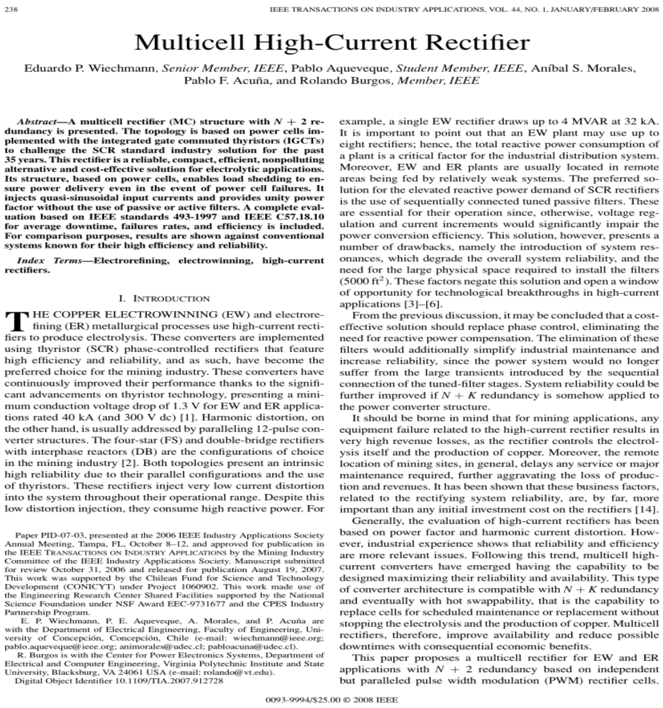
C57.18.10-1998 IEEE Standard Practices and Requirements for Semiconductor Power Rectifier Transforme



Multicell High-Current Rectifier

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***Abstract*—A multicell rectifier (MC) structure with $N + 2$ redundancy is presented. The topology is based on power cells implemented with the integrated gate commuted thyristors (IGCTs) to challenge the SCR standard industry solution for the past 35 years. This rectifier is a reliable, compact, efficient, nonpolluting alternative and cost-effective solution for electrolytic applications. Its structure, based on power cells, enables load shedding to ensure power delivery even in the event of power cell failures. It injects quasi-sinusoidal input currents and provides unity power factor without the use of passive or active filters. A complete evaluation based on IEEE standards 493-1997 and IEEE C57.18.10 for average downtime, failures rates, and efficiency is included. For comparison purposes, results are shown against conventional systems known for their high efficiency and reliability.**

***Index Terms*—Electrorefining, electrowinning, high-current rectifiers.**

I. Introduction

THE COPPER ELECTROWINNING (EW) and electrorefining (ER) metallurgical processes use high-current rectifiers to produce electrolysis. These converters are implemented using thyristor (SCR) phase-controlled rectifiers that feature high efficiency and reliability, and as such, have become the preferred choice for the mining industry. These converters have continuously improved their performance thanks to the significant advancements on thyristor technology, presenting a minimum conduction voltage drop of 1.3 V for EW and ER applications rated 40 kA (and 300 V dc) [1]. Harmonic distortion, on the other hand, is usually addressed by paralleling 12-pulse converter structures. The four-star (FS) and double-bridge rectifiers with interphase reactors (DB) are the configurations of choice in the mining industry [2]. Both topologies present an intrinsic high reliability due to their parallel configurations and the use of thyristors. These rectifiers inject very low current distortion into the system throughout their operational range. Despite this low distortion injection, they consume high reactive power. For example, a single EW rectifier draws up to 4 MVAR at 32 kA. It is important to point out that an EW plant may use up to eight rectifiers; hence, the total reactive power consumption of a plant is a critical factor for the industrial distribution system. Moreover, EW and ER plants are usually located in remote areas being fed by relatively weak systems. The preferred solution for the elevated reactive power demand of SCR rectifiers is the use of sequentially connected tuned passive filters. These are essential for their operation since, otherwise, voltage regulation and current increments would significantly impair the power conversion efficiency. This solution, however, presents a number of drawbacks, namely the introduction of system resonances, which degrade the overall system reliability, and the need for the large physical space required to install the filters (5000 ft^2). These factors negate this solution and open a window of opportunity for technological breakthroughs in high-current applications [3]–[6].

