

## Integrated Grounding, Equipotential Bonding and Lightning Protection in Smart Grids and Smart Buildings – A Multi-Faced Approach

Ernst SCHMAUTZER  
TU Graz / IFEA / Austria  
[schmautzer@tugraz.at](mailto:schmautzer@tugraz.at)

Stephan Pack  
TU Graz / HSPT / Austria  
[pack@tugraz.at](mailto:pack@tugraz.at)

Maria Aigner  
TU Graz / IFEA / Austria  
[maria.aigner@tugraz.at](mailto:maria.aigner@tugraz.at)

Christian Raunig  
TU Graz / IFEA / Austria  
[christian.raunig@tugraz.at](mailto:christian.raunig@tugraz.at)

### ABSTRACT

*With the implementation of smart meters many new electric energy applications in supply areas and in buildings (single or multiple dwelling, office buildings, industry) will be initiated. The usage of smart meters in smart buildings and smart grids requires enhanced communication lines and the usage of modern electrical installations and sensitive measurement, data acquisition and control systems in the area of the customer installations and the grid under consideration of the demands of high reliability. To guarantee the reliable functioning of the required electronic equipment low induction grounding, equipotential bonding and lightning protection systems are a pre-condition starting from the transformer stations via the mains connection to the location of the electrical / electronic equipment in the buildings.*

*The increasing number of sensitive electronic equipment and the necessary bidirectional information and data flow requires not only the provision of new intelligent measurement equipment (e.g. smart meters and communication lines), but also new concepts regarding the implementation of grounding, bonding, lightning protection and shielding with regard to inductive and resistive influences and disturbances in the fundamental and transient frequency range.*

*To provide the base for a safe and reliable use concerning the low and high frequency effects in new buildings on the one hand and for the revitalization of existing buildings on the other hand are presented in the paper two approaches are presented:*

- 1. The first approach includes the implementation of grounding, bonding, lightning protection and shielding from the beginning of the planning and construction phase of the electrical installation.*
- 2. The second approach demonstrates the integration of a closed-meshed fish trap structure of grounding, bonding, lightning protection and shielding.*

*In this context the introduced coordination and installation measures representing the state-of-the-art and scientific results for new buildings are relatively easy and cost-effective if considered in the planning phase, for the renewal and revitalization of existing buildings, these*

*measures may be very complex and additional restrictions in functionality have to be accepted.*

### INTRODUCTION

To provide the safe and reliable operations of electric / electronic equipment in modern low-voltage grids intended to be suitable for a bidirectional energy and information flow and further to fulfil requirements of ensuring protection measures against electric shock, special attention has to be focused on the integration of earthing, equipotential bonding, shielding and lightning protection - starting from the transformer stations via the interconnection point to the location where the equipment used for the electrical and information technology is located. Beginning in the planning phase and continued in the implementation and examination state these themes usually are considered mostly separately, leading in practice to a multitude of problems caused on the one hand by stray-currents, undesired interfering electromagnetic fields and inductive influences by low-frequency and transient currents and on the other hand by effects due to switching operations in the grid or as a result of atmospheric discharges.

In the following proposal a functional, comprehensive approach for the planning, installation and refurbishment of grounding, equipotential bonding, shielding and lightning protection systems is presented, taking the operational frequency as well as transient frequency processes to assure the basic requirements of different electrical grid-bound supply systems such as electricity, gas, water and telecommunications and the shielding of energy- and information- and communication technology (ICT) - lines into account.

### METHODOLOGY - NEW BUILDINGS

In order to ensure safe functionality of both, the protection against electric shock as well as protection measures against resistive, inductive and capacitive influences of electrical / electronic equipment in electrical installations grounding, equipotential bonding and shielding measures and lightning protection systems have to be suitable coordinated already at the planning stage [1]... [8]. As in single buildings, building complexes (smart buildings) and spacious electrical systems (smart grids), the function of the