EXPERIMENTAL STUDIES ON THE MITIGATION OF CHANCE OUTAGES IN GIS DUE TO CONDUCTING PARTICLES

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ABSTRACT

Gas Insulated substations or GIS operable at medium voltages are in vogue for sometime now. In view of their compactness, GIS posses a high degree of reliability of operation in power utility systems. Among the more important problem areas concerning GIS is the adverse effect of metallic particle contamination of the gas medium. In order to be able to improve the operation of GIS in the inevitable presence of particles, a novel method by which the particles are passivated has been suggested. Studies have been conducted to obtain optimal value **of** conductivity of the coating material to have a better performance.

INTRODUCTION

Gas insulated substations have been a major innovation in power transmission and distribution with proven reliability, and nearly maintenance free operation. The other attractive features being compactness, easy operability and less affected by external disturbances. GIS inherently are prone to failures due to certain internal and external causes. GIS are very sensitive to minute disturbances because of high electrical stress in relatively small geometries. Inadvertent outages are more often traced to particle induced breakdown. Owing to its large physical dimension and the presence of the gaseous medium, which has a tendency to keep the particles floating, their occurrence cannot be completely eliminated. Minute particles enter the system during various stages of assembly, erection, and regular re-filling of the gas. Their later occurrence are due to internal faults like the disconnector and circuit breaker operation, periodic arcing of corona ring or any floating electrode [1].

Thin filamentary particles are found to be detrimental to the operation of the GIS under normal operating stress levels. The field at the particle tip exceeds the limiting dielectric strength **of** the gas at least locally, initiating a corona discharge, which in time fructifies into a breakdown. This is highly undesirable. Recent studies have indicated that GIS can be operated successfully operated in the presence of the particles. Methods have been suggested to restrain the movement of the particle into the high stress zone [2].

It has been proposed elsewhere[3] that dielectric coating using selected dielectric with modified conductivities has yielded significantly higher lift-off voltages. There is however an alternate possibility for immobilizing the conducting particles by deliberately inducing a charge of opposite polarity to that of the acquired charge. This new technique is called the 'reverse polarity charging' appears to be a very promising technique.

EXPERIMENTAL

A prototype GIS chamber designed and fabricated with necessary features was used to carryout the proposed studies. The chamber was provided with ports for visual observation, illumination and connection to the gas handling system. A hollow, thick walled, cylindrical electrode acting as the high voltage electrode and a Rogowski-profiled electrode at ground potential was the chosen electrode geometry in the experiments reported here. Electrodes were profiled to avoid corona by providing sufficient field relief at the edges. The surfaces were polished and degreased before the experiment

A test transformer rated for 10kVA, 220V/115kV (GE) generated high voltage at power frequency. The low voltage supply to the transformer was given from a regulator rated for 60A, 240V, 50Hz. A current limiting resistor of 40-50MΩ provided for limiting the current, which would otherwise vaporize the particles. An auxiliary transformer rated for 1.5kVA, 230V/50kV along with a 25kVA, 110A, 230V variac and a 45kR current limiting resistor were used to obtain the phase reversed supply. Fig. (1) shows the schematic representation of the entire experimental system. The chamber was equipped with vacuum and pressure gauges. A high capacity pump (200l/m) fitted with magnetic isolation valve was used to evacuate the chamber to pressure of about 10^{-3} Torr. Nitrogen gas was used in the studies reported here. The gas was passed through moisture traps and the flow of the dried gas regulated. Pressure was maintained in the range **of**