ELECTRIC APPLIANCES IMMUNITY LABELING

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ABSTRACT

The paper deals with the problems associated with the electric appliances immunity to voltage dips and short interruptions. The immunity levels of electric appliances are not the same because there are many types of appliances and their immunity levels depend on the appliances functions and design. Although the appliance immunity level is the main parameter for appliances classification into correct electromagnetic environment for its usage, in the meanwhile no specific information about appliances immunity is available. The paper describes a proposal to sign all electric appliances by immunity labels which nearly specify a range of theirs applicability.

1. INTRODUCTION

The electric power system is a complicated system which contains all electric components connected to power grid – power sources, components for electric energy transmission and distribution (lines, transformers, substations, etc.) and loads. Loads consist of many types of electric appliances (computers, lights, TV, washing machines and other domestic ones, medical appliances, industrial machines, etc). Due to very complicated structure of supply system and weather conditions, many types of electromagnetic disturbances occur in the power system. The quality of electric power system and its reliability is assessed by several voltage quality parameters (in accordance with [1]), whereas each voltage quality parameter has determined specific limits in which the each one can be. Of course that it is not possible to hold all voltage parameters in their allowed limits for all the time. The voltage dips and short interruptions are ones of the very important voltage quality parameters to correct working of all electric appliances because appliances have one common property: no one can run without electric energy for a long time. The ability to run without energy is possible only for a short time and it depends on the design of each appliance.

As well as the most of domestic electric appliances are signed by power efficiency labels which specify the operating behavior about each appliance and, among other things, the efficiency of electric energy transform to other type of energy, each appliance could have a label containing correct information about appliance immunity to electromagnetic disturbances which occur in electric power supply system and which are not totally eliminable. This paper proposes only appliances labels which will express their immunity to voltage dips and short interruptions.

2. CLASSES OF ELECTROMAGNETIC ENVIRONMENTS

The Electromagnetic compatibility (EMC) is a branch studying the electric appliances ability to correct run in the environment where electromagnetic disturbances occur. Along the expected disturbance level the power system is divided into several classes whereas the level of voltage dips and short interruptions in the power system is one of the main factors to determine the appliances applicability. In accordance with [2] three following classes of electromagnetic environments are defined:

- ***Class 1*** – is typical for very sensitive appliances which need a continual supply. The supply use to be mostly protected by UPS. The immunity of appliances belonging to this class has lower level than immunity of standard used appliances is.
- ***Class 2*** – is typical for points of common coupling (PCC) and some of supply points in factories. In this class there are the most of domestic and office electric appliances. These appliances have no special supply protection.
- ***Class 3*** – is typical only for internal points of coupling (IPC) in industries. The electromagnetic disturbance level is much greater than in public supply networks and that is why the immunity levels of connected appliances have to be higher than appliances immunity levels in the Class 2.

As it results from dividing of electromagnetic environments the each class is characterized by level of electromagnetic disturbance. In [3] there was published a proposal of compatibility levels for voltage dips and short interruptions which express the recommended maximum levels of disturbances in the each class of electromagnetic environments (shown on Figure 1).

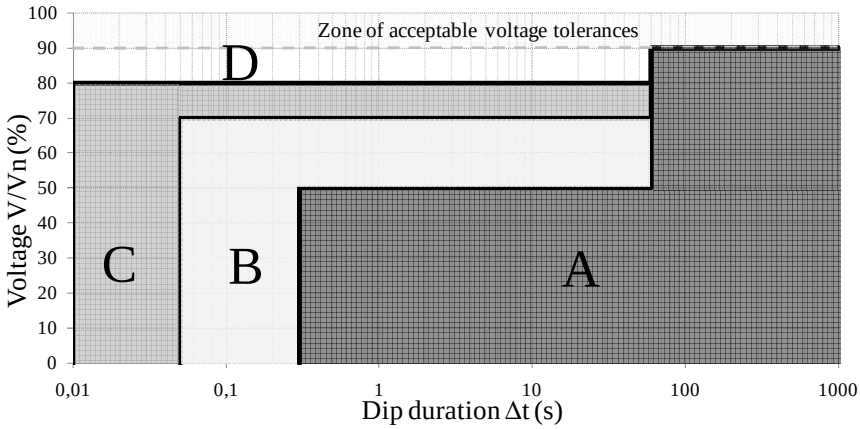

Figure 1: Compatibility levels for voltage dips and short interruptions for known three classes of electromagnetic environments [3]

The proposed compatibility levels are depicted by bold lines – the bottom line belongs to class 3, the middle line belongs to class 2 and the top line belongs to class 1. All the lines border the zones under the lines and to appliance insertion to correct class of electromagnetic environment, the immunity level of appliance (the appliance immunity to voltage dips and short interruptions is mostly expressed by immunity curve [3][4][5]) should fall into one of these zones. In other words if the appliance should run properly its immunity level to electromagnetic disturbances has to be greater than disturbance level is. For example the appliance can be used in class 3 of electromagnetic environments only if its immunity curve falls into the zone bordered by bottom bold line – this zone is signed **A**. In class 2

there is possible to use appliances whose immunity curves fall into zone signed **B**, but also all appliances from class 3 (zone **A**). Similarly in class 1 there is possible to use appliances whose immunity curves fall into zone **C**, but also into zone **B** and zone **A**. Only in compliance with above mentioned conditions the reliability of electric appliances will be higher and much less failures of appliances running due to voltage dips and short interruptions will occur in the supply system.