From the previous discussion, it may be concluded that a cost-effective solution should replace phase control, eliminating the need for reactive power compensation. The elimination of these filters would additionally simplify industrial maintenance and increase reliability, since the power system would no longer suffer from the large transients introduced by the sequential connection of the tuned-filter stages. System reliability could be further improved if $N + K$ redundancy is somehow applied to the power converter structure.

It should be borne in mind that for mining applications, any equipment failure related to the high-current rectifier results in very high revenue losses, as the rectifier controls the electrolysis itself and the production of copper. Moreover, the remote location of mining sites, in general, delays any service or major maintenance required, further aggravating the loss of production and revenues. It has been shown that these business factors, related to the rectifying system reliability, are, by far, more important than any initial investment cost on the rectifiers [14].

Generally, the evaluation of high-current rectifiers has been based on power factor and harmonic current distortion. However, industrial experience shows that reliability and efficiency are more relevant issues. Following this trend, multicell high-current converters have emerged having the capability to be designed maximizing their reliability and availability. This type of converter architecture is compatible with $N + K$ redundancy and eventually with hot swappability, that is the capability to replace cells for scheduled maintenance or replacement without stopping the electrolysis and the production of copper. Multicell rectifiers, therefore, improve availability and reduce possible downtimes with consequential economic benefits.

This paper proposes a multicell rectifier for EW and ER applications with $N + 2$ redundancy based on independent but paralleled pulse width modulation (PWM) rectifier cells.

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Description: Amendment to IEEE Std C testing, and calculation methods for dry-type or liquid-filled semiconductor power rectifier transformers.(This introduction is not part of IEEE Std C, IEEE Standard Practices and Requirements for Semiconduc- tor Power Rectifier Transformers.).Browse Standards > IEEE Std C C - IEEE Standard Practices and Requirements for Semiconductor Power Rectifier Transformers.IEEE Xplore. Delivering full text access to the world's highest quality technical literature in engineering and technology.ANSI/IEEE C). IEEE Standard Practices and. Requirements for Semiconductor Power Rectifier Transformers. Sponsor Transformers Committee of the.IEEE Standard Practices and Requirements for Semiconductor Power Rectifier Transformers.C IEEE Standard Practices and Requirements for Semiconductor Power Rectifier Transformers: Books - nutritionmayhem.comBuy IEEE C Practices and Requirements for Semiconductor Power Rectifier Transformers from SAI Global.(This introduction is not part of IEEE Std C, IEEE Standard Practices and Requirements for Semiconductor Power Rectifier Transformers.).IEEE-CPDF IEEE Standard Practices and Requirements for Semiconductor Power Rectifier Transformers.Transformers for Industrial Applications, is the most recent. IEEE Std, C , Practices for Semiconductor. Power Recti fier Transformers, is a revision.Converter transformers are manufactured in dry or oil immersed types. transformer and the pulse rectifier needs a three-winding transformer, having IEEE Std, C, Practices for Semiconductor Power Rectifier Transformers.IEEE Std C (R). IEEE Standard Practices and Requirements for Semiconductor Power Rectifier Transformers. Practices and requirements for .requirements. A. Increasing Rectifier Transformer Power Capacity. At first glance it .. [1] IEEE Standard Practices and Requirements for. Semiconductor Power Rectifier Transformers, IEEE. C [2] GE Co. Ltd. Power Converter.Transformer Committee, and chaired IEEE C,. IEEE Practices and Requirements for Semiconductor Power. Rectifier Transformers. He is the United States He is the past Chairman of the Accredited Standards. Committee CSemiconductor rectifier transformers, which supply DC load currents, always deal with harmonic Finally, an example of IEEE Standard No. . C [6] for semiconductor power In practice and under load conditions, the magnitude of . currents, it is not required to add the % factor [6].C for semiconductor power rectifier transformers evidently verifies the usefulness of the presented approach. the proposed approach to an example of IEEE Standard required current waveforms of primary, secondary, and if any, . practice and under load conditions, the magnitude of.IEEE C, IEEE Standard General Requirements for for Dry-Type Distribution and Power Transformers; IEEE C, IEEE Standard Practices and Requirements for Semiconductor Power Rectifier Transformers; IEEE.IEEE standard C -. IEEE Standard Practices and. Requirements for Semiconductor. Power Rectifier Transformers. IEEE Std C IEEE standard for pole mounted equipment - enclosure nutritionmayhem.com IEEE Std C IEEE standard practices and requirements for semiconductor power rectifier nutritionmayhem.com IEEE Std C Standard Requirements for Semiconductor Power.

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