SIMARIS design uses the pre-set TN-S network for evaluation

Hospital da Luz,
Lissabon, Portugal

3. Saving as Favourite

This simulation of IT isolation transformers by means of subdistribution boards with equivalent impedances can also be saved as Favourite.
After the "equivalent impedance" circuit has been selected, the IT isolating transformer and all its outgoing feeders can be saved as Favourite either from the context menu (right mouse button) or the "Tools" menu on the menu bar (Figure 4).

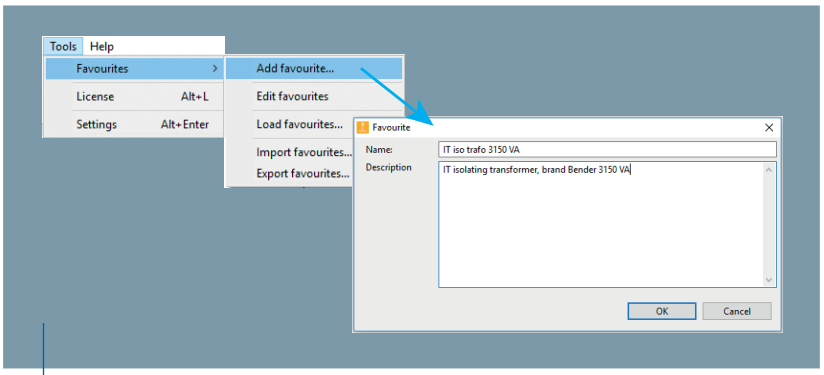

Figure 4: Context menu of the subdistribution board with equivalent impedance and input dialog for saving as Favourite

This way users can save relevant IT isolating transformers with model feeders as Favourites in SIMARIS design. The Favourites section thus makes them available to all projects (Figure 5).

Our model favourites for distribution boards with IT isolating transformers can be integrated into SIMARIS design from the menu bar using Tools > Favorites > Import favorites. To do so, you have to save the "IT-Isolating_Transformer_2020.sdt" file enclosed with the document on your computer.

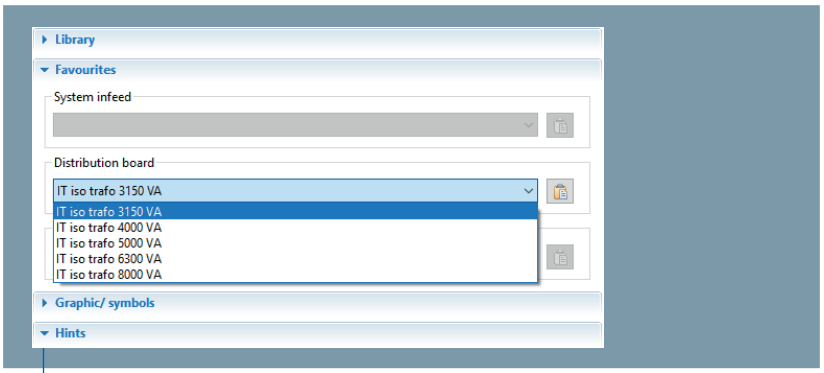

Figure 5: Example of distribution boards favourites for IT isolating transformers

Enclosed please find the SIMARIS design model network with IT isolating transformers and Technical Datasheet on IT isolating transformers made by Bender and the corresponding model favourites (.sdt).

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