3. IMMUNITY LABELS

The appliances immunity to voltage dips and short interruptions is the basic request to correct operation of all electric appliances. In the power supply system there are many types of connected appliances and the levels of their immunities are typical for each appliance type. Along the appliances immunity levels their usability could be determined (the appliance usability means the determination of correct class of electromagnetic environment in which the appliance should be used). Currently no information about appliances immunity levels are presented by producers. Producers probably do not distribute the information about appliance immunity together with each appliance (for example via immunity labels on the box of appliances) because this information will not be useful for laic users. The problem is that most of the laic population has no one or only basic information about electrical engineering and too many information about electric appliances behaviour cause that the users would be confused and they would not be able to choose the one with the best parameters.

Nevertheless the information about appliances immunity to voltage dips and short interruptions should be available for professional users. The one of possibilities is the creation of the special database in which the information from all producers should be. As well as the information about immunity to voltage dips and short interruptions, the information about appliance immunity to other types of electromagnetic disturbances should be available in the created database.

3.1. CONDITIONS FOR DETAILED DETERMINATION OF IMMUNITY LEVELS CLASSIFICATION

The detailed determination of immunity levels classification is conditioned by compliance of several presumptions:

- A concept of compatibility level for voltage dips and short interruptions in LV power supply systems (for example proposal in [3]) has to be accepted.
- The proposed immunity levels have to be consistent with compatibility levels. No crossing with compatibility level lines is allowable.
- The immunity levels should appear from parameters of voltage dips and short interruptions which are expected and occur in the each class of electromagnetic environment.
- An adequate number of immunity levels should be proposed. Too many immunity levels would be unnoticed and useless.

In agreement with all presumptions 9 immunity levels were proposed. The immunity levels (expressed by dotted lines) as well as the original compatibility levels [3] (expressed by bold lines) and voltage dips and short interruptions occurred in real power supply system (expressed by crosses) are shown on Figure 2.

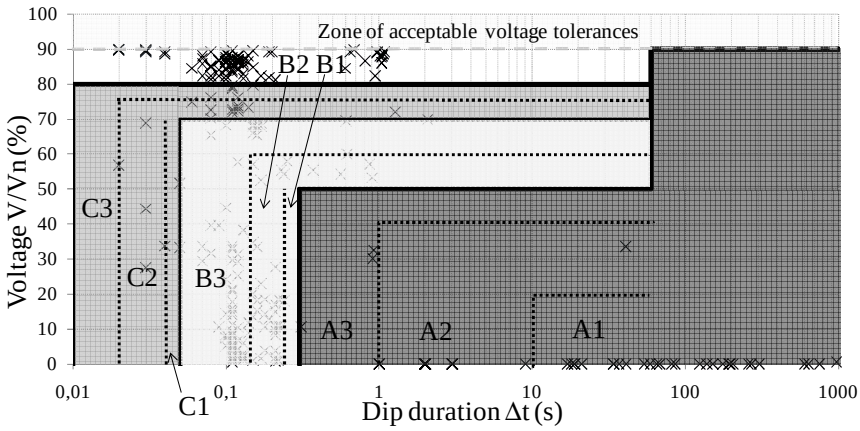

Figure 2: The proposal of detailed immunity classification levels

As Figure 2 shows the each class of electromagnetic environment is divided into the several immunity levels. The each immunity level is signed by a specific sign which consists of two symbols – the first letter represents the class of electromagnetic environment (in accordance with [2]) and the second letter represents the appliance immunity level whereas numeration is done from the best immunity level (the best level has number 1 and each followed number presents worse immunity level than the previous one).

3.2. THE PROCESS OF APPLIANCES IMMUNITY LEVELS CLASSIFICATION

Electric appliances should be tested to immunity to voltage dips and short interruptions before they leave the factory. Of course that it is not necessary to test all made electric appliances, it is relevant to test only the certain number of made appliances in the same series. The testing should be done according to actual valid EMC standard [6] or its accepted improvements and testing result is the immunity curve of each tested appliance. This immunity curve will be compared with the proposed immunity classification levels shown on Figure 2 and than the concrete immunity classification level, into which the immunity curve is, will be chosen. In the case the immunity curve crosses more than one immunity classification levels the worst one must be chosen. Similarly if the immunity curve appertains to more than one classes of electromagnetic environment the class with lower disturbance level must be preferred.

3.3. THE FINAL DESIGN OF IMMUNITY LABEL

Design of immunity label can be based on well known energy efficiency label which belongs to chosen electric appliances. The immunity label must contain appliance identification specifications such as type, serial number or serial code which will guarantee the connection between label and product. Designed immunity label is for washing machine is shown on Figure 3.

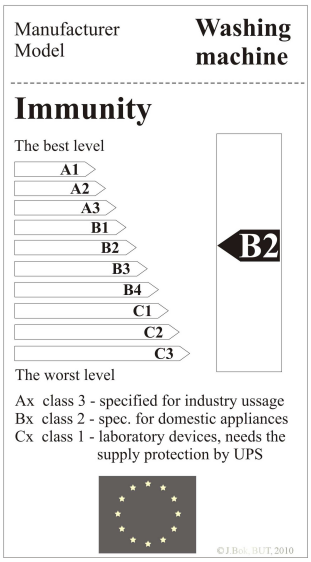

Figure 3: Designed immunity label

4. CONCLUSION

The paper brings a proposal of immunity labels which should be available for users who interest about appliances immunity to voltage dips and short interruptions. The proposed immunity label indicates the level of appliance immunity to voltage dips and short interruptions and also specifies the possibilities to usage of each appliance.

ACKNOWLEDGEMENTS

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