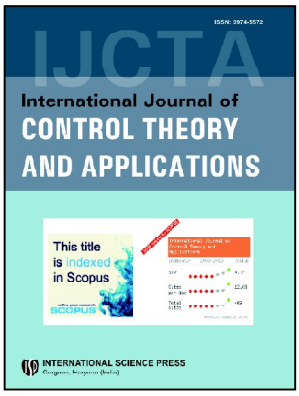

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Safeguard against Impulsive Electrical Vulnerabilities: A Perception

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Abstract: For major fluctuations of voltage or sudden change from zero to full voltage and vice versa the system faces serious consequences on the electrical appliances. To save the system from damage, a remedy has been suggested by using time delay circuit. Hence a preventive method has been suggested to protect the system due to voltage surge or sudden zero state to full capacity. It also suggests design considerations for a cost effective implementation of the system.

Keywords: Multiple time delay Circuit, MEMS, TTD, Electric hazard control, Current carrying capacity, Generator oil consumption

I. INTRODUCTION

The increase in load demand and expansion in distribution portion in a power system made the load balance more and more complex. The complex issue there by introducing a concept of power fluctuations at the distribution system which is hazardous for consumer appliances and also to the supply system. In medium scale consumer appliances like firm and commercial loads draws current continuously for the appliances like fans, motors etc. where there is no individual controlling strategy under power fluctuation conditions. This leads to huge pressure in the supplying systems under power fluctuation conditions for the initial power cycles. This leads to the need for innovations in the current limiting circuit design to the distribution system, which further leads to added advantages for the healthier system operating conditions. Based on the requirements, a suitably designed time delay circuit provides the solution. The designed circuit basically compromises of sensors and IC network. Multi vibrator circuits in combination of time delay circuits will resolve fast acting functionalities in the consumer levels.

The concept of time delay circuits has been proven as emerging technique in the field of protection in power engineering. Frederick Bartholy *et al.* have been presented a sensor based time delay circuit in the better restoration of system condition [1]. Charles E. Benedict has been proposed a technique of vehicle ignition switch and starter switch use alternating system with double relay control [2]. George H. Mealy applied a method of the

theoretical basis, synthesis is developed which emphasizes formal procedures rather than the more familiar intuitive ones [3]. Pierre Demever worked on Solid-state trip unit for digital processing current sensors. The proposed system which provides a delay for short and long delay based upon which functionality of tripping circuit acts instantaneously through the relay setup. Parallel operation of analog processing unit and digital processing unit has been proven as finest application for time delay system in [4]. Jeff Walters employed the concept of time delay in illumination and flourished in controlling the intensity corresponding to the day light intensity and supremacy of time delay circuits has been evolved [5]. Microprocessor based controlling circuits are the best suitable for the fast acting circuits. Pierre Demeyer used digital simulation of the heating and cooling of a bimetallic strip and applied for time delay response for longer or short trip [6]. M. Kim *et al.* have been proposed a monolithic true-time delay (TTD) network where the TTD network has been designed to produce flat delay time which is used metal-to-metal contact RF Micro Electro Mechanical Systems (MEMS) [7]. The induction of harmonics into the existing electrical system due to the signals generated with other than power frequency by the protection circuits can be minimized by time delay circuits. JF Fuller et al have been given a rigorous analysis on the significance of time delay circuit for overcurrent relays in mitigation the current harmonics into the systems [8]. Multi-functional models will be having its own significance in employability in the future applications. A hybrid model has been proposed by James E. Hansen which incorporates the functionalities of sensing the current and voltage magnitudes along with time delay option [9]. The concept of introducing time delay circuits in bulk system and wide interconnected systems has been explained with modern power system stabilizer [10]-[13] which proven the improvement in system conditions.

Section II presents the overall concept of the paper that has been considered. Section III presents various case studies and explains the prominence of the proposed technique. Section IV concludes the work reported.

II. PROPOSED CONCEPT IN DISTRIBUTION SYSTEM

The concept of protection against abrupt changes in the system state of a distribution system has been proposed in this paper as shown in fig 1. The perception basically involves the provision of local multiple time delay circuits at definite regional locations in the existing distribution system. The role of time delay circuits involve the smooth operation of entire distribution system for uneven disturbances occurred in the system condition. In the present scenario of generation-load balancing system, it is quite common to experience seasonal power cuts in the remote locations and even in urban areas in some power deficit spells. Keeping all these in view, it is suggested that, for getting better power quality objective, impulsive changes at load centres are not encouraged. And it is always preferred to maintain smooth operation by installing time delay circuits from region to region for the efficient output. This concept basically contains a local DC regulating power source for the purpose of maintenance of whole control system which was directly sending signals to relay system under fluctuations in power supply. The designed plant is proposed to incorporate with the existing regional substations in the distribution system.

