



Engineers and scientists now know what went wrong. They discovered that voids and contamination in the insulation, combined with ionic contamination in the semiconducting shields, as well as other design and manufacturing deficiencies, led to voltage stress concentrations within the cables. These elevated voltage stresses, combined with moisture ingress into the cable structure created what are known today as water trees. These microscopic cavities degraded the insulation over time, ultimately causing the cables to fail.

After many years of research and testing, we now know how to avoid premature cable failures. XLPE insulations must be made using high-quality, state-of-the-art compounding equipment. They must remain free of contamination; from the time they are manufactured to the time they are extruded to form the cable insulation. They must also be applied in a manner that prevents the formation of voids.

Today there are XLPE insulations that are designed to inhibit the growth of water trees, allowing for even greater reliability for distribution class cables. Semiconducting screens that are free of excessive ionic contamination are also available. Manufacturers have also learned how to produce cable with insulations that are free of voids and with smooth interfaces between the semiconducting screens and the insulation.

Cables must also be designed properly to ensure that the right cable is used for a given application. Experience with paper cables is also true for XLPE-insulated cables – cables can only perform reliably when they are manufactured, installed, maintained and operated properly.

It must be noted that cables are connected to each other and to equipment such as transformers, switchgear and overhead lines. Thus it is universally recognized that the whole system (accessories and cables) must be manufactured and installed properly in order to have a reliable underground cable system. While all elements of a cable system are important, this book focuses on cables because they are the most critical component of an underground power cable circuit. Specifically, the focus is on XLPE-insulated cables due to the popularity of this economical, yet reliable technology.