STAMFORD | AvK ™

POWERING TOMORROW, TOGETHER

Application Guidance Notes: Technical Information from STAMFORD | AvK

AGN 122 – Lightning Strikes

INTRODUCTION

STAMFORD | AvK do not have a fund of experience to draw on with regard to this subject. This may be because, as component part suppliers for a Generating Set, we are one step back from Generating Set user's experiences.

THE THEORY

The energy contained within an electrical storm is phenomenal and a 'direct hit' is not necessary for electrical equipment to be damaged. The radiated energy during a lightning strike can induce high voltages into conductive materials in the vicinity of lightning activity. Therefore; any electrical distribution system to which a Generating Set is connected, will act as a 'collector', or aerial, for lightning energy and every metre of connected conductor will have some electrical pressure [voltage] induced into it. The more metre's in the system the higher the induced voltage [electrical pressure] into that system. This results in an electrical pressure wave 'flowing' along the distribution system conductors.

ALTERNATOR DAMAGE

This very high-pressure wave [voltage] will eventually hit an END-STOP and that can be the alternator's stator winding of the connected Generating Set. Once this pressure wave 'enters' the alternator, it is very capable of breaking down the insulation materials within the windings; between phases and to lamination core pack. The structure of the semiconductor junctions would also be damaged; as would all electronic devices.

So, the extent of the alternator damage would vary, but is very likely in some way; maybe just AVR and rotating diodes and surge suppresser, but often the stator winding is damaged and requires rewinding. The stator core pack could well be damaged too.

TRANSMISSION SYSTEM NETWORK

For this reason a well-engineered overhead transmission line / distribution system incorporates 'surge suppressors' and 'line arrestors', each located at strategic points around the transmission system network, with very careful engineered considerations being given for this protection equipment at the power generation source. Familiar sights in the UK are the arc-horns between conductors and an earth connection provided by the stay wire of wooden pole overhead rural distribution systems. Because of the characteristics of the lightning 'electricity', these points that allow the high voltage pressure wave to escape by 'flashing-over' to earth are usually located at the corner/bend in the routing of an overhead distribution line system.

If an alternator stator winding is neutralised, by having one point solidly bonded to mother-earth via a very effective low impedance earth rod or mat, it is likely to survive the effects of lightning strikes in the high 'pressure wave' will not hit an end-stop, but will in fact be directed to a designed low impedance path to earth. If the pressure wave is not too high, the alternator stator winding will survive. If the pressure wave is many times the normal working pressure [voltage] of the alternator's windings, then the insulation system could well be ruptured. Similar considerations need to be given to survival expectations of any of the alternator's electronic components, because if there is only a low pressure build up in the stator, then in theory this should safeguard the AVR and the rotor diodes and their surge suppresser.

Lightning strike 'electricity' though, has very unfriendly characteristics. It is a very high frequency and has the ability to generate a pressure [voltage] wave with a very steep front edge. This means that it is reluctant to flow through the convoluted path of the stator windings in an orderly manner on the route to earth and often just bludgeons its way through any electrical system leaving chaos in its wake.

Although the above explanation tends to concentrate on overhead distribution systems, in truth any cabling - whether hard wired or with plugs and sockets - which connect a Generating Set to an electrical load, is at risk of having a voltage induced into it during a local electrical storm.

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