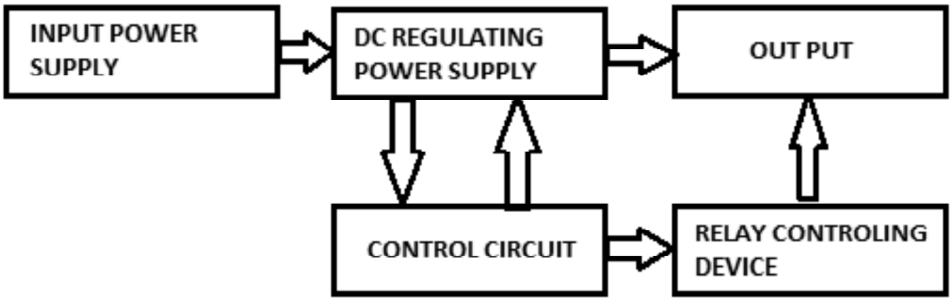

Figure 1: Block diagram representation of the proposed concept

The time delay circuits can be of various emerging concept in the field of novel controllers. Microprocessor based and artificial intelligence based control techniques are the best suitable for the proposed concept. As the proposed concept dealt with issues involved in the on-going distribution system, it has been having a great prominence in inculcating to the existing network.

III. CASE STUDY

The proposed concept has been designed for the on-going distribution system and it can be evaluated by considering a case study of the present day scenario. For the better understanding, a small scale industry has been considered for the evaluating the proposed technique. The small scale distributing unit which contains 20 blocks and each block contains 10 fans load each rated of 50W and it has been assumed that a 220V supply has been provided to it. The system conditions without time delay circuit has been explained by the fundamental calculations as follows:

The current drawn by individual fan load is given by: 0.227 A (50W/220V). In fact, the fans that are present in the utility are designed by single phase induction motor which draws a starting current of 3 to 4 times that of its rated value. This leads a starting current of 0.69A approximately by the single device. As per the assumption, the total fan loads which are connected in parallel will draw a current of 6.9 A from its main input. The total small scale unit that has been considered draws a current of 138A approximately which is considered of 20 rooms at a time.

Form the basic case study that has considered, it has been observed that, a huge current has been drawn from the source there by the grid for the initial power cycles once there is restore of power supply to a particular region. In fact in the present existing scenario the connected load go on existing to meet the consumer requirements. As the load is getting increasing, the scenario in restoring the power supply under fluctuations playing a predominant role not only in distribution system but also in the whole power system. The perception presented in this paper has more prominence in the industrial and commercial areas.

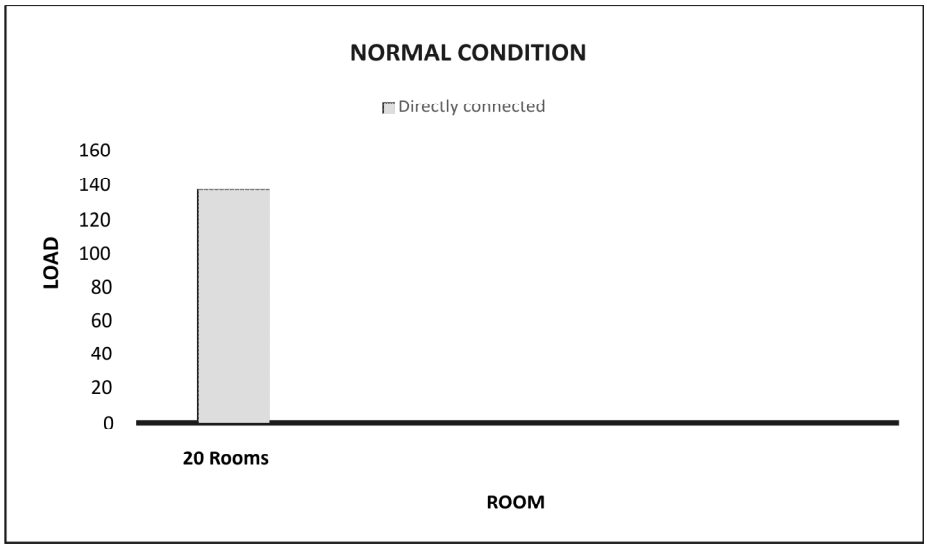

Figure 2 (a): Current drawn from the source under Normal Condition

In the case study that has been considered above, the perception basically suggests that, to incorporate fast acting time delay circuits over the different partitions. In the case study, it has been suggested that for the first few power cycles sharing of power is to be designed to avoid simultaneous starting current withdrawal by all the connecting devices from the source. A scheduled cycle can proposed for particular loads at the time of starting

so that sharing of rated current and high starting current will takes place in each cycle which leads to the smoother operation of the system. It can be represented for the given case study as shown in fig. 2(a) and fig. 2(b) with direct connection and connection through time delaying circuit respectively.

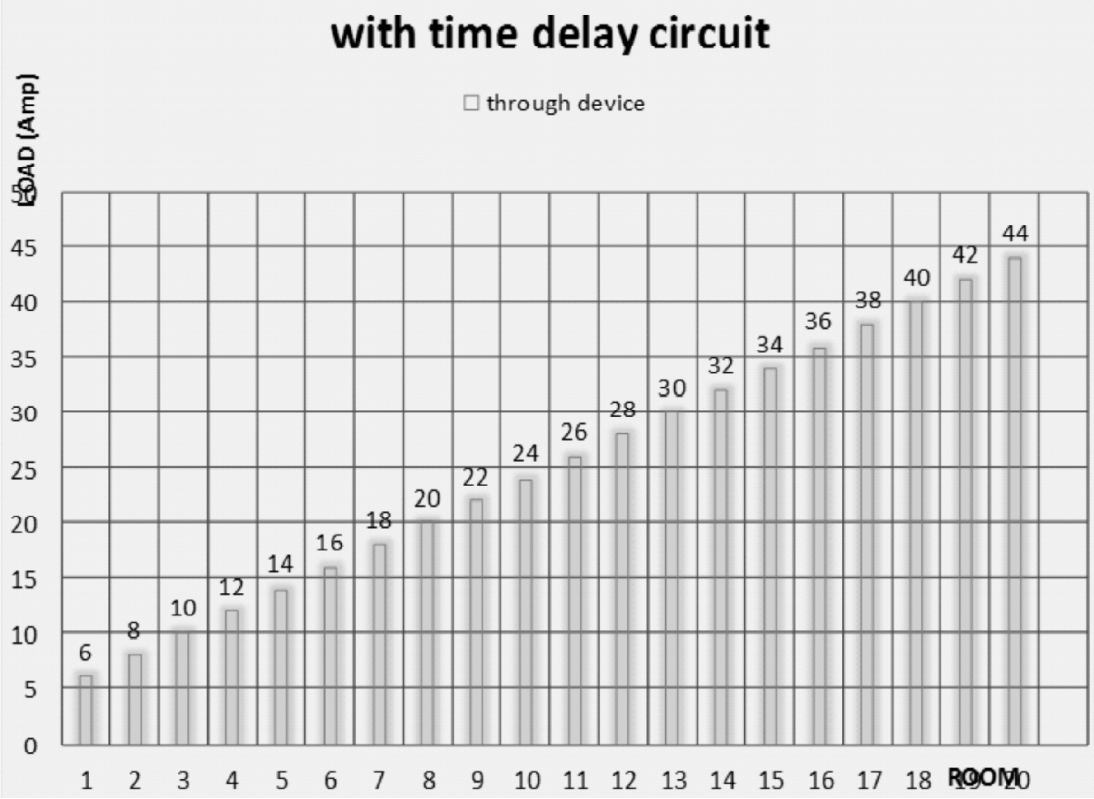

Figure 2 (b): Current drawn from the source under proposed technique

Fig 2(a) and 2(b) give a consolidated view on the current drawing from the source under the existing and proposed conditions. Comparing the statistics, it has been observed that, the heavy withdrawal of current from the system can be limited by proposed time delay concept and it has been a best suitable for existing power system.

The process of lessening the starting currents leads to numerous benefits in the component design aspects. As the instantaneous maximum current at any instant of time in the power lines is diminishing, the current carrying capacity of the materials in designing the line is less which leads in reduction in the material cost which is the most predominant factor in the design aspect. It is also having an advantage in mechanical design aspect due to reduction in maximum current by reducing the generator oil consumption in complementary power sources in the consumer side.

Apart from the several advantages by the proposed technique, it has its own feasibility in incorporation to the existing system. The proposed technique is not a complex idea to implement in the existing distribution system and it is environmental friendly. As there is possibility of introducing innovative concepts in the time delay circuits, up gradation of the technique can be done to meet the future needs in a feasible manner.

IV. CONCLUSION

In the forecasted system conditions, sudden changes in system states have been considered and their consequence has been discussed brought out in this paper. Hence for the abnormalities, a remedy has been proposed and

thorough justification has been presented by considering a real time case study. Thus the proposed concept is most suitable to tackle voltage fluctuation problems resulting in better equipment operating conditions and longer life. Implementation of the concept would save electrical appliances and equipment both in domestic as well as industrial sector. Hence this paper has given a detailed guidelines for the expansion of forthcoming distribution system and for the design aspects.

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