Modelling electric treeing in XLPE insulation using electric field concepts
GANGA S., NAGAMANI H.N., MOORCHING S.N., Central Power Research Institute, Bangalore, India

Abstract
Developed a methodology to model electrical tree growth in XLPE insulation by using electric field and probability concepts. Tree patterns have been numerically simulated considering point plane electrode geometry in XLPE insulation. The strategy of modelling is verified by comparing fractal dimensions of simulated and experimentally generated tree patterns. Also, certain defects like metallic particles, protrusions, voids etc. in XLPE insulation with needle plane geometry have been modelled. This modelling approach appears to be effective in sensing the type of defect that influences the tree growth.

Introduction
XLPE insulation employed in high voltage cables is well known for its excellent electrical and thermal properties. However, it has two serious disadvantages, viz., (i) poor resistance to partial discharges and (ii) not being a perfect non hygroscopic material. Inclusion of defects like voids, metallic & non-metallic impurities, sharp projections of semi-conducting layer into cable insulation of underground power cables leads to stress concentration and hence partial discharges. These discharges result in localised breakdown of insulation due to a well known process called electrical treeing. The internal channels or paths thus generated propagate in the direction of applied field until complete failure of insulation takes place. Since these pre-breakdown channels bear striking similarity to a ‘tree’ in nature, they are called electrical trees.

Experimental work
The present study has been conducted on XLPE samples taken from a 132kV cable. Electrical trees were generated by employing single needle experiments as per ASTM-3756-79 [3]. XLPE samples of thickness of 3mm were considered. Stainless steel sewing needle was used as HV electrode.