2026 Volume: 02 Issue: 06 www.ijrpa.com ISSN 2456-9995 Review Article

International Journal Research Publication Analysis

Page: 01-03

# CONCEPT OF SMART SURGE ARRESTERS FOR ELECTRICAL POWER SYSTEM

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**Article Received: 29 April 2026**
**Article Revised: 19 May 2026**
**Published on: 09 June 2026**

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DOI: https://doi-doi.org/101555/ijrpa.6919

## ABSTRACT

Electrical Power System requires protection against surge voltage for which surge arresters areconnected. Earlier gapedtype surge arresters wereused in thesystemand further gapless surge arresters were invented. Since then utilities use gapless surge arrester. Gapless surge arresters are consist of Zinc oxide elements. Here the concept of smart surge arresters has been discussed. What are the various feature must the Smart Surge Arrester (SSA) should have has been discussed in this paper.These feature can be implemented in smaller ratings of SSA and it can be implemented for the higher ratings.

**KEYWORDS:** Overvoltage, Smart Surge Arrester.

## 1 INTRODUCTION

Electrical system exposed to outdoor experienced lightning strikes and hence required protection must be provided to system. If the protection against lightning strike may not adequate it results in to system failure. Surge arresters provides protection against lightning over voltages by limiting its magnitude, below the basic insulation ofsystem. When a metal-oxide surge arrester (MOSA) is subjected lightning surgeit responds by shunting surge current thereby limiting the overvoltage on the protected equipment [1]. The performance of surge arresters can be evaluated by currents flowing through it,IT, IR, and third harmonic component of the resistive leakage current($I_{R3rd}$) [2].As SurgeArrester limitsthe overvoltageacrossprotected equipment to its tolerable limit, it stresses continuously. Also,under operating voltage, instantaneous overvoltage, pollution,and humidity, MOSA characteristics get deteriorates.Thisresultsindeviationfrominitialparameterswhichdecidesthehealth

index.The combined effects of ageing parameters increase its initial parameters such asresidual voltage ratio, increase in internal partial discharges (PD) and also increase leakage current flowing through it [3]. As surge arrester is protecting device it health also needs to verified at regular interval like other installed power system equipment. Researchers suggest to evaluate resistive current and third harmonic resistive current component to be evaluated to decide to healthiness. As suggested by various researchers, The most popular techniques for monitoring the condition of MOSAs are based on leakage current and temperature. Leakage current and analysis of its harmonic content is based on the IEC 60099-5 standard [4] [5]. Studies on ageing effect on MOSA performance parameters has been done and it proves that the due to ageing effect resistive leakage current, total leakage current and internal PD increases [6]. Research results also concludes that increase in leakage current internal PD, watt loss also increases, which may cause of failure of MOSA [7]. Our previous case study indicates that the trend analysis is important to decide the healthiness of MOSA and if variationinresistive leakage current component foundby more than40 %to50 %has been considered cautious [8].

Researchers also proposed method based on current ratios of 3rd harmonic resistive current, resistive current, fifth harmonic restive current and total leakage currents to check healthiness of MOSA [9]. From the above facts various parameters needs to be monitored to check healthiness of surge arresters, Surge counters are provided with surge arresters which indicates the current flowing through it and also indicates the numbers of lightning strikes and bypass to ground through the surge arrester,However, many time it is observed that the surge counters are not in workingcondition if it is very old. Hence in this paper here the concept of SSA proposed and further research on implementation of this concept it continue.

## 2. Concept of Smart Surge Arrester

As during normal operation few micro ampere current flows through surge arresterand during lightning strike very high in terms of few thousands of ampere currentspass through it. Here, the concept is the SSA must include with Surge counter.The following features proposed in the surge counter which is connected to SSA.

- Audio signal can be include if the leakage current increased beyond certain or pre-set value.
- Audio signal can be added in Surge counter predefined signal based on magnitude of the leakage current
- Iftheearhingterminalbreakstheremustbeindicationforthe same

- In-case of open circuit inside the surge arresters due to damage of zinc oxideblocks this results in very low leakage current, this can be indicated by setting the minimum magnitude of the leakage current
- In case of highly polluted environments external surface leakage current increases, this must be captured in surge counter by algorithm so such conditions can be detected and actions can be taken timely.

## 3. CONCLUSION

The Concept of SSA is useful for the researcher and implement in actual system. If such concept implemented the failure rates of the surge arresters can be reduced. Further research on this subject is continue.

## 4. REFERENCES


1. IEEEGuidefortheApplicationofMetal-OxideSurgeArrestersforAlternating-Current Systems, *IEEEstandard*.
2. Anil S. Khopkar and Umesh N. Soni, "Technique for Online Condition Monitoring of SurgeArrestors", WorldAcademyof Science,Engineeringand TechnologyInternationalJournalofElectricalandComputer Engineering,Vol:18, No:7, 2024. Pp 140 to 145, International Scholarly and Scientific Research & Innovation 18(7) 2024.
3. Anil S. Khopkar and Kartik S. Pandya, Online Condition Monitoring Technique for Metal Oxide SurgeArresters Based on Leakage Current Components",*Engineering and Technology Journal,* Volume 10 Issue 03March-2025, pp. 4095-4098.
4. SurgeArresters–SelectionandApplicationRecommendation",*IECStandard60099-5*,2018.
5. SurgeArresters–Etaloxidesurgearresterswithoutgapsfora.c.systems,*IECStandard60099-4*,2014.
6. Anil S. Khopkar and Kartik S. Pandya "A novel approach to the ageing process of metal oxide surge arresters[",*Engineering, Technology and Applied Science Research,* 2025, 15(4): 24600-24604.
7. Anil S. Khopkar and Kartik S. Pandya, "Comparative analysis of various condition monitoring techniques formetal oxide surge arresters", *8th international R&D conference on global trends in water resources, power andRE sectors, 08-09 February, 2024,* IIT Roorkee, India.
8. Anil S. Khopkar and Umesh N. Soni, "Condition monitoring ofMetal Oxide Surge Arresters – A case study",*GIS science journal,* Vol 12, issue 11, 2025 pp 41-48.
9. Anil S. Khopkar and Kartik S. Pandya, "Advance technique for online condition monitoring of surge arresters",Bulletin of electrical engineering and informatics, Vol. 14, No.4, August 2025, pp.2526-